Platinum Jubilee 1942-2016

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वार्षिक प्रतिवेदन | ANNUAL REPORT
2016-2017

CSIR-NIIST

राष्ट्रीय अंतर्विषयी विज्ञान तथा प्रौद्योगिकी संस्थान

(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद्)
तिरुवनंतपुरम

National Institute for Interdisciplinary Science & Technology

(Council of Scientific & Industrial Research)
Thiruvananthapuram

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CSIR-National Institute for Interdisciplinary Science & Technology (NIIST)

(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद्)

(Council of Scientific & Industrial Research)

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■ CSIR-NIIST scientists produce enzyme complex from Western Ghat soil

New enzyme to make ethanol cheaper

ARCHANA RAVI | DC
THIRUVANANTHAPURAM, OCT 13

An indigenous enzyme complex produced at CSIR-NIIST could help bring down the cost of ethanol production from biomass to a great extent. To produce the enzyme complex called cellulase, the institute relies on a microbial system which was isolated from soil samples collected from

K. Madhavan Nampoothiri

produce ethanol need to be purchased from multinationals. Since its cost is more than 40 percent of the cost of production, depending on commercial enzymes is not viable.

K. Madhavan Nampoothiri, principal scientist and head of Microbial Processes and Technology Division, says, "cellulase helps to hydrolyze the cellulosic portion of the complex biomass substrate

from 70-80 kilogram of biomass. The plant has been used to produce ethanol from various kinds of biomass, like rice straw, wheat straw, sorgum and sugarcane bagasse.

"The versatility of the plant is a big advantage. For this reason, we have been able to be part of different collaborative projects dealing with different biomass," says Madhavan. The plant was fully established by 2011.

converted to ethanol using yeast cultures".

The pilot-level plant programme.

The project was conceived and initiated by former head and chief scientist Ashok Pandey around eight years ago. Currently, Rajiv K. Sukumaran is leading the bio-energy programme in CSIR-NIIST along with Madhavan. The plant was

Institute has held

മാലിന്യസംസ്കരണത്തിന് നൂതന സാങ്കേതികവിദ്യയുമായി നിസ്റ്റ്

NIIST tech for titanium plants

The CSIR-NIIST process removes iron oxide using a rotary kiln. It is only to remove the last traces of iron oxide that a small quantity of acid is used.

Now, corp banks on NIIST to manage waste

Kerala co to lease out biogas plants

NIIST technology may aid PSUs in curbing pollution

Benefit twice from NIIST waste treatment plan

വിടുകൾക്കു ചെറിയ ബയോഗ്യാസ് പ്ലാന്റുമായി കേന്ദ്ര സ്ഥാപനം

Proposal for new centre on NIIST campus awaits nod

LaxmiPrasanna.Ajai
@timesgroup.com

Thiruvananthapuram: The National Institute of Interdisciplinary Science and Technology (NIIST) under the Council for Sci-

The aim of setting up the Centre for Phytochemicals and Ayurveda is to scientifically validate & ove the efficacy of redic products

cts that any medica- an cause," said CSIR- director Dr A Ajay- h. The centre will e efficacy of phyto- cals or chemical unds extracted plants before pro- are released.

centre estimated to 25-crore will take an iciplinary appro- d work closely with NIIST divisions in-

cluding agro-processing and chemical sciences, he said.

"Once we get the nod from our parent CSIR, we will approach other funding agencies including department of science and technology (DST) and department of ayurveda, yoga, naturopathy, unani, siddha and homeopathy (AYUSH)," he said.

M M Sreekumar, head and chief scientist of agro-processing and natural products division said technology innovation can result in cost reduction.

The proposed centre will help in quality control, technology up-gradation, modernisation and value-addition of ayurveda products.

ശാസ്ത്രസാങ്കേതികവിദ്യ സാധാരണക്കാരന് പ്രയോജനപ്പെടണം - ഗവർണർ

प्रस्तावना

वर्ष 2016-17 की अवधि के लिए सीएसआईआर- एनआईआईएसटी की वार्षिक रिपोर्ट प्रस्तुत करना मेरे लिए अत्यंत खुशी एवं सौभाग्य की बात है। इस अवधि के दौरान उच्च प्रभाव अनुसंधान, आईपी उत्पादन, औद्योगिक गठबंधन, मानव संसाधन विकास तथा संस्थान के मिशन और भविष्य निरूपण के साथ संरेखन में नए सहयोगी साझेदारों और हितधारकों को आकर्षित करने में संस्थान ने महत्वपूर्ण योगदान दिया। संस्थान के उद्देश्यों और लक्ष्यों को प्राप्त करने के लिए अपनी कड़ी मेहनत और सहयोग प्रदान किए हमारे वैज्ञानिकों, तकनीकी कर्मचारियों, छात्रों और अन्य सहायक प्रणाली की समर्पित टीम को मैं बधाई देता हूं।

रसायन विज्ञान तथा प्रौद्योगिकी, पदार्थ विज्ञान तथा प्रौद्योगिकी, कृषि प्रसंस्करण तथा प्रौद्योगिकी, माइक्रोबियल प्रक्रिया तथा प्रौद्योगिकी एवं पर्यावरण प्रौद्योगिकी हमारे ध्यान केंद्रित क्षेत्र हैं। मुझे यह बताने में खुशी है कि समन्वयित आंतरक दक्षता, उच्च प्रभाव विज्ञान के लिए उद्योगों और अकादमिक क्षेत्र के साथ परस्पर निर्भरता गठबंधन, तकनीकी-व्यावसायिक रूप से महत्वपूर्ण आईपी और समाज पर प्रत्यक्ष प्रभाव के साथ उत्पादों और प्रौद्योगिकियों के माध्यम से पिछले कुछ वर्षों में सीएसआईआर-एनआईआईएसटी अंतर्राष्ट्रीय ख्याति के एक संस्थान के रूप में उभरा है। विभिन्न क्षेत्रों में अंतर्विषयी अनुसंधान- अर्थात समुद्र तट खनिज प्रसंस्करण, रेअर अर्थ पिगमेंट, फसलोत्तर प्रौद्योगिकी, आयुर्वेद के लिए फाइटोकेमिकल्स, अपशिष्ट उपचार, जैव ईंधन, सौर ऊर्जा, विशेषता कोटिंग्स, सुरक्षा स्याही, नैदानिक जांच, दवा मध्यवर्ती, बहुलक कंपोजिट, हल्के धातु मिश्र, कम्प्यूटेशनल मॉडलिंग आदि के माध्यम से सार्वजनिक, निजी और सामाजिक माल की सेवा करते हुए सीएसआईआर-एनआईआईएसटी हमेशा एक जीवंत और जिम्मेदार सार्वजनिक संगठन के रूप में बना रहता है। रिपोर्टिंग अवधि के दौरान, प्रौद्योगिकी हस्तांतरणों, समझौता ज्ञापनों, सहयोगी, प्रायोजित, परामर्श और सहायता अनुदान परियोजनाओं में स्थिर वृद्धि हुई है। अंतर्विषयी अनुसंधान के उच्च मानकों को बनाए रखते हुए, जो उच्च प्रभाव प्रकाशनों, प्रौद्योगिकी हस्तांतरणों और परामर्श सेवाओं की संख्या से स्पष्ट है, प्रयोगशाला द्वारा अनुसंधान के लिए बाह्य स्रोतों के माध्यम से लगातार निधि पैदा की है और वर्तमान में यह कुल बजट के 25% तक पहुंच गयी है। अतीत में सीएसआईआर-एनआईआईएसटी द्वारा विकसित प्रौद्योगिकियों और प्रक्रियाओं का आगे सुधार और लाइसेंस के लिए लगातार निगरानी की जाती है। प्रगति के अधीन शामिल नई प्रौद्योगिकियॉ हैं- शांत छत / ऊर्जा बचत अनुप्रयोगों के लिए आईआर परावर्तक पिंगमेंट्स का विकास तथा निम्न ग्रेड इल्मेनाइट का उच्च ग्रेड सिंथेटिक रूटाइल में इष्टतमीकरण। दस्तावेज़ संरक्षण के लिए सुरक्षा लेबल और मार्कर, सौर ऊर्जा रूपांतरण के लिए डिवाइज़, आयुर्वेदिक योगों के लिए फाइटोकेमिकल्स, बड़ी मात्रा में जैविक अपशिष्ट और नगरपालिका ठोस अपशिष्ट प्रबंधन के लिए स्केल अप जैसे क्षेत्रों में अनुसंधान तथा नवाचार प्रगति में हैं। अपशिष्ट प्रबंधन के लिए प्रक्रिया और तकनीकी जानकारी प्रदान करते हुए सीएसआईआर-एनआईआईएसटी पर्यावरण संरक्षण और निगरानी के प्रति प्रतिबद्ध है। यह उल्लेखनीय है कि सीएसआईआर- एनआईआईएसटी केरल में श्रेणी " ए" परियोजनाओं में ईआईए सलाहकार के रूप में एनएबीईटी/एमओईएफ मान्यता प्राप्त एकमात्र संगठन है। आंतरिक आर एंड डी गतिविधियों के साथ ही साथ संस्थान बाह्य ग्राहकों के लिए परीक्षण और विश्लेषणात्मक सेवाओं की एक विस्तृत श्रृंखला प्रदान करता है। संस्थान में एक समर्पित डाइऑक्सीन परीक्षण सुविधा है। एसीएसआईआर के तत्वावधान में प्रतिष्ठित अकादमिक कार्यक्रम के माध्यम से छात्रों की एक बड़ी संख्या अपनी पीएच.डी कर रही हैं। परियोजना गतिविधियों के तहत स्नातक और स्नातकोत्तर छात्रों के लिए हम प्रशिक्षण भी प्रदान करते हैं। सीएसआईआर- एनआईआईएसटी ने औद्योगिक आवश्यकताओं को लक्षित करते हुए विशिष्ट क्षेत्रों पर कौशल विकास कार्यक्रम भी शुरू किया है।

छात्रों को आमंत्रित करके उन्हें अनुसंधान एवं विकास गतिविधियों और अवसरों से अवगत कराना, एमएसएमई सहित निजी, सार्वजनिक क्षेत्रों का प्रतिनिधित्व करके उद्योगों के साथ आपसी हित के क्षेत्रों का पता लगाने के लिए अनुसंधान एवं विकास उद्योग बैठक जैसे आउटरीच कार्यक्रम का भी आयोजन किया गया।

उद्योगों और अंतिम उपयोगकर्ताओं के समर्थन के साथ अपने वैज्ञानिक ज्ञान को व्यावसायिक रूप से व्यवहार्य प्रक्रियाओं और उत्पादों में स्थानांतरण करने में आगे की प्रगति करने के लिए हम निर्धारित और प्रतिबद्ध हैं। मैं सभी सदस्यों को धन्यवाद देता हूं जिन्होने पुरस्कार, फेलोशिप और अन्य उपाधि के रूप में संस्थान को ख्याति अर्जित की। सीएसआईआर मुख्यालय, अन्य वित्त पोषण एजेंसियों और उद्योगों से प्राप्त समर्थन के लिए मैं अत्यंत आभारी हूं। समाज को प्रभावित करने वाले लक्ष्यों को प्राप्त करने में समान विचारधारा वाले वैज्ञानिक और औद्योगिक समुदाय के साथ मैं सहयोग की मांग करता हूं।

शुभकामना सहित

ए अजयघोष
निदेशक

Foreword

It is my pleasure and privilege to present the Annual Report of CSIR-NIIST for the period 2016-17. During this period the Institute made significant contributions in high impact research, IP generation, forging industrial alliance, human resource development, attracting new collaborating partners and stake holders in aligning with the mission and vision of the Institute. I congratulate our dedicated team of scientists, technical staff, students and other supporting system for their hard work and cooperation in achieving the objectives and the targets.

Our thrust areas of focus are Chemical Sciences and Technology, Materials Science and Technology, Agro-Processing and Technology, Microbial Processes and Technology and Environmental Technology. I am happy to convey that over the years, CSIR-NIIST has emerged as an Institution of international repute through synergized core competencies, symbiotic alliance with industries and academia for high impact science, techno commercially important IP, technologies and products with direct impact on society. CSIR-NIIST has always remained as a vibrant and responsible public organization, serving public, private and social goods through interdisciplinary research in various fields viz. beach mineral processing, rare earth pigments, post harvest technology, phytochemicals for Ayurveda, waste treatment, biofuels, solar energy, specialty coatings, security inks, diagnostic probes, drug intermediates, polymer composites, light metal alloys, computational modeling etc.

During the reporting period, there had been a steady increase in the technology transfer MoUs, collaborative, sponsored, consultancy and grant-in aid projects. The Laboratory has been constantly generating research funds through external sources reaching to the current level of 25% of the total budget by way of maintaining the high standards of interdisciplinary research which is evident from the number of high impact publications, technology transfers and consultancy services.

Technologies and process developed by CSIR-NIIST in the past are continuously monitored for further improvement and licensing. New technologies which are under progress includes development of IR reflecting pigments for cool roof/energy saving application and for beneficiation of low grade ilmenite to high grade synthetic rutile. Research and innovation in the areas of security labels and markers for document protection, devices for solar energy conversion, phytochemicals for ayurvedic formulations, scale up for large volume organic waste and municipal solid waste management are in progress.

CSIR-NIIST is committed towards environment protection and monitoring by providing process and knowhow for waste management. It may be noteworthy that CSIR-NIIST is the only organization in Kerala with NABET/MOEF accreditation as an EIA consultant in category A projects. Institute also offers a wide range of testing and analytical services to the external clients while pursuing in house R&D activities. The Institute has a dedicated dioxin testing facility.

Through the prestigious academic program under the aegis of AcSIR a large number of students are pursuing their Ph.D. We also impart training to graduate and post graduate students as part of project activities. CSIR-NIIST has also launched skill development programme on specific areas targeting industrial requirements.

The Institute organized outreach programmes such as inviting students to make them aware of R&D activities and opportunities, R&D Industry meet to explore areas of mutual interest with industries representing private, public sectors including MSMEs.

We are determined and committed to make further progress in translating our scientific knowledge into commercially viable processes and products with the support of industries and end users. I thank all members who brought laurels to the institute in the form of awards, fellowships and other distinctions. Let me also acknowledge the support received from CSIR Headquarters, other funding agencies and industries. I solicit collaboration with like-minded scientific and industrial community in achieving the targets that impacts the society.

With best wishes

A. Ajayaghosh
Director

महत्वपूर्ण उपलब्धियां 2016-2017

इंडस्ट्रियल एस्टेट, पाप्पनंकोड, तिरुवनंतपुरम, केरल में स्थित राष्ट्रीय अंतर्विषयी विज्ञान तथा प्रौद्योगिकी संस्थान (एनआईआईएसटी), वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद (सीएसआईआर) की प्रमुख अनुसंधान प्रयोगशालाओं में से एक है, जो देश के लिए मौलिक महत्व के कई क्षेत्रों में बुनियादी और व्यावहारिक दोनों प्रकृति की आर एंड डी परियोजनाओं पर कार्य करती है। डॉ. ए. अजयघोष, जिन्होंने जून 2015 में निदेशक का पदभार ग्रहण किया था, के डायनामिक नेतृत्व के तहत वर्तमान में, संस्थान वैश्विक अर्थव्यवस्था की चुनौतियों का अच्छी तरह से सामना करने की ओर अग्रसर है, जबकि कृषि उत्पादों, सामग्रियों और ऊर्जा की क्षेत्रीय जरूरतों को पूरा करने के लिए संस्थान का प्रयास जारी है। वर्ष 2016-2017 के दौरान भी सीएसआईआर-एनआईआईएसटी ने बाहरी स्रोतों से राजस्व पैदा करने में पर्याप्त वृद्धि प्राप्त करने के लिए औद्योगिक, निजी और सार्वजनिक क्षेत्रों को शामिल करके अत्याधुनिक अनुसंधान परियोजनाओं और नए सहयोग में वृद्धि हासिल करने के मामले में अपना उत्कृष्ट प्रदर्शन जारी रखा। सुनिश्चित डिलिवरेबल्स के साथ 12 वीं पंचवर्षीय योजना परियोजनाओं के सफल समापन के रूप में वर्ष 2016-17 को चिह्नित किया गया। सीएसआईआर के मिशन और विज़न और राष्ट्रीय लक्ष्यों के साथ संरेखित करते हुए समुद्र तट खनिज प्रसंस्करण, रेअर अर्थ पिगमेंट, कृषि प्रसंस्करण, आयुर्वेद के लिए फाइटोकेमिकल्स, अपशिष्ट उपचार, जैव ईंधन, सौर ऊर्जा, कोटिंग्स, सुरक्षा स्याही, नैदानिक जांच, दवा मध्यवर्ती जैसे आला क्षेत्रों की पहचान के साथ संस्थान ने इस रिपोर्टिंग वर्ष में अपने विज़न और रोड मैप में आगे सुधार किया। एनआईआईएसटी को सीएसआईआर द्वारा सौंपी गयी तीन फास्ट ट्रैक स्थानांतरीय परियोजनाएं हैं। रिपोर्ट की गयी अवधि के दौरान हमारे पास कुछ महत्वपूर्ण प्रौद्योगिकी हस्तांतरण थे। पिछले वर्षों के दौरान विकसित व्यावसायिक रूप से महत्वपूर्ण कई कार्यात्मक सामग्री को आगे प्रौद्योगिकी हस्तांतरण के कगार पर ले लिया गया है। इल्मेनाइट के इष्टतमीकरण के लिए एक पर्यावरण अनुकूल प्रक्रिया प्रौद्योगिकी हस्तांतरण के लिए तैयार है । एनआईआईएसटी के वैज्ञानिकों द्वारा विकसित एनआईआर परावर्तक ब्लू पिगमेंट प्रौद्योगिकी का स्केल अप किया जा रहा है। बायोरिफाइनरियों के लिए बायोमास हाइड्रोलिसिस के लिए बड़े पैमाने पर β-ग्लूकोसिडेस एंजाइम के उत्पादन की प्रक्रिया जानकारी विकास के अंतिम चरण पर है। आयुर्वेदिक मुक्तशेष सामग्री का मूल्य वर्धन, आयुर्वेदिक उद्योग से कच्चे माल के योगों की मान्यता आदि उल्लेखनीय अन्य उपलब्धियों में से कुछ हैं। विकास के चरण में उपलब्ध कुछ अन्य प्रौद्योगिकियॉं हैं -नगर पालिका ठोस अपशिष्ट प्रबंधन के लिए एकीकृत जैव सुखाने की प्रक्रिया और सुरक्षा अनुप्रयोगों के लिए नई फ्लोरोसेंट सामग्री और स्याही । सीएसआईआर- एनआईआईएसटी इस क्षेत्र में पर्यावरण इंजीनियरिंग को काफी समर्थन प्रदान करता है। इसके अलावा, एक एनारोबिक डायजेस्टर को प्रस्तुत करते हुए हमने भारत सरकार की स्वच्छ भारत पहल की पूर्ति की है। नव विकसित एनारोबिक डायजेस्टर कचरे को कंपोस्ट खाद के रूप में स्थायी करता है और उत्पत्ति के स्रोत पर बायोमास अपशिष्ट से मीथेन युक्त बायोगैस को उत्पन्न करता है। सीएसआईआर- एनआईआईएसटी ने केरल के कुछ स्थानों पर भूजल के परक्लोरेट संदूषण को एक गंभीर सार्वजनिक स्वास्थ्य समस्या के रूप में पहचान की है, जहां परक्लोरेट थोक मात्रा में निपटाया जाता है। एनआईआईएसटी ईआईए अध्ययनों में भी शामिल है। वास्तव में, एनआईआईएसटी, केरल में

एनएबीईटी-मान्यता प्राप्त श्रेणी "ए" परामर्शदाता संगठन है, जिसे खनन और बंदरगाहों और हार्बर क्षेत्रों में मान्यता प्राप्त है। इस पृष्ठभूमि में, सीमांत अनुसंधान के प्रबल आवेशन और चुनौतीपूर्ण अंतर्विषयी वातावरण में अपनी भविष्य की योजनाओं के साथ संरेखित करते हुए वर्ष 2016-2017 की वार्षिक रिपोर्ट सीएसआईआर- एनआईआईएसटी द्वारा किए गए नवाचार, उपलब्धियों, प्रगति और इंपैक्ट को निर्धारित करता है।

अनुसंधान एवं विकास कार्यक्रम में प्रगति और निष्पादन

इस रिपोर्ट की अवधि के दौरान केंद्रित गतिविधियों के माध्यम से पांच प्रभागों में से प्रत्येक ने उत्पाद विकास, प्रक्रिया योग, शैक्षणिक उत्कृष्टता और अनुसंधान सहयोग में, महत्वपूर्ण प्रगति की है। इस रिपोर्ट में रसायनों, सामग्रियों, माइक्रोबियल प्रक्रियाओं, कृषि-प्रसंस्करण और पर्यावरण प्रौद्योगिकियों के क्षेत्रों में की गयी गतिविधियों और उपलब्धियों को संक्षेप किया गया है।

कृषि प्रसंस्करण तथा प्रौद्योगिकी प्रभाग ने टेक्नोलॉजी बिजनेस इनक्यूबेशन सेंटर के माध्यम से एमएसएमई का समर्थन, विश्लेषणात्मक सेवाओं के माध्यम से परामर्शिता, कार्यात्मक खाद्य पदार्थों और न्यूट्रास्युटिकल के लिए उत्पाद विकास और शेल्फ लाइफ वृद्धि आदि के माध्यम से महत्वपूर्ण सुविधा भूमिका निभाई है। पौधों से बायोएक्टिव यौगिकों का औषधीय मूल्यांकन और चयापचयी रोग और कैंसर के प्रबंधन में उनका शोषण, बायो-उर्वरक और जैव कीटनाशकों का विकास आदि वर्तमान में अनुसंधान के प्रमुख क्षेत्र हैं।

माइक्रोबियल प्रक्रिया तथा प्रौद्योगिकी प्रभाग (एमपीटीडी) का वर्तमान ध्यान (i) बायोप्रोसेस और उत्पाद विकास (ii) बायोफ्यूल और बायोरिफाइनरी (iii) स्वास्थ्य, जीनोमिक्स और जैव विविधता पर केंद्रित है। बायोप्रोसेस और उत्पादों के क्षेत्र में प्रभाग का ध्यान औद्योगिक एंजाइमों, बायोपॉलिमर्स, एमिनो एसिड, मूल्य वर्धित प्लेटफॉर्म रसायनों, प्रोबायोटिक्स, माइक्रोबियल न्यूट्रास्यूटिकल आदि के उत्पादन पर केंद्रित है। जैव ईंधन अनुसंधान का मूल विषय जैव ईंधन के वाणिज्यिक तौर पर व्यवहार्य उत्पादन के लिए रणनीति का विकास और मानव जीवन की भलाई के लिए गैर-अक्षय रसायनों और उत्पादों के लिए विकल्प के उत्पादन के लिए हरी और सतत प्रक्रियाओं का विकास है। प्रभाग ने ठोस अवस्था किण्वन और लिग्नोसेलुलोसिक बायोमास से इथेनॉल के उत्पादन के लिए एक प्रारंभिक संयंत्र सुविधा स्थापित की है। प्रभाग की अन्य गतिविधियों में पादप जीवाणू इंटरैक्शन और माइक्रोबियल बायोएक्टिव्स के लिए जैव विविधता का अन्वेषण शामिल हैं।

रसायन विज्ञान तथा प्रौद्योगिकी प्रभाग द्वारा संस्थान के निम्नलिखित तीन प्राथमिकता क्षेत्रों पर ध्यान केंद्रित किया गया है, अर्थात कार्बनिक और हाइब्रिड इलेक्ट्रॉनिक्स (ऊर्जा उत्पादन और भंडारण, ठोस अवस्था प्रकाश व्यवस्था, वर्णजनक कोटिंग्स, स्मृति तत्वों और कम्प्यूटेशनल रसायन विज्ञान), फ्लोरोसेंट सामग्री (सुरक्षा अनुप्रयोग, निदान और इमेजिंग जांच और पराद्रुत कैनेटीक्स),फाइटो फार्मास्यूटिकल और ड्रग इंटरमीडिएट (औषधीय पौधों का जैव मूल्यांकन, उन्नत दवा मध्यवर्ती)। प्रभाग द्वारा अक्षय ऊर्जा, सुरक्षा अनुप्रयोगों के लिए फ्लोरोसेंट सामग्री और प्राकृतिक उत्पादों जैसे क्षेत्रों में कई महत्वाकांक्षी परियोजनाओं का प्रारंभ कर रहा है।

पदार्थ विज्ञान तथा प्रौद्योगिकी प्रभाग का अनुसंधान मुख्य रूप से सामरिक, ऑटोमोबाइल, ऊर्जा और सामाजिक अनुप्रयोगों के लिए उन्नत कार्यात्मक सामग्री और कॉम्पोनेंट्स के विकास पर केंद्रित है। वर्ष 2016-17 के दौरान प्रभाग के प्रमुख अनुसंधान क्षेत्रों में ऊर्जा बचत अनुप्रयोगों के लिए बहु कार्यात्मक पिगमेंट, प्रकाश व्यवस्था के लिए संदीप्तिशील सामग्री, पर्यावरणीय अनुप्रयोगों के लिए कार्बन डाइऑक्साइड अधिशोषण के लिए छिद्रपूर्ण सिरेमिक सामग्री, डाई-क्षरण के लिए नैनो फोटो उत्प्रेरक, मुद्रित इलेक्ट्रॉनिक्स, चुंबकीय और चुंबक प्रशीतन सामग्री, पॉलिमर और पॉलिमर नैनो कंपोजिट, खनिजों का इष्टतमीकरण और औद्योगिक स्लैग के लिए मूल्य संवर्धन और सामरिक और ऑटोमोबाइल अनुप्रयोगों के लिए एल्यूमीनियम और मैग्नीशियम आलाय्स और कंपोजिट शामिल है।

पर्यावरण प्रदूषण नियंत्रण केलिए अभिनव प्रक्रियाओं के डिजाइन और क्षेत्र के प्राकृतिक संसाधनों की मूल्यवृद्धि के

माध्यम से पर्यावरण प्रौद्योगिकी प्रभाग (ईटीडी) स्वदेशी प्रौद्योगिकियों के विकास का एक केंद्र बन गया है। इस प्रभाग के अंतर्गत एनआईआईएसटी के कम्प्यूटेशनल मॉडलिंग समूह और सीआरटीडीएच (एमएसएमई में पर्यावरण के हस्तक्षेप के लिए आम अनुसंधान और प्रौद्योगिकी विकास केंद्र) कार्य कर रहा है, जो पर्यावरण के मुद्दों के प्रबंधन के लिए एमएसएमई को प्रौद्योगिकी और सेवाएं प्रदान करता है।

प्रभाग की प्रौद्योगिकी उपलब्धियों में काली या हरी मिर्च से सफेद मिर्च के उत्पादन के लिए प्रक्रिया, पर्यावरण अनुकूल कॉयर रेट्टिंग, बहि :स्राव उपचार, ठोस अपशिष्ट प्रबंधन, गंध नियंत्रण के लिए जैव-फिल्टर, बायोगैस संयंत्र, खाद्य अवशिष्ट डाइजेस्टर्स, रसोई कचरे कम्बोस्टर, फाइबर कंपोजिट से लकड़ी का विकल्प जैसे टेक-उत्पादों और कम्प्यूटेशनल मॉडलिंग टीम से, एमएसएमई धातु कास्टिंग फाउंड्री उद्योग के लिए एक सस्ती सिमुलेशन सॉफ्टवेयर आदि शामिल हैं।

सभी प्रमुख सुविधाओं के साथ पूरी क्षमता पर काम कर रही संस्थान की विश्लेषणात्मक सुविधा, उद्योग और शैक्षिक संस्थानों से नमूनों के परीक्षण से राजस्व पैदा करने के अलावा इन-हाउस आर एंड डी कार्यक्रमों के लिए बड़े पैमाने पर उपयोग किया गया। एनआईआईएसटी की डाइऑक्सीन विश्लेषण सुविधा एक और आकर्षण है। इस रिपोर्टिंग अवधि के दौरान बाहरी अनुदान में लगातार वृद्धि के साथ सीएसआईआर से प्राप्त निरंतर आर्थिक सहायता ने उच्च गुणवत्ता वाले प्रकाशनों के साथ समझौता किए बिना स्थानांतरणीय अनुसंधान और प्रौद्योगिकी विकास पर ध्यान केंद्रित करके हमारी मदद की है।

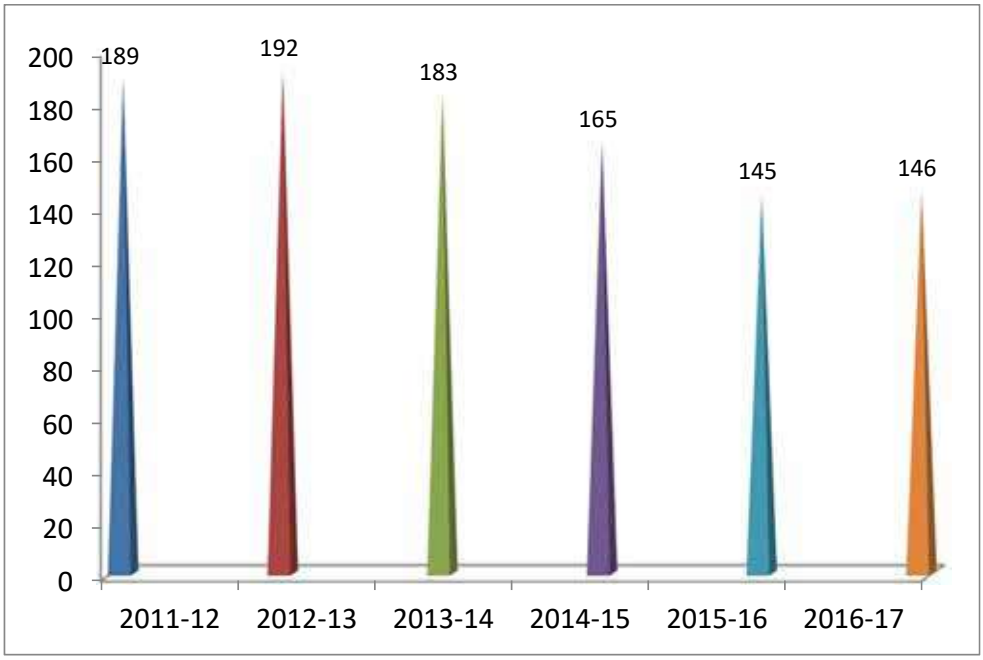
वर्ष 2016-2017 की अवधि के दौरान, सीएसआईआर-एनआईआईएसटी में कई महत्वपूर्ण कार्यक्रम आयोजित किए गए थे। एमएसएमई सहित निजी, सार्वजनिक क्षेत्रों और उद्योगों के साथ गठबंधन बनाने के लिए पारस्परिक हित के मुद्दों की पहचान करने के लिए संस्थान ने 6 जनवरी 2017 को एक दिवसीय अनुसंधान एवं विकास- उद्योग बैठक का आयोजन किया। केरल के माननीय मुख्यमंत्री श्री पिनरायी विजयन ने इस बैठक का उद्घाटन किया और सम्माननीय विधायक श्री ओ राजगोपाल ने बैठक की अध्यक्षता की। माननीय सांसद डॉ. शशि थरूर ने मूल व्याख्यान दिया। कई उद्योगपतियों ने बैठक में भाग लिया और कई समझौता ज्ञापनों पर हस्ताक्षर किए गए।

केरल के माननीय राज्यपाल श्री न्यायमूर्ती (सेवानिवृत्त) पी सदाशिवम की अध्यक्षता में 6 अक्टूबर 2016 को सीएसआईआर-एनआईआईएसटी में सीएसआईआर-एनआईआईएसटी स्थापना दिवस मनाया गया। रिपोर्ट की गयी अवधि के दौरान कई महत्वपूर्ण राष्ट्रीय और अंतर्राष्ट्रीय कार्यक्रम भी आयोजित किए गए। सीएसआईआर-एनआईआईएसटी और केरल राज्य विज्ञान, प्रौद्योगिकी तथा पर्यावरण परिषद् (केएससीएसटीई) के संयुक्त तत्वावधान में "प्रोमिस"कार्यक्रम का आयोजन किया। सीएसआईआर-एनआईआईएसटी और भारतीय रसायन अनुसंधान सोसाइटी, त्रिवेन्द्रम चैप्टर के संयुक्त तत्वावधान में "प्राकृतिक उत्पाद रसायन विज्ञान में हाल की प्रवृत्तियों" पर एक दिवसीय संगोष्ठी का आयोजन किया। दक्षिण भारत में स्वच्छता के लिए नवीन प्रौद्योगिकियों और इंजीनियरिंग पर कार्यशाला, एक दिवसीय विज्ञान आउटरीच कार्यक्रम और हल्की धातुओं, कंपोजिट और विनिर्माण प्रक्रियाओं पर राष्ट्रीय संगोष्ठी आदि संस्थान द्वारा आयोजित किये अन्य कार्यक्रम थें।

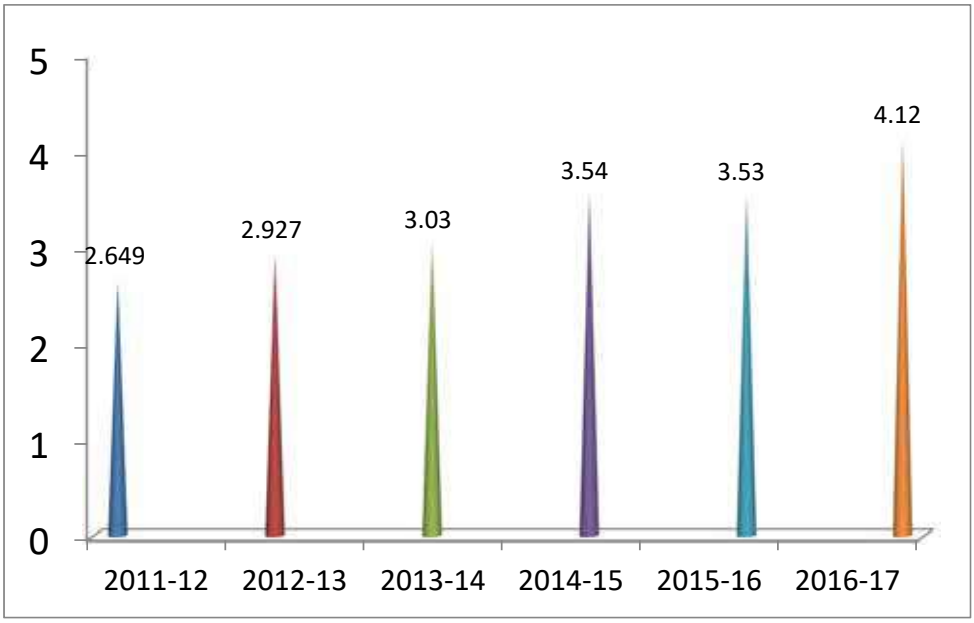
संस्थान में राष्ट्रीय विज्ञान दिवस, राष्ट्रीय प्रौद्योगिकी दिवस और सीएसआईआर स्थापना दिवस भी मनाया गया। इन अवसरों पर प्रयोगशाला द्वारा खुला दिन मनाया गया और बड़ी संख्या में छात्रों और संकायों ने संस्थान का दौरा किया और वैज्ञानिकों के साथ विचार-विमर्श किया। प्रयोगशाला में हिंदी सप्ताह और सतर्कता जागरूकता सप्ताह का आयोजन किया गया। संस्थान में स्वच्छ भारत मिशन से संबंधित गतिविधियां शुरू की गयी और कर्मचारियों और छात्रों की भागीदारी से प्रयोगशाला और इसके आसपास के क्षेत्रों को साफ किया गया।

वैज्ञानिकों और शोध छात्रों ने कई प्रतिष्ठित पुरस्कार, सम्मान और मान्यता के माध्यम से संस्थान के लिए ख्याति अर्जित की। शोध छात्रों ने प्रतिष्ठित सेमिनार और संगोष्ठी में सर्वश्रेष्ठ पोस्टर, सर्वश्रेष्ठ मौखिक प्रस्तुति और शोध पत्र पुरस्कार प्राप्त करते हुए अपनी जीत का दौर जारी रखा।

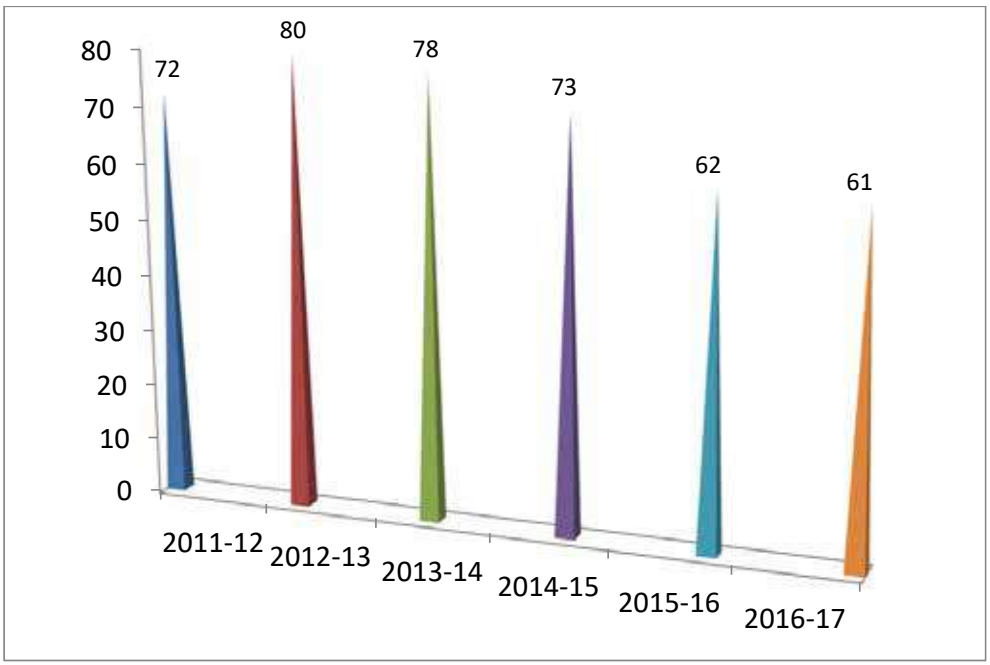
कर्मचारियों की संख्या
STAFF STRENGTH



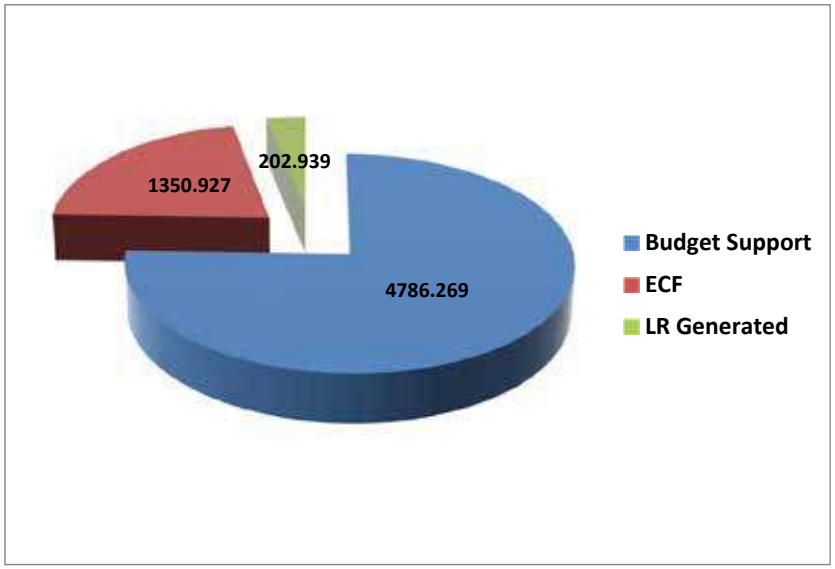
औसत प्रभाव कारक
AVERAGE IMPACT FACTOR



वैज्ञानिक स्थिति
Scientist Position



बजट 2016-17 (लाखों में)
BUDGET 2016-17 (in lakhs)



महत्वपूर्ण उपलब्धियां 2016-2017

SIGNIFICANT ACHIEVEMENTS 2016-2017

National Institute for Interdisciplinary Science & Technology (NIIST) located at Industrial Estate, Pappanamcode, Thiruvananthapuram, Kerala is one of the major research laboratories of Council of Scientific Industrial Research (CSIR), which undertakes R&D projects of both basic and applied nature in a number of areas of fundamental importance to the country. At present, the institute is well poised to meet the challenges of globalized economy under the dynamic leadership of Dr. A. Ajayaghosh, who took over as Director in June 2015, while continuing to cater the regional needs in agro products, materials and energy.

CSIR-NIIST continued to excel in its performance during the year 2016-2017 also in terms of securing cutting edge research projects, upsurge in new collaborations involving industrial, private and public sectors which lead to an substantial increase in generating revenue from external sources. The year 2016-17 also marked the successful completion of XIIth Five Year Plan projects with tangible deliverables. The vision and road map were further finetuned in this reporting year by identifying niche areas in the field of beach mineral processing, rare earth pigments, agro processing, phytochemicals for Ayurveda, waste treatment, biofuels, solar energy, coatings, security inks, diagnostic probes, drug intermediates etc., aligning with the mission and vision of CSIR and also with national goals.

NIIST has three fast track translational projects assigned by CSIR. We had some important technology transfers during the period under report. Several commercially important functional materials developed during the previous years have been further taken to the verge of technology transfer. An environment-friendly process for beneficiation of ilmenite is in line for transfer of technology. The NIR reflecting blue pigment technology developed by NIIST scientists is being scaled up. Process know-how for large-scale production of β-glucosidase enzyme for biomass hydrolysis for biorefineries is getting ripened. Value addition of ayurvedic spent materials, validation of raw material formulations from ayurvedic industry are some of the other achievements worth mentioning. Few others in the developmental stage are integrated biodrying process for municipal solid waste management and new florescent materials and inks for security applications.

CSIR-NIIST also provides solutions to environmental management issues of this region. In addition, we could cater to Swachh Bharat initiative of Govt. of India by introducing an anaerobic digester. The newly developed anaerobic digester stabilizes wastes as compost manure and generates methane rich biogas from biomass wastes at the source of generation. CSIR-NIIST has identified perchlorate contamination of ground water as a serious public health problem at few places in Kerala where perchlorate is handled in bulk. NIIST is also involved in EIA studies. In fact, NIIST is a NABET- Accredited Category A consultant organization in Kerala having accreditation in the Mining and Ports & Harbour Sectors.

Against this backdrop, the Annual Report for the period 2016-2017 sets out the innovation, achievements, progress and impact made by CSIR-NIIST aligning with its future plans in a vigorously changing and challenging interdisciplinary environment of frontier research.

Progress and Performance in R&D Programs

Through focused activities, each of the five divisions have made significant progress in product development, process formulations, academic excellence and

research collaborations during the period of this report. Activities and achievements in the areas of chemicals, materials, microbial processes, agro-processing and environmental technologies are summarized in this report.

The Agro Processing and Technology Division played a key facilitation role through the Technology Business Incubation Center supporting MSMEs, providing consultancy through analytical services, product development and shelf-life enhancement for functional foods, nutraceuticals. Pharmacological evaluation of bioactive compounds from plants and their exploitation in the management of metabolic disorders and cancer, development of bio-fertilizers and bio-pesticides are the current major focus areas of research.

The current focus of the Microbial Processes and Technology Division are (i) Bioprocess and product development (ii) Biofuel and biorefinary (iii) Health, Genomics and Biodiversity. In the area of bioprocess and products, the division's emphasis is on production of industrial enzymes, biopolymers, amino acids, value added platform chemicals, probiotics, microbial nutraceuticals etc. The theme of biofuel research is mainly on developing strategies for commercially feasible production of biofuels and developing green and sustainable processes for production of alternatives to non-renewable chemicals and products for betterment of human lives. The division has established a pilot plant facility for solid-state fermentation and for the production of ethanol from lignocellulosic biomass. Other activities include the exploration biodiversity for plant microbe interaction and for microbial bioactives.

The Chemical Sciences and Technology Division has been focusing on the following three priority areas of the Institute viz., Organic and Hybrid Electronics (Energy generation and storage, solid state lighting, chromogenic coatings, memory elements and computational chemistry), Fluorescent materials (Security applications, diagnostics and imaging probes and ultrafast kinetics) and Phytopharmaceuticals and Drug Intermediates (Bio-evaluation of medicinal plants, Advanced pharmaceutical intermediates). The division is embarking on several ambitious projects in the areas of renewable energy, fluorescent materials for security applications and natural products.

The research of Materials Science and Technology Division has been mainly focused on the development of advanced functional materials and components for strategic, automobile, energy and societal applications. The major research areas of the division during the period 2016-17 were multifunctional pigments for energy saving applications, luminescent materials for lighting applications, porous ceramic materials for CO_2 adsorption for environmental applications, nano photo catalysts for dye-degradation, printed electronics, magnetic and magneto refrigeration materials, polymers and polymer nano-composites, beneficiation of minerals and value addition to the Industrial Slag and Aluminium and Magnesium Alloys and Composites for Strategic and Automobile Applications.

The Environmental Technology Division is a hub of indigenous technology development, achieved through the design of innovative processes for environmental pollution control and value addition to the region's natural resources. This Division is also home to the Computational Modeling group of NIIST and CRTDH (Common Research and Technology Development Hub) for Environmental Interventions in MSMEs, which provides technology and services to MSMEs for managing their environmental issues. The division's technology basket has processes for production of white pepper from black or green pepper, environment-friendly coir retting, effluent treatment, solid waste management and tech-products like bio-filters for odour control, biogas plants, food-waste digesters, kitchen waste composter, wood substitutes from fibre composites and from the computational modeling team, a simulation software, affordable to the MSME metal casting foundry industry.

The analytical facility of the Institute was extensively utilized for the in-house R&D Programs with all major facilities working to the full capacity, besides generating revenue from testing of samples from industry and academia. Dioxin analysis facility in NIIST is another added attraction The sustained funding from CSIR during this reporting period along with a steady rise in external funding, have helped us in focusing on translational research and technology development without compromising on high quality publications.

During the period 2016-2017, several important events were organized in CSIR-NIIST. The Institute organized a one-day R&D Industry meet on 6th January 2017 to identify the issues of mutual interest and to forge alliances with industries from private and public sectors

including MSMEs. The honourable chief minister of Kerala Shri. Pinarayi Vijayan inaugurated the meet, and it was also presided over by honourable MLA Shri. O. Rajagopal. Honourable MP, Dr. Shashi Tharoor delivered key-note address. Many industries attended the meet and several MoUs were executed.

CSIR-NIIST foundation day was celebrated at CSIR-NIIST on 6th October 2016. The function was presided over by Shri. Justice (retd.) P. Sathasivam, honourable Governor of Kerala. Many important national and international events also were organised during the period of this report. CSIR-NIIST and Kerala State Council for Science, Technology and Environment (KSCSTE) jointly hosted PROMISE program, CSIR-NIIST and Chemical Research Society of India, Trivandrum Chapter jointly organized a one-day Symposium entitled "Recent trends in Natural Product Chemistry". Other events organized were Workshop on Novel technologies and Engineering approaches to sanitation in South India, one day science outreach programme and a national symposium on light metals, composites and manufacturing processes.

The Institute also celebrated the National Science Day, National Technology Day, and CSIR Foundation Day. Open day was observed by the Laboratory on these occasions and large number of students and faculty visited the Institute, interacted with the scientists. Hindi Week and Vigilance Awareness Week were conducted in the Laboratory. Activities related to the Swachh Bharat Mission started in the Institute. The laboratory and its neighbouring areas were cleaned with the involvement of staff and students.

The scientists and research fellows brought many laurels to the institute through several prestigious awards, honours and recognitions. The research scholars continued their winning streak by achieving best poster, best oral presentation and paper awards in prestigious seminars and symposia.

कृषि प्रसंस्करण तथा प्रौद्योगिकी प्रभाग

कृषि प्रसंस्करण तथा प्रौद्योगिकी प्रभाग मसाले, तेल बीज और प्राकृतिक उत्पादों पर विशेष जोर देने के साथ कृषि उत्पादन के क्षेत्र में प्रक्रियाओं और प्रौद्योगिकियों के विकास पर काम करता है। कार्यात्मक खाद्य पदार्थ, न्यूट्रास्यूटिकल, पौधों से बायोएक्टिव यौगिकों के औषधीय मूल्यांकन और चयापचय संबधी रोग और कैंसर के प्रबंधन में उनका उपयोग, वर्तमान में अनुसंधान के प्रमुख संकेद्रित क्षेत्र हैं। एंडोफाइटिक जीवाणुओं से बायो-उर्वरक और बायोपेस्टीसाइड का विकास, मसालों और फलों से सक्रिय तत्वों के अलगाव के लिए औद्योगिक रूप से महत्वपूर्ण कई एंजाइम के उत्पादन करनें में सक्षम नूतन स्वदेशी माइक्रोबियल उपभेदों का निर्माण वर्तमान शोध के अन्य कुछ क्षेत्र हैं। एक प्रमुख अंतर्विषयी कार्यक्रम, उर्वरक और कीटनाशकों के रूप में नूतन सिंथेटिक यौगिकों का विकास वर्तमान में प्रगति के तहत है। प्रभाग में कृषि प्रसंस्करण के क्षेत्र में प्रमुख पायलट संयंत्र सुविधा और टेक्नोलॉजी बिज़नेस इनक्यूबेशन सेंटर (टी.बी.आई.सी) उपलब्ध है।

मुख्य विशेषताएं

- उत्पाद और प्रक्रिया विकास, प्रौद्योगिकी उन्नयन और स्वास्थ्य लाभ के वैज्ञानिक सत्यापन के लिए आर.एंड़.डी उद्योग इंटरफ़ेस प्रोग्राम (प्रायोजित और परामर्श)।
- विटामिन ए की कमी के लिए रेड पाम ओलेन (आर. पी.ओ) आधारित कार्यत्मक खाद्य उत्पाद-कार्यात्मक वनस्पति तेल और मुलायम जेल।
- कृषि-औद्योगिक अपशिष्ट और पारंपरिक खाद्य फसलों से प्रीबायोटिक आहार फाइबर।
- एक्रिलमाइड पर ध्यान देने के साथ खाद्य सुरक्षा में आर. एंड डी. की पहल: केला चिप्स में (*मूसा पाराडिसिएसा*) पकने के साथ एक्रिलामाइड का निर्माण।
- चयापचय संबंधी रोग और कैंसर के लिए पौधों से बायोएक्टिव यौगिकों के औषधीय मूल्यांकन।
- देशी रोगाणुओं से औद्योगिक रूप से महत्वपूर्ण एंजाइमों के माध्यम से साक्रिय संघटक के निष्कर्षण के लिए वानस्पतिकों का बायोप्रोसिंग।
- एंडोफाइटिक जीवों पर विशेष ध्यान के साथ जीवाणुओं से जैव उर्वरक और जैव कीटनाशक का विकास।

AGRO PROCESSING AND TECHNOLOGY DIVISION

Agro Processing and Technology Division works on the development of processes, products and technologies in the areas of agro produces with special emphasis on spices, oil seeds and natural products. Functional foods, nutraceuticals, pharmacological evaluation of bioactive compounds from plants and their exploitation in the management of metabolic disorders and cancer are the current major focus area of research. Development of bio-fertilizers and bio-pesticides from endophytic microbes, mining of novel indigenous microbial strains capable of producing industrially important multiple enzymes for the active ingredients isolation from spices and fruits are some of the other area of current research. Development of novel synthetic compounds as fertilizer and pesticides is a major interdisciplinary programme presently under progress. This division has major pilot plant facilities and a Technology Business Incubation Centre (TBIC) in the area of agro processing.

Highlights

- R & D, Industry interface programmes (sponsored & consultancy) for product and process development, technology up gradation and scientific validation of health benefits
- Red Palm Olein (RPO) based functional food products for vitamin A deficiency - functional vegetable oil & soft gel
- Prebiotic dietary fibre from agro-industrial waste and traditional food crops
- R & D initiatives in food safety with a focus on acrylamide : Acrylamide formation in plantain (*Musa paradisiaca*) chips with ripening
- Pharmacological evaluation of bioactive compounds from plants for metabolic disorders and cancer
- Bio processing of botanicals for active ingredient extraction through industrially important enzymes from native microbes
- Bio-fertilizers and Bio-pesticides from microbes with special emphasis on endophytic organisms.

Technology Business Incubation Centre (TBIC) in Agroprocessing

TBIC is a specialized infrastructure for Agroprocessing which envisages various technical services like process /product development,establishment of technical feasibility, samples for market evaluation, analytical services, facility to try out new concepts by entrepreneur, technical consultancy / tech up-gradation, validation of ayurvedic / functional foods/ nutraceuticals etc. During last year, many MSME's were benefitted through product development for value addition of agro produces (dehydrated / preserved fruits & vegetables, mushroom, cardamom etc.). Few industries also collaborated for related activities some of which are listed below:

- Dietary fiber recovery from pressed coconutcake M/s Vaama Oils, Coimbatore)
- Evaluation of shelf life stability for coffee concentrate (New Entrepreneur)
- Value addition of tender coconut pulp (Lifetree Agro industries, Palakkad)

Modernization of the breakfast mix unit

Sponsor: Brahmins Food Products Pvt. Ltd.

A modified process was developed and optimized in pilot plant & semi commercial level for making breakfast mix from different food grains. A semi commercial manufacturing facility was put into operation based on the modified process and the technical specifications of the machinery provided by NIIST. The new unit could replace many of the batch wise operations with an integrated continuous processing. NIIST will further extend engineering consultancy for the erection of the modernized commercial unit having 20 TPD processing capacity.

Development & evaluation of formulated food products

Sponsor: Sreedhareeyam Ayurveda Speciality Eye Hospital & Research Centre

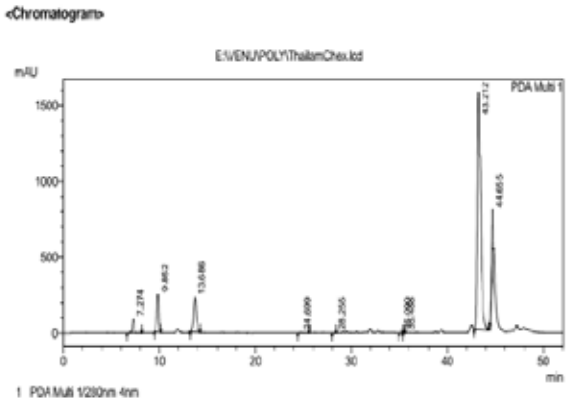
In collaboration with the reputed Ayurvedic group M/s SreedhareeyamSpeciality Eye Hospital, the institute envisages the development of innovative products as healing food for preventive health management. This includes Functional food products from traditional grains, fruits and vegetables (instant breakfast mixes, soup mix, beverages). The developed products were supplied for feedback & evaluation and the formulations made by the industry were evaluated & validated for the health benefits.

Validation of 'Thailamurcchanam' in Ayurveda

Sponsor: M/s Aarshaveda Wellness Pvt Ltd, Aluva

We scientifically validated a process in classical Ayurveda "Thailamurcchanam" for M/s Arshaveda Wellness Pvt Ltd, Aluva,which is a preprocessing

technique adopted for raw fats & oils used in classical medicated oil manufacture. The different samples provided by the industry were investigated through chemical finger printing, shelf life / stability, antioxidant properties. The comparative evaluation of the samples is applied to validate the process in terms of solvency efficacy, enhancement in polyphenol/ flavonoid content, better antioxidant properties etc.



AARSHAVEDA

Chemical & biological evaluation of product samples

Sponsor:M/s Bipha Drug

A leading Ayurvedic manufacturing industry M/s Bipha Drug Laboratories has approached NIIST to evaluate some of their product samples with respect to phytochemical analysis, anti-diabetic and anti-cancer activities of some of the popular formulation. As a sponsored project we undertook the activities and the following tasks performed:

- α-amylase and α- glucosidase assay, inhibition assay and glucose uptake assay for a maximum of three samples.
- MTT assay, cell cycle analysis, apoptosis, caspase assay and western blots for marker proteins (for maximum of three samples)
- The analytical charges for the phytochemical analysis [total phenolic content (TPC), total flavonoid content (TFC), terpenes and alkaloids and HPLC profiling of phenolic compounds (for maximum of 20 samples)

Hydrogenation of fish oil

Sponsor:M/s Aarbee Marine Extracts Pvt Ltd

M/s Aarbee Marine Extracts Pvt Ltd, India's leading exporter in marine based products had approached to conduct hydrogenation of fish oil using pilot plant facility. The task was undertaken as sponsored project and the following studies are in progress as part of the programme.

- Process development for making a specialty emollient by hydrogenation & purification (1- 2 kg batch level)
- Optimization: Process parameters, catalyst concentration, kinetics, process time, process efficiency etc.
- Evaluation of the product developed (physicochemical / GCMS)
- Pilot scale trials for Product recovery from alternative phyto-resources

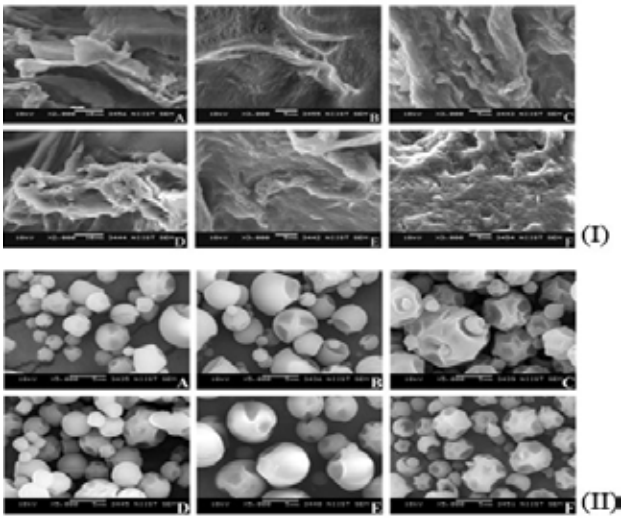
Red Palm Olein (RPO) based functional vegetable oil

The objective of the programme was to develop functional vegetable oil enriched with β- carotene by blending of commonly used vegetable oil with red palmolein for addressing malnutrition due to vitamin A deficiency. Field level studies were conducted in 30 families to evaluate the acceptability of the oil blends in collaboration with Medical trust Hospital, Kulanada, Pandalam in collaboration with Achutha Menon Centre for Health Science Studies (ACHSS, SreeChithiraTirunal Institute for Medical Science and Technology, Trivandrum). The oils were distributed

among 30 families in the field area. Most of the families chose the oil as a healthy cooking oil based on the colour, slight viscous nature of the oil, reduced quantity of consuption when compared with the other oils. RPO based soft gel was also prepared as vitamin A supplement.

Prebiotic dietary fibre from *Musa paradisiaca*inflorescence to enhance the gastrointestinal stability of probiotics

The prebiotic properties of soluble dietary fibre form *Musa paradisiaca* (*Nendran* variety) inflorescence (PIF) were investigated. PIF enhanced the growth of probiotics-*Lactobacillus casei* and *Bifidobacterium bifidum* selectively in mixed culture and inhibited the growth of pathogenic *E. coli*. After confirming the prebiotic potential, incorporation of PIF in the encapsulating matrix for the encapsulation of *Lactobacillus casei* and *Bifidobacterium bifidum* using spray drying and freeze drying for gastrointestinal delivery was studied. The pH and bile acid tolerance of the encapsulated probiotics as well as its viability during storage were studied and compared with that of inulin, a known prebiotic. The developed synbiotic components withstood adverse gastric conditions and the viability of probiotic bacteria was maintained up to 45th day at room temperature. The study suggests that PI could be a potential source of dietary fibre with prebiotic properties for the development of functional foods for gastro intestinal health.



SEM images of Lyophilized beads [I] and Spray dried powders [II].(A) Control-*Lactobacillus casei*, (B) Inulin + *Lactobacillus casei*, (C) PIF + *Lactobacillus casei*, (D) Control-*Bifidobacterium bifidum*, (E) Inulin + *Bifidobacterium bifidum*, (F) PIF + *Bifidobacterium bifidum*. PIF- Soluble dietary fibre from Plantain Inflorescence.

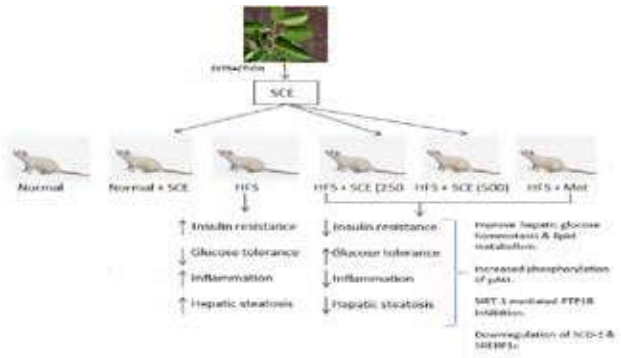
First report on isolation of 2,3,4- trihydroxy-5-methylacetophenone from Palmyra palm (*Borassus flabellifer* Linn.) syrup, its antioxidant and antimicrobial properties

Palymyra palm jaggery popularly known as 'golden palm gur'processed from palm sap used as substitute for table sugar in India, is reported to have immunomodulation properties. Conventional preparation of palm ghur lacks cleanliness and often makes it unpalatable. Hence, a process was developed to produce syrup from palm sap which can be used as a substitute to conventional palm ghur. After optimizing the process for syrup development, isolation and characterization of 2,3,4-trihydroxy-5-methylacetophenone (1), nicotinamide (2), and uracil (3) was done for the first time from palmyra palm syrup. DPPH radical scavenging activity and antibacterial activity of compound 1 was then evaluated. Total phenolic content (TPC) and Total

flavonoid content (TFC) of palymyra palm syrup were also investigated.

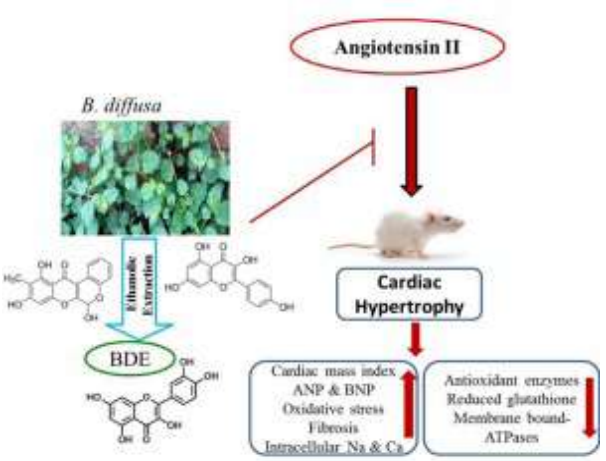
Symplocos cochinchinensis increases insulin sensitivity via the down regulation of lipogenesis and insulin resistance in high energy diet rat model.

Symplocos cochinchinensis has been utilized in Indian system of medicine for treatment of diabetes and is one of the main ingredients of Ayurvedic preparation for diabetes 'Nisakathakadi Kashayam'. The molecular mechanisms underlying the insulin sensitizing effects of *Symplocos cochinchinensis* ethanol extract (SCE) using a high fructose and saturated fat (HFS) fed insulin resistant rat model was elucidated. SCE administration attenuates the insulin resistance in HFS rat by the down regulation of SCD1 gene expression that modulates SREBP-1c dependent and independent hepatic lipid accumulation. SCE enhances insulin sensitivity via the down regulation of lipogenesis and insulin resistance in HFS rat model.



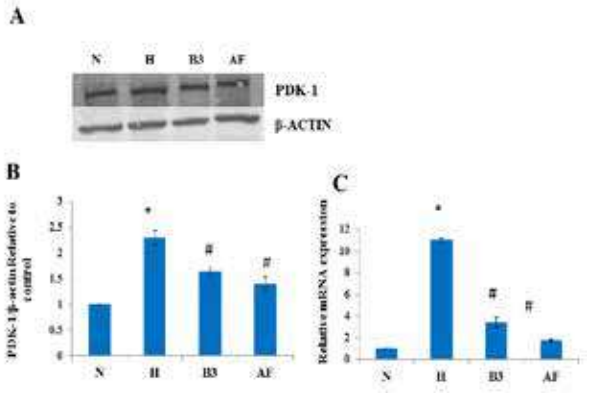
Boerhavia diffusa L. mitigates angiotensin II induced cardiac hypertrophy and fibrosis in rats.

Boerhavia diffusa is a renowned edible medicinal plant extensively used against different ailments including heart diseases in the traditional system of medicine in several countries. The therapeutic efficacy of ethanolic extract of *Boerhavia diffusa* (BDE) on cardiac hypertrophy and fibrosis induced by angiotensin II (Ang II) in male wistar rats was evaluated. A substantial increase of hypertrophy markers such as cardiac mass index, concentration of ANP and BNP, cardiac injury markers like CK-MB, LDH and SGOT, has been observed in hypertrophied groups whereas BDE treatment attenuated these changes when compared to hypertrophied rats. Moreover, Ang II induced myocardial oxidative stress was reduced by BDE which was apparent from diminished level of lipid and protein oxidation products, increased activities of membrane bound ATPases and endogenous antioxidant enzymes along with enhanced translocation of Nrf2 from the cytosol to nucleus. It appears that BDE evokes its antioxidant effects by attenuating lipid peroxidation, enhancing the translocation of Nrf2 from the cytoplasm to nucleus as well as by regulating the metabolism of glutathione. The extent of fibrosis during cardiac hypertrophy was determined by histopathology analysis and the results revealed that BDE treatment considerably reduced the fibrosis in the heart. HPLC analysis of BDE leads to the identification of four compounds viz., quercetin, kaempferol, boeravinone B and caffeic acid. The study substantiated the effect of *B. diffusa* in protecting the heart from pathological hypertrophy and the attenuation of cardiac abnormalities may be partly attributed through the reduction of oxidative stress and cardiac fibrosis. Since the plant is widely used as a green leafy vegetable, incorporation of this plant in diet may be an alternative way for the prevention and better management of heart diseases and associated complications.



Bilobalide protects 3T3-L1 adipocytes from hypoxia through protecting mitochondrial bioenergetics, biogenesis and dynamics

Natural products are the cornerstone of modern therapeutics. Bilobalide was found to be effective against hypoxia induced alterations in innate antioxidant status in our earlier study. Adipose tissue hypoxia in obesity contributes to insulin resistance *via* mitochondrial dysfunctions. Mitochondria are a central control point of many metabolic pathways and various pathophysiological conditions. In the present investigation, we evaluated the effect of hypoxia on crucial mitochondrial functions in 3T3-L1 adipocytes and possible protection with bilobalide. Hypoxia for 24 hours substantially increased ($P \leq 0.05$) HIF-1α expression (5.3 fold) as well as PDK-1 expression (2.3 fold) at the protein level in 3T3-L1 adipocytes. The aconitase enzyme activity was significantly ($P \leq 0.05$) reduced (4.5 fold) in the hypoxic group indicating an elevated level of mitochondria-generated ROS production. It also affected mitochondrial bioenergetics like oxygen consumption (2.23 fold), ATP synthesis (4.32 fold), and the activities of respiratory chain complexes such as complexes I, III and IV (2.05, 2.35 & 2.9 fold) in hypoxic adipocytes. Hypoxia also impaired ($P \leq 0.05$) mitochondrial dynamics such as mitochondrial biogenesis and fusion/fission balance in 3T3-L1 adipocytes. Bilobalide protected the 3T3-L1 adipocytes from adverse effects of hypoxia by safeguarding mitochondrial bioenergetics and dynamics, *via* downregulating HIF-1α expression. These findings suggest that bilobalide could be used as a therapeutic agent for adipocyte hypoxia-mediated mitochondrial dysfunctions in obesity.

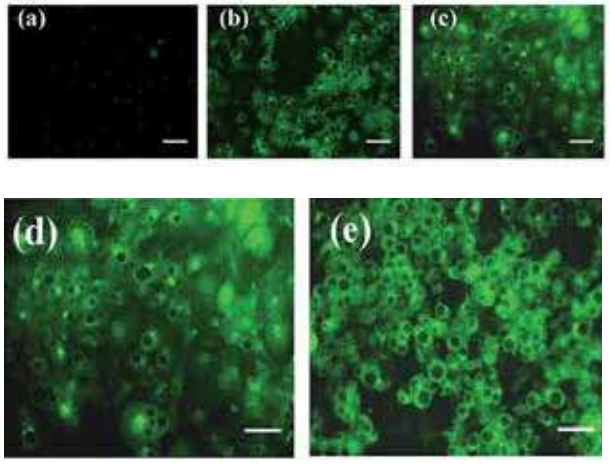


Expression of Pyruvate dehydrogenase kinase 1 in normoxic and hypoxic adipocytes: A) Immunoblot analysis of PDK-1. B) Quantification of protein level normalized to β-actin. C) mRNA expression of Pdk-1 normalised to β-actin. N-normoxia, H-hypoxia, B3-50 µM of bilobalide, and AF-5 µm of acriflavine treated hypoxic groups.

Licarin B from *Myristica fragrans* enhances insulin sensitivity *via* PPARγ and activation of GLUT4 in the IRS-1/PI3K/AKT pathway in 3T3-L1 adipocytes

Peroxisome proliferator-activated receptors (PPARs) are ligand-activated transcription factors regulating lipid and glucose metabolism. The objective of the present study is to characterize the cellular effect of Licarin B (LB), a neolignan isolated from *Myristica fragrans* on the PPARγ and insulin

signaling pathways in 3T3-L1 preadipocytes. The molecular mechanism of action of LB on PPARγ and insulin signaling pathways were studied using *in vitro* and *in silico* methods. Functional activation of PPARγ *in vitro* was confirmed by 3T3-L1 preadipocyte differentiation, regulation of target genes and protein expression. LB caused triglyceride accumulation during adipogenesis but significantly less compared to rosiglitazone (RG), a PPARγ full agonist. In *in vitro* time-resolved fluorescence resonance energy transfer-based competitive binding assay, LB showed an IC_{50} value of 2.4 μM whereas for RG and GW9662 it was 57.96 nM and 18.68 nM respectively. Virtual screening of LB with PPARγ showed hydrophobic interactions with a binding energy of −9.36 kcal mol^{-1}. Interestingly enough LB improved insulin sensitivity by up regulating the GLUT4 expression and translocation *via* IRS-1/PI3K/AKT pathway, enhanced adiponectin secretion and modulated mRNA expression profile of PPARγ target genes C/EBPα, IRS-2, and LPL significantly compared to RG. This scientifically validates LB as a promising bioactive for insulin resistance and associated complications through its partial PPARγ activity.

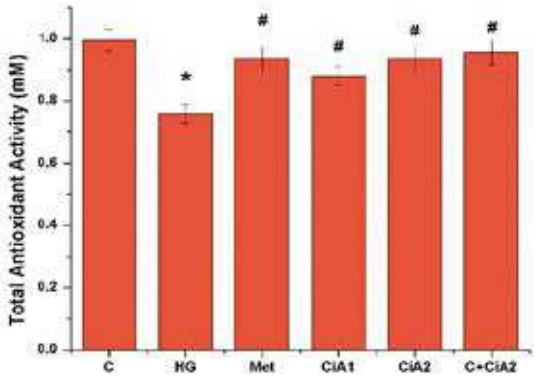


Translocation of GLUT4 protein was measured through immunofluorescence and was analyzed by fluorescent microscope imaging (original magnification 20). (a) Vehicle control (b) 10 mM RG (c) 5 mM LB (d) 10 mM LB (e) 15 mM LB.

The role of bioactives (chlorogenic acid and cinnamic acid) in preventing high glucose induced cardiac alterations

Role of cinnamic acid (CiA) in ameliorating alterations induced by diabetic cardiomyopathy:

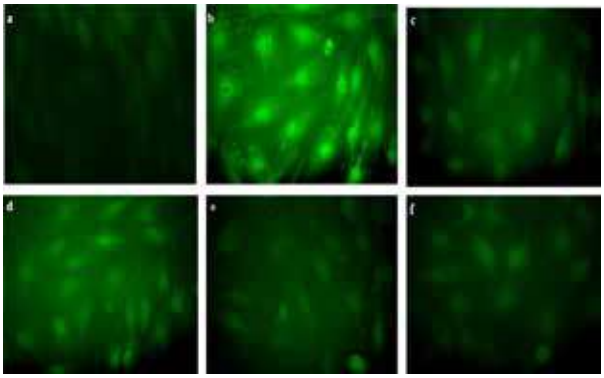
Kerala is blessed with rich biodiversity as well as traditional system of medicine like Ayurveda. *Cinnamomum verum* is a commonly found tree in Kerala with multiple medicinal properties. Our preliminary investigation had shown effectiveness of cinnamon extract against oxidative stress related complications. Effectiveness of cinnamic acid (CiA) against hyperglycemia induced alterations in biology of H9c2 cells emphasizing oxidative stress and mitochondrial functions was evaluated. Oxidative stress is considered to be one of the major causes for the pathogenesis of the diabetic cardiomyopathy. Recent studies have shown that oxidative damage induced by reactive oxygen or nitrogen species (ROS and/or RNS) derived from hyperglycemia plays a critical role in diabetic injury in multiple organs. Mitochondria are a major source of ROS production in H9c2 cardiomyocytes. The hyperglycemic model was established in vitro in H9c2 cells simulating diabetic cardiomyopathy. Mitochondrial functions were assessed by quantifying mitochondrial superoxide generation, and mitochondrial transmembrane potential. Apoptosis has also been considered as one of the outcome of cardiomyocytes in response to diabetic hyperglycemia. Alterations in innate antioxidant status and apoptotic death in hyperglycemic condition was ameliorated with CiA showing its potential activity against hyperglycemic cardiomyopathy.



Effect of CiA on total antioxidant status of H9c2 cells: C- control, HG- high glucose, Met- metformin, CiA1- cinnamic acid (100 nM), CiA2- cinnamic acid (500 nM), C+CiA2- compound + control

Role of chlorogenic acid (CA) in reducing oxidative stress and glycation during hyperglycemia

Efforts were also taken to evaluate effectiveness of chlorogenic acid (CA) against hyperglycemia induced alterations emphasizing advanced glycation end products and oxidative stress. Hyperglycemia induced oxidative stress in H9c2 cells with 33 mM glucose for 48 h incubation was taken as model that mimics diabetic cardiomyopathy in humans. Hyperglycemia caused generation of surplus ROS and significant depletion of antioxidant enzymes [(SOD (CuSOD, MnSOD), total antioxidant enzyme, GPx)]. Interestingly the simultaneous application of CA brought back the content of innate antioxidants to almost normal. Increased level of MDA and carbonyls are reported as the potent biomarker of oxidative stress. Hyperglycemia caused increased production of protein carbonyls as well as peroxides. CA reduces the content of advanced glycation end products (AGEs). AGEs can induce crosslinking of collagen which can cause vascular stiffening and entrapment of low-density lipoprotein particles (LDL) in the artery walls. The development of diabetic cardiomyopathy is also accompanied with a high membrane bound PKC. During hyperglycemia there is hyperactivity of PKC. CA ameliorates the activity of PKC. Overall results reveal the protective property of this compound against hyperglycemia induced oxidative damage.



H9c2 cells treated with or without CA under high glucose(33 mM for 48 h). Incubated with DCFDA-intracellular ROS levels. Microscopic scans(a) Control, (b) HG treated group, (c) C + CA2, (d) CA1, (e) CA2, (f) HG + Metformin

Bio-prospecting of two coded anti-diabetic medicinal plants based on ethno medical leads with special reference to diabetic complications – A Molecular Pharmacological Approach

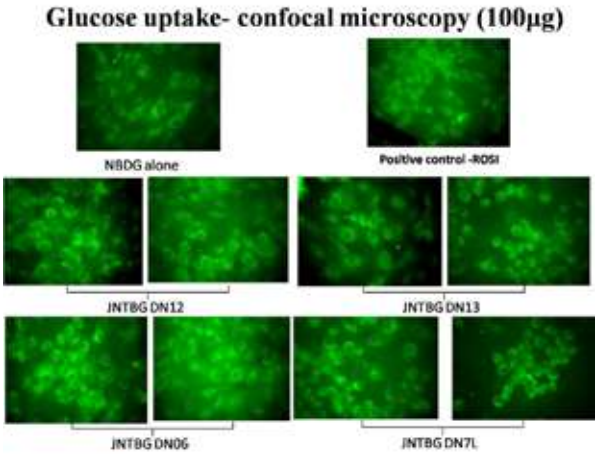
The potential anti-diabetic activity of 15 medicinal extracts coded as JNTBG DN03, JNTBG DN06, JNTBG DN07F, JNTBG DN07L, JNTBG DN07S, JNTBG DN10, JNTBG DN11, JNTBG DN01, JNTBG DN02, JNTBG DN04, JNTBG DN09, JNTBG DN08, JNTBG DN005, JNTBG DN12, JNTBG DN13 were evaluated at a concentration of 1mg/ml in distilled water for various biochemical assays like α-glucosidase, amylase inhibition assay, antiglycation assay, DPP IV inhibition assay and cell culture studies in rat skeletal muscle cell lines and L6 myoblasts.

Antidiabetic effect of different extracts was carried out in terms of its efficiency to inhibit the enzymes, α-glucosidase and α-amylase using acarbose as standard (IC_{50}=32µg/ml). Results showed that the extracts JNTBG DN06 (IC_{50} =22.7 µg/ml), JNTBG DN07S (IC_{50} =25.22 µg/ml), DN12 (IC_{50} =15.5 µg/ml) and DN13 (IC_{50} =36.17µg/ml) have shown the

highest α glucosidase inhibitory potential and the extracts JNTBG- DN11 (IC_{50} =24.8 µg/ml), DN12 (IC_{50} =36.9 µg/ml) and DN13 (IC_{50} =12.8 µg/ml) have shown the highest α amylase inhibitory potential. Antiglycation potential of different extracts carried out using aminoguanidine [IC_{50} value = 259(uM)] as standard indicated that all the extracts have shown antiglycation potential and the highest potential was shown by the extracts JNTBG-DN03, JNTBG-DN07F, JNTBG-DN07S, J NTBG-DN10, JNTBG-DN11, JNTBG-DN06 and JNTBG-DN7L. The extracts were investigated for their DPP-IV inhibitory activity at concentrations 10 and 100 µg. Results indicated that at a lower concentration (10mg) JNTBG -DN12, JNTBG-DN01, JNTBG-DN11, JNTBG-DN13, JNTBG-DN005, JNTBG-DN04 and JNTBG-DN08 have good activity to inhibit DPP-IV and was comparable with the activity shown by Diprotein A (Positive control). However, at a higher concentration (100mg), almost all the extracts have good potential to inhibit DPP-IV.

Cell toxicity studies performed in L6 cell lines with different extracts at a concentration ranging from 1µg to 100 µg on 24-hour treatment found that all the extracts were less than 20% toxic up to 100ug concentration. The antidiabetic effect of all the extracts were examined in differentiated L6 cells by their ability to uptake 2NBDG (a glucose analog) by fluorescent microscopy and quantitatively by flow cytometry analysis. Rosiglitazone served as positive control. Fluorescent images demonstrated that the extracts JNTBG-DN06, JNTBG-DN07L, JNTBG-DN12 and JNTBG-DN13 pretreatment on L6 showed the highest glucose uptake potential. Further, the flow cytometry analysis quantitatively supported the results interpreted from flurorescent image. Antihyperglycemic effect of different extracts were analysed by PTP-1B inhibition assay. The assay was carried out using orthovanadate as positive control. Results indicated that most of the extracts have more than 20% PTP1B inhibition demonstrating their antidiabetic potential. Among the extracts, the most potent PTP1B inhibition was shown by JNTBG-DN04, JNTBG-DN01, JNTBG-Dn12, JNTBG-SN02, JNTBG-DN08 and JNTBG-DN13.

Based on the preliminary assays carried out in 15 extracts received, it is observed that JNTBG-DN06, JNTBG-DN07L, JNTBG-DN12 and JNTBG-DN13 had demonstrated significant antidiabetic potential when tested using different targets of diabetes using chemical, enzyme inhibition and cell based methods. These extract can be considered for the development of formulations targeting diabetes and its complications.



Glucose uptake potential of coded extracts

Phytochemical investigation of *Syzygium cumini* seeds in ameliorating lifestyle associated diseases

Antioxidant potential of three different geographical variants (Trivandrum-TVM, Trichy-TCH, Malampuzha-MPA) of *Syzygium cumini* seeds in correlation with the phenolic profiling evaluated, showed that TVM variant of *S. cumini* seed showed potent antioxidant activity among all the variants. There existed a linear correlation between phenolic

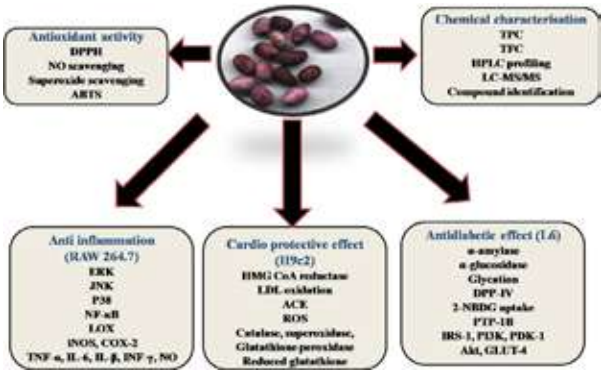
content and antioxidant activity. HPLC, LC-MS/MS data of different fractions of TVM variant revealed the presence of phenolic compounds with high concentrations of ellagic acid and gallic acid. The differences in phenolic concentration due to geographical changes might be the reason for higher antioxidant potential showed by 70% methanol fraction of TVM variant from which a compound named b-sitosterolglucoside was isolated and confirmed by NMR and HRMS data.

The studies on cardioprotective effect of *S. cumini* seed fractions in modulating angiotensin converting enzyme (ACE), HMG-CoA reductase, LDL oxidation and tertiary butyl hydrogen peroxide (TBHP) induced oxidative stress in H9c2 cardiac cell lines revealed that *S. cumini* effectively attenuated the cellular oxidative stress in H9c2 cardiomyoblasts. These fractions possess inhibitory potential against ACE, HMG-CoA reductase and LDL oxidation. Molecular docking studies of the predominant polyphenols with ACE and HMG-CoA proteins revealed the binding interactions of these compounds, thus confirming their modulation of activity.

The antidiabetic potential of fractions of *S. cumini* seeds and its mechanism of action were investigated. Potential α-glucosidase and α-amylase inhibition was demonstrated by 70% methanol fraction. The highest antiglycation potential was exhibited by ethyl acetate fraction. The methanol fraction showed potent DPP-IV inhibition. Major phenolics identified were docked with target enzymes of diabetes investigated in the present study and analyzed. A four-fold increase in 2-NBDG uptake in L6 skeletal muscle cells following the pretreatment of 70% methanol fraction further confirmed the antidiabetic potential of *S. cumini* seeds. Western blot analysis of key signaling molecules involved in IRS-1 pathway and the gene expression analysis of GLUT 4, IRS-1, PI3K, PDK-1 confirmed the molecular mechanism behind the antidiabetic activity. The cardioprotective and antidiabetic efficacy of *S. cumini* seed fractions can be attributed to the presence of phenolic acids and flavonoids.

The anti-inflammatory potential was studied in ethyl acetate, methanol and 70% methanol fractions of *S. cumini*. The anti-inflammatory effects of *S. cumini* were studied by using lipopolysaccharide (LPS)-stimulated RAW 264.7 cells. *S. cumini* seeds effectively reduced the production of nitric oxide (NO) and pro-inflammatory cytokines. Results showed that *S. cumini* inhibited LPS-activated lipoxygenases and reduced the levels of iNOS and COX-2 mRNA expression in murine macrophages. These effects were mediated by impaired translocation of nuclear factor (NF)-κB and inhibition of the phosphorylation of JNK, ERK and p38 in LPS-stimulated RAW 264.7 cells. This study gives scientific evidence that *S. cumini* seeds inhibits the LPS-induced expression of inflammatory mediators via suppression of JNK, ERK and p38 mediated NF-κB pathway as well as down regulation of iNOS and COX-2, indicating that *S. cumini* seeds have a potential application against inflammation.

The detailed investigation of *S. cumini* seed fractions in various biochemical targets relevant to diabetes, inflammation and cardioprotective action showed that this seed fractions especially 70% methanol and methanol fractions possess significant antioxidant, cardio protective, anti-diabetic and anti-inflammatory activity. Thus this under-utilized seed can be used in the treatment of various life style diseases.



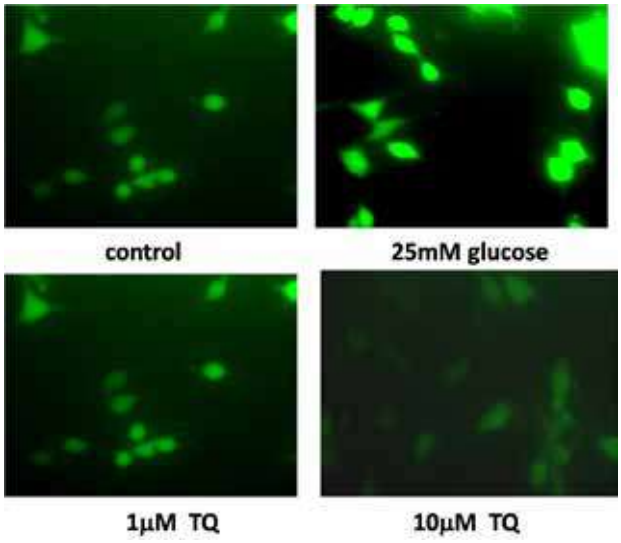
Potential of Syzygium cumini seeds against lifestyle associated disorders

Delineation of mechanism of action of thymoquinone and its derivatives in ameliorating hyperglycemia induced oxidative stress in skeletal muscle and pancreatic beta cells.

Thymoquinone (TQ), a major phytochemical component of the *Nigella sativa* seeds volatile oil shows a promising antidiabetic effect. Besides being a relatively safe compound there is no clinical evaluation for its antidiabetic effectiveness in humans known until now. Therefore, the study was aimed at determining the effect of TQ on pancreatic beta cells against hyperglycaemic stimuli using Beta TC6 and L6 cell lines.

Cell toxicity studies performed in L6 cell linestreated with different concentration of TQ ranging from 1µM to 50 µM and after 24 hour treatment found that TQ was less than 20% toxic up to 10mM concentration. Hyperglycemic condition was also standardised with varying concentration of glucose ranging from 5mM to 50mM for 24 hour and found less than 20% toxic upto a concentration of 30mM glucose. These concentrations were taken for further studies. To establish the role of TQ as an antioxidant, oxidative stress was induced in L6 cell lines by inducing a hyperglycaemic condition using 25mM glucose. Results from DCFH assay after treatment with TQ indicates that, TQ can act as an effective antioxidant against the intracellular ROS produced, indicating its antioxidant potential. To establish the role of TQ as an antidiabetic agent, a preliminary study was carried out in L6 myotubes in the presence of TQ after the induction of hyperglycaemic condition. Metformin served as a positive control. A result from confocal microscopy indicates the glucose uptake potential of TQ. More studies using flow cytometry have to carried out to establish the role of TQ for its glucose uptake potential.

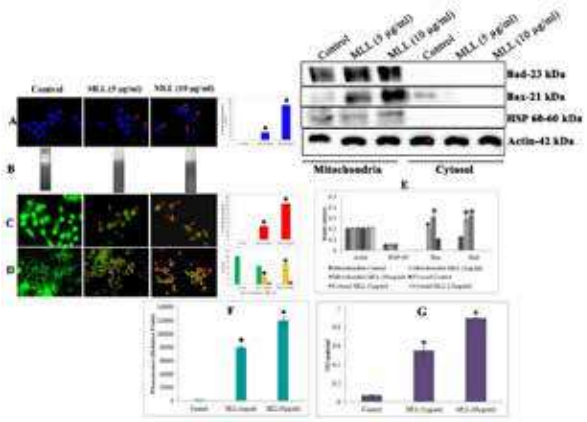
Based on the preliminary evidence from the studies using TQ, it is found that TQ can act as an antioxidant in skeletal cell lines. More studies needs to be carried out in terms of the glucose uptake and glucose transporter expression levels to clearly establish the antidiabetic property of TQ in these cell lines.



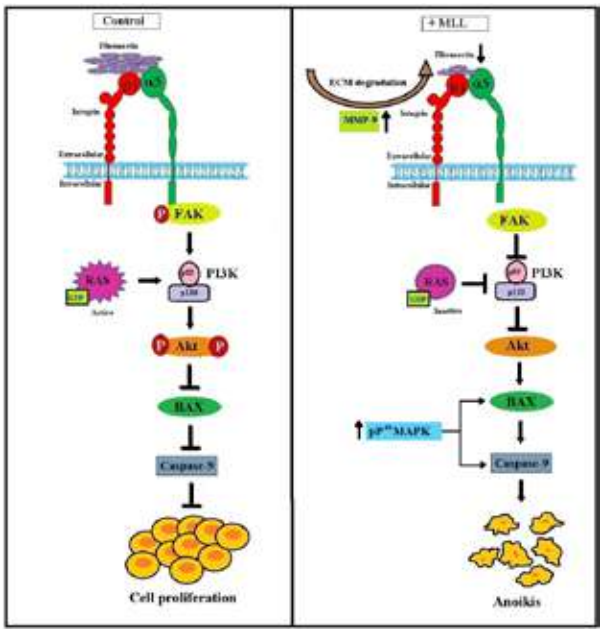
Intracellular ROS production in L6 myoblast

Mulberry leaf lectin (MLL) sensitizes anoikis in breast cancer cells

The detachment induced cell death (anoikis), an important property of mulberry leaf lectin (MLL) is demonstrated. Anoikis is a process by which apoptosis is inducted in cells once the cells are detached from the extracellular matrix. MLL induced anoikis in breast cancer cells which was confirmed by the up regulation in the apoptotic marker activities. Also it disengages the interaction between the integrin and associated signaling. The detached cells failed to re-adhere even in the presence of matrix proteins. There was downregulation of fibronectin (FN) production and upregulation of MMP production. Increase in MMP production helps to detach the cells and decrease in FN helps to reduce the integrin associated signaling. MLL blocked the FAK phosphorylation which involve the downregulation of active Ras. Other signaling molecules like Akt, p38 MAPK and JNK were also involved in the signaling cascades for anoikis induction by MLL.

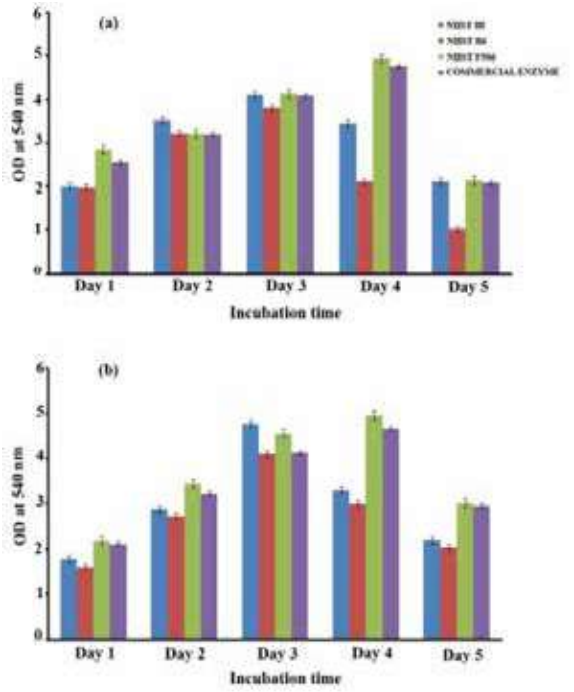


Upregulation of various apoptosis marker activities on treatment with MLL. **A.** DAPI stsining. **B.** Agarose gel showing DNA fragmentation. **C.** Acridine orange/Ethidium bromide staining for membrane integrity. **D.** Annexin V staining for PS translocation. **E.** Westernblot for apoptotic specific proteins. **F.** Caspase activity **G.** Activity of Bax in the mitochondrial fraction



Schematic representation of MLL induced anoikis in MCF-7 cells; Upregulation of MMP-9 as a result of MLL treatment caused ECM degradation and reduced FN expression. Reduced FN level decreased its interaction with the integrin receptor and downstream signaling. In association with this, integrin –FAK interaction and phosphorylation FAK inhibited. This in turn decreased the expression of PI3K and phosphorylation of Akt. In the unphosphorylated condition Akt promote the expression of proapoptoticBax and caspase 9 which caused programmed cell death (anoikis). Inactivation of Ras protein also inhibited the level of PI3K. Moreover, phosphorylated upregulation of P^{38}MAPK activate Bax and caspase 9 which in turn contributed to the anoikis process.

ENZYME PRODUCTION FROM MICROBIAL STRAINS AND THEIR EXPLOITATION IN ENHANCED CAPSAICIN EXTRACTION FROM *CAPSICUM*

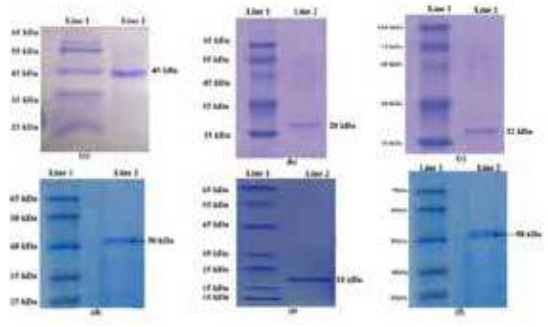


Assay of cellulase and pectinase

Bacterial and fungal strains were isolated from biologically important places of Kerala were screened for five industrially important enzymes viz. cellulase, pectinase, amylase, protease and lipase. An emphasis was given for the cellulase and pectinase enzyme. Two bacterial and a fungal strain, identified as ***Bacillus subtilis*** (NIIST B1), ***B. amyloliquefaciens***(NIIST B6) and ***Aspergillus niger*** (NIIST F506) produced test enzymes, were further

assayed for enzyme production and activity. NIIST B1, NIIST B6 and NIIST F506 produced cellulase 4.10, 3.80, 4.93 U/mL and pectinase 4.75, 4.09 and 4.94 U/mL respectively in optimized media. NIIST F506 was found to be best enzyme producer. Purification of cellulase produced in optimized media from NIIST B1, NIIST B6, and NIIST F506 recorded a yield of 55.36, 42.10 and 44.21% respectively. Whereas pectinase enzyme produced from test organisms recorded a yield of 59.62, 62.25, and 58.09% respectively from all three strains. The molecular weight exhibited a single band on gel with 45, 28 and 32 kDa for cellulase and 50, 18 and 58 kDa for pectinase respectively.

Application of enzyme from NIIST B1, NIIST B6 and NIIST F506 recorded a yield of 5.0±1.9, 3.2±1.5 and 9.7±2.6% for cellulase alone treatment whereas it was 4.2±1.5,3.0± 1.8 and 8.0±2.4% for pectinase alone treatment for capsaicin extraction from ***Capsicum annuum***. A combination of cellulase and pectinase enzyme from these strains recorded an increment of 13.0±3.2, 9.2±2.6 and 25.05±1.6% yield of capsaicin from ***Capsicum annuum.*** Extraction of capsaicin from 1Kg of capsicum was established under pilot plant conditions

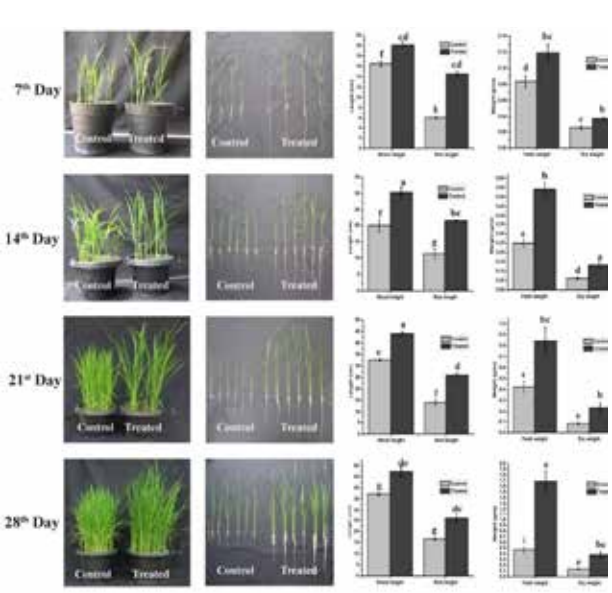


SDS-PAGE studies of cellulase and pectinase

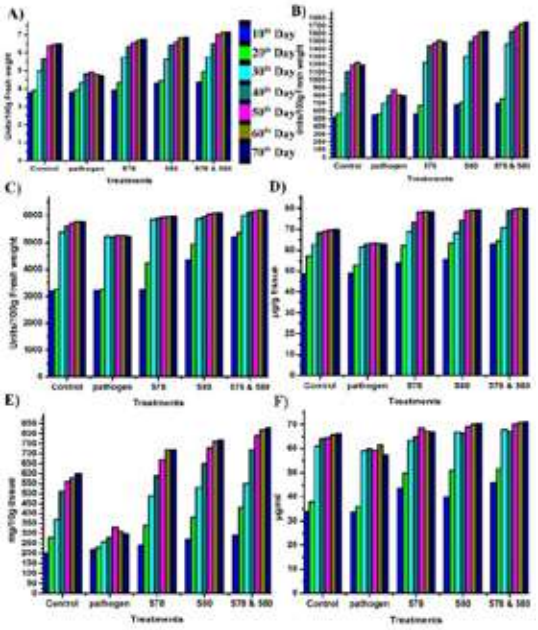
Endophytic bacterial flora of the rice plants from the acidic soils of Kuttanad and their exploitation in improved paddy cultivation

As a part of this investigation, rice plants sample grown in acidic soils were regularly collected from different parts of Kuttanad region for isolation of endophytes for more than a year. The organisms were isolated from root, pseudo stem and leaf of the collected samples in five different media. The pH of the area where samples are collected varied from 3.86 to 5.16 and majority of places exhibited good urease activity which indicate a rich microbial diversity. Among the 229 endophytes isolated comprised of 211 bacteria, 11 fungi and 7 actniomycetes, which were distributed in the root (35%), stem (33%) and leaf (32%) of sample plants.Many of them exhibited ***in vitro*** antagonism and plant growth promotion in laboratory, gnotobiotic and nursery conditions. Four types of bio-formulation consisting endophytic organisms were developed from this collection with the ability of plant growth promotion and yield enhancement besides disease management. One of the formulation induced systemic resistance in rice plants against sheath blight caused by ***Rhizoctoniasolani.*** Enhanced production of bioactive metabolites responsible for growth promotion and yield enhancement produced by an organism through RSM was completed and the endophytic nature of the selected strains were confirmed through Scanning Electron Microscopy (SEM) and fluorescent microscopy. A technology developed from this work is ready for transfer to parties interested for commercial production.

SEM of Root associated endophytes



Plant growth promotion by Endophytic strain



Elicitation of defense by endophytic strains

माइक्रोबियल प्रक्रिया तथा प्रौद्योगिकी प्रभाग

माइक्रोबियल प्रक्रिया तथा प्रौद्योगिकी प्रभाग (एम.पी.टी.डी.) का वर्तमान ध्यान (i) बायोप्रोसेस और उत्पाद विकास (ii) बायोफ्यूल और बाययोरिफाइनरी (iii) स्वास्थ्य, जीनोमिक्स और जैव विविधता पर केंद्रित है, जो कि सी.एस.आई.आर की प्राथमिकता वाले क्षेत्रों जैसे सस्ती स्वास्थ्य देखभाल, ऊर्जा और रसायन विज्ञान तथा पर्यावरण से अच्छी तरह से गठबंधित हैं। बायोप्रोसेस और उत्पादों के क्षेत्र में प्रभाग का ध्यान औद्योगिक एंजाइमों, बायोपॉलिमर्स, एमिनो एसिड, मूल्य वर्धित प्लेटफॉर्म रसायनों, प्रोबायोटिक्स, माइक्रोबियल न्यूट्रास्यूटिकल आदि के उत्पादन पर केंद्रित है। जैव ईंधन अनुसंधान का मूल विषय जैव ईंधन के वाणिज्यिक तौर पर व्यवहार्य उत्पादन के लिए रणनीति का विकास और मानव जीवन की भलाई के लिए गैर-अक्षय रसायनों और उत्पादों के लिए विकल्प के उत्पादन के लिए हरी और सतत प्रक्रियाओं का विकास है। प्रभाग ने ठोस अवस्था किण्वन और लिग्नोसेलुलोसिक बायोमास से इंथेनॉल के उत्पादन के लिए एक प्रारंभिक संयंत्र सुविधा स्थापित की है। प्रभाग की अन्य गतिविधियों में पादप जीवाणू इंटरैक्शन और माइक्रोबियल बायोएक्टिव्स के लिए जैव विविधता का अन्वेषण शामिल हैं।

मुख्य विशेषताएं

- डी.एन.पी.एच अभिकर्मक का उपयोग करके कीटोरिडक्टेस एंजाइम की गतिविधि और एनएंटिओसेक्लेक्टिविटी का पता लगाने के लिए दोहरी एंजाइम आधारित विधि विकसित की।
- डी-स्टार्च किये गेहूं के भूसे से फेरिलिक एसिड के अलगाव के लिए एक एंजाइमेटिक प्रक्रिया का अनुकूलन।
- *स्ट्रेप्टोमाइजिस अल्बिडोफ्लुवस* का उपयोग करके कैराटीनस के उत्पादन के लिए प्रक्रिया मापदंडों को अनुकूलित किया गया और एन.जी.एस. रणनीति का उपयोग करके जीनोम का पूरा न्यूक्लियोटाइड अनुक्रम निर्धारित किया गया।
- बेहतर हेमिसेलुलाज़ और लिग्नित हटाव के लिए मिर्च के फसलोत्तर अवशेष के अल्ट्रासाउंड सहायक क्षार पूर्वोपचार और सर्फक्टेन्ट सहायक संक्रमण धातु पूर्व उपचार जैसी नूतन वैकल्पिक रणनीतियाँ विकसित की गयी।
- फरफ़रल जैसे किण्वन अवरोध के चयनात्मक अधिशोषण के लिए एक शोषक के रूप में एसिड़ पूर्वोपचार किये शराब से आणविक मॉडलिंग द्वारा शोषक के साथ इसके इंटरैक्शन पर आधारित फैनील ग्लाइसिन-पी-सल्फोनिक एसिड भरी पॉलिस्ट्रीरिन का डिज़ाइन किया गया।
- ठोस अवस्था किण्वन के तहत 240 आईयू/जी.डी.एस (24 आई.यू / एम.एल.) एंजाइम गतिविधि के साथ अर्ध-पायलट पैमाने परीक्षणों में बी.जी.एल. उत्पादन की प्रक्रिया का अनुकूल और मूल्यांकन किया गया।
- एन.जी.एस. रणनीति का उपयोग करके सेलुलेस उत्पादन करने वाला *पेनिसिलिलियम जेन्थिनेलम* एन.आई.आई. सी.-02 जीनोम के पूर्ण न्यूक्लियोटाइड अनुक्रम निर्धारित किए गए।
- एन.आई.आई.एस.टी. के खमीर वियुक्तों में से एक, *सैकरोमिसेस सर्विसिए* आर.पी.पी. 03 एन, ईथेनॉल के लिए 90.51 % दक्षता के साथ गन्ना कचरा (एस.सी.टी.) जलापघटनज के किण्वन में सक्षम था।
- माइक्रोएल्गे में सेलुलर लिपिड संचय को 61% और ई.पी.ए. को 10.7 प्रतिशत तक बढ़ाने के लिए प्रक्रिया अनुकूलन।
- यांत्रिक और एंजाइमेटिक उपचार दोनों को नियोजित करके *एस. क्वाड्रटौकोडा* सी.ए.एस.ए. सीसी 202 सेल की दीवार के चुनिंदा निम्रीकरण के लिए एक व्यापक विधि विकसित की गई।
- कार्यात्मक खाद्य पदार्थ बनाने के लिए संभावित लाभ के साथ *लैक्टोबैसिलस प्लांटारम* बी.आर. 2 से ग्लूकोमानेन प्रकृति के एक उच्च आणविक भार ई.पी.एस. की प्राप्ति और शुद्धीकरण।
- लिग्नोसेलुलोसिक पेन्टोस शर्करा से जाइलिटोल उत्पादन के लिए *कोरीनेबैक्टीरियम ग्लूटेमिकम* को सफलतापूर्वक डिजाइन किया गया।
- 16 एस आर.आर.एन.ए. अनुक्रमण के आधार पर पोक्काली चावल से पहली बार रेजोबैक्टीरियल उपभेदों *फॉलवोबैक्टीरियम* एल 1152^T और *राइज़ोबियम* 544^T टी. से जुड़ी दो संभावित पौधों की पहचान की गई।
- पहली बार संभावित नूतन हालोफिलिक एक्टिनोमाइसेट्स की पहचान की गई और *एस.औरस* के खिलाफ ए.सी.टी. एन.आर.के. 143 उपभेद ने शक्तिशाली जीवाणुरोधी गतिविधि दिखायी। क्रोमैटोग्राफी पद्धतियों के आधार पर एंटीबैक्टेरियल यौगिक को एक्टिनोमायसीन डी के रूप में पहचान की गई।

MICROBIAL PROCESSES AND TECHNOLOGY DIVISION

The Current focus of the Microbial Processes and Technology Division (MPTD) are (i) Bioprocess and product development (ii) Biofuel and biorefinary (iii) Health, Genomics and Biodiversity which are well aligned with the priority sectors of CSIR such as Affordable health care, Energy, Chemistry & Environment. In the area of bioprocess and products, the division's emphasis is on production of industrial enzymes, biopolymers, amino acids, value added platform chemicals, probiotics, microbial nutraceuticals etc. The theme of biofuel research is mainly on developing strategies for commercially feasible production of biofuels and developing green and sustainable processes for production of alternatives to non renewable chemicals and products for betterment of human lives. The division has established a pilot plant facility for solid-state fermentation and for the production of ethanol from lignocellulosic biomass. Other activities include the exploration of biodiversity for plant microbe interaction and for microbial bioactives.

Highlights

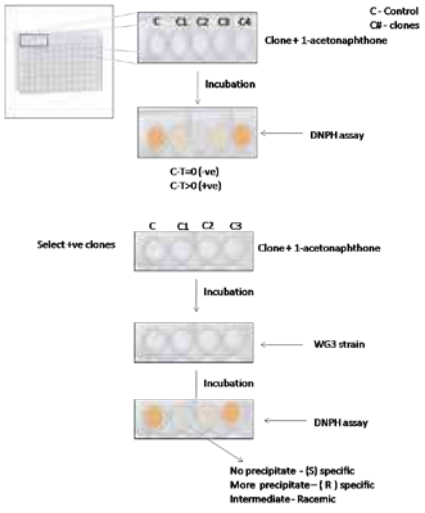
- Developed a dual enzyme based method to detect activity and enantioselectivity of ketoreductase enzyme by using DNPH reagent.
- Optimized an enzymatic process for release of ferulic acid from destarched wheat bran.
- Optimized the process parameters for the production of Keratinase using ***Streptomyces albidoflavus*** and the complete nucleotide sequence of the genome was determined using NGS strategy
- Developed novel alternate strategies such as ultrasound assisted alkali pre treatment and surfactant assisted transition metal pretreatment of chili post-harvest residue for better hemicelluloses and lignin removal.
- Phenyl Glycine-p-sulfonic acid loaded polystyrene was designed as an adsorbent for selective adsorption of fermentation inhibitors such as furfural from the acid pretreated liquor based on its interaction with adsorbent by molecular modeling.
- Process for BGL production under solid state fermentation optimized and evaluated in semi-pilot scale trials with 240 IU/gDS (24IU/ml) enzyme activity
- The complete nucleotide sequence of the cellulase producing ***Penicillium janthinellum*** NII-C-02 genome was determined using NGS strategy.
- One of the yeast isolates of NIIST , ***Saccharomyces cerevisiae*** RPP 03 N, was capable of fermenting sugar cane trash (SCT) hydrolysates with 90.51% efficiency to ethanol
- Process optimization to enhance the cellular lipid accumulation in microalgae up to 61 % and EPA percentage to 10.7 %
- A comprehensive method was developed for selective degradation of ***S. quadricauda*** CASA CC 202 cell wall, by employing both mechanical and enzymatic treatment
- A high molecular weight EPS of glucomannan nature was recovered and purified from a ***Lactobacillus plantarum*** BR2 with potential benefits for making functional foods
- Successfully engineered ***Corynebacterium glutamicum*** for Xylitol Production from lignocellulosic pentose sugars
- Based on the 16S rRNA sequencing two potential plants associated rhizobacterial strains ***Flavobacterium*** L1I52^T and ***Rhizobium*** 544^T were identified for the first time from pokkali rice.
- Potential novel halophilic actinomycetes were identified for the first time and strain ACT NRK 143 showed potent antibacterial activity against ***S. aureus.*** Based on chromatography methods the antibacterial compound was identified to be actinomycin D.

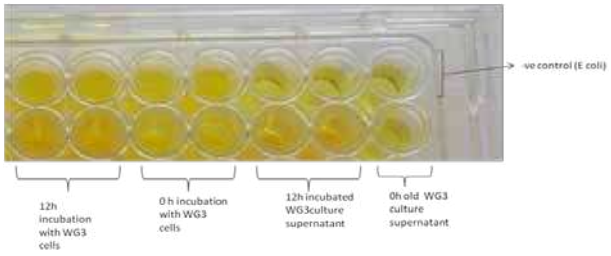
BIO-PROCESSES AND PRODUCTS DEVELOPMENT

Industrial enzymes

High-throughput assay method to screen enantiospecific ketoreductases

A new enzyme-coupled high throughput 96-well microtiter plate colorimetric screening method was developed based on enantioselective alcohol oxidase enzyme for determination of both the rate and enantioselectivity of asymmetric ketone reduction by using 2,4-dinitrophenylhydrazine (2,4-DNPH) reagent. The reaction of 2, 4-DNPH and 1-Acetonapthone result in the formation of an orange colour product which showed maximum absorbance at 560 nm. The developed method has good detection range (0.05mM-3mM) with R^2 value of 0.99. It shortens the experimental time and tedious process of HPLC, avoids the use of organic solvents, expensive enzymes, cofactors and chemicals and the detection range in the visible range is better over UV range. In short, the proposed method possesses properties of simplicity, sensitivity and rapidity. The developed method is suitable for rapid screening of large number of microbes for enantiospecific ketoreductase enzyme in high-throughput manner.

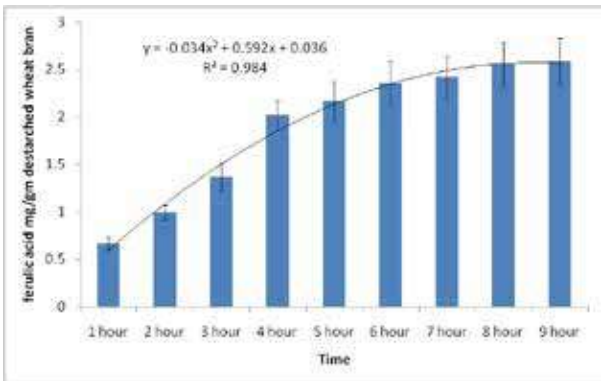




High-throughput assay method for screening microbes for enantiospecific ketoreductase enzyme

Enzymatic extraction of Ferulic acid from biomass

Optimized a process for release of ferulic acid from destarched wheat brann by using feruloyl esterase from the fungus *Aspergillus niger.* Statistical optimization of numerical parameters like the pH, temperature and feruloyl esterase units added/g of destarched wheat bran used. A cubic model for release of ferulic acid was developed and predicted a maximum release of 2.03 mg/1.5g destarched wheat bran at 3 hours of reaction at pH 3.5 and 50°C. A study for selecting good adsorbents for the purification of ferulic acid from the reaction mixture has also been carried out and XAD4 with a capacity of 45 mg/g was found to be the best adsorbent.



Release of ferulic acid from wheat bran

Production of Keratinase using *Steptomyces albidoflavus* and whole genome sequencing of the actinomycete

Multistep optimization resulted in an enhancement of Keratinase activity from ~120 IUs/gDS to 638 IUs/gDS.The genome of ***Streptomyces albidoflavus*** was sequenced using the Illumina-HiSeq 2500 paired-end technology. It produced a total of 5,250,424 paired-end reads. Quality of the sequences obtained from sequencer was checked by various parameters like base quality score distributions, average base content per read and GC distribution in the reads. The average base quality was above Q30 (error-probability >= 0.001) for ~90% of bases. ***De novo*** assembly was performed using MaSuRCA (Version:MaSuRCA -3.1.3). The final assembly contains 2091 contigs of total size 7,061,951 bp, with an N50 contig length of 6.247kbp; the largest contig assembled measures 134.848 kb. The genome of ***Streptomyces albidoflavus*** consists of a single circular chromosome of 70, 61,951 bp in length with an average GC content of 68.87%. Glimmer was used to predict CDSs from the contigs. The chromosome of ***Streptomyces albidoflavus*** contains a total of 6149 predicted coding sequences (CDS). A total of 78 tRNA genes were also predicted from the contigs using tRNAscan-SE. Since the major interest in sequencing of this organism was to study its keratinase (s), a search of the serine proteases in the genome was performed (as keratinases are serine proteases). Twelve different serine proteases were identified. The contigs with gene sequences of serine protease confirmed by prosite search (3 Nos) were selected for PCR amplification and cloning. Primers were designed based on these for PCR amplification of suspect genes and work is progressing on cloning of these genes

Biomass hydrolyzing enzymes Cellulase Cocktails for Biomass Hydrolysis

NIIST–MPTD is working on development of efficient enzymes that are also cost effective. Efforts are also on to enhance performance of cheap acid cellulases available in Indian market by blending in of our beta glucosidase (BGL) enzymes and commercial xylanases, so that they can become biomass hydrolyzing cocktails. Trials were conducted with a commercial acid cellulase for textile applications (Brand Z) where NIIST BGL and a commercial xylanase was blended so as to make this preparation capable of hydrolyzing pretreated sugar cane trash (SCT). Different combinations of cellulase (Z), commercial xylanase (Xyl) and NIIST–BGL were blended to make the cocktails and their efficiency in hydrolysis of pretreated biomass was evaluated. The textile cellulase which gave only 57% efficiency in hydrolysis of SCT with a 10 FPUs/g biomass loading, was significantly improved in its efficiency for biomass hydrolysis (to 90 %) by addition of commercial xylanase and NIIST BGL (Table 1), highlighting the need for developing appropriate cocktails for each biomass types. This also demonstrated that the cheap indigenous enzymes may be converted to highly efficient biomass hydrolyzing cocktails

Table 1. Enzyme cocktails and their efficiency in hydrolysis of pretreated biomass

Enzyme(s) used	Enzyme Loading (U/g)	Hydrolysis Efficiency (%)
Z	10	57.33
Z/Xyl/NIIST BGL	10/7500/19	90.19
Z	20	58.67
Z/Xyl/NIIST BGL	20/7500/19	90.46

A comparison of the enzymes produced using ***Penicillium janthinellum*** mutants (MUT 21 and EU2D) and that from ***Trichoderma reesei*** RUT C30 was performed for hydrolysis of alkali pretreated rice

straw with and without supplementation of NIIST BGL. In all the cases, addition of BGL enhanced the hydrolytic performance. Among the cellulases, The *P. janthinellum* cellulases performed better than T. reesei cellulase and the cellulase from *P. janthinellum* strain EU2D was the most efficient in hydrolysis of rice straw attaining ~80% conversion efficiency in 36h (Table 2)

Table 2. Comparison of the enzymes activities using *Penicillium janthinellum* mutants (MUT 21 and EU2D) and that from *Trichoderma reesei* RUT C30 for hydrolysis of alkali pretreated rice straw with and without supplementation of NIIST BGL

Time (h)	T reesei (10F PU/g)	T reesei (10FPU) + An BGL (50 U/g)	MUT21 (10FP U/g)	MUT 21 (10FPU) + An BGL (50 U/g)	EU2D (10F PU/g)	EU2D (10FPU) + An BGL (50 U/g)
12	421	458	467	514	467	559
24	487	521	525	553	517	593
36	501	556	579	601	584	

Whole Genome sequencing of cellulase producing *Penicillium janthinellum* NII-C-02

The whole genome sequence of this fungus was sequenced so that better insights are gained on its carbohydrate active enzymes and their gene regulatory elements, which will eventually have a bearing on cellulase production using this fungus. The genome was sequenced using the Illumina-HiSeq 2500 paired-end technology. It produced a total of 30,693,398 paired-end reads. Quality of the sequences obtained was checked and average base quality was above Q30 (error-probability >= 0.001) for ~90% of bases. *De novo* assembly was performed using MaSuRCA. The final assembly contains 1801contigs with an N50 contig length of 71.830kbp; the largest contig assembled measures 276.987 kb. The genome of *Penicillium janthinellum* NIIST-C1 consists of ~37 Mbp in size with an average GC content of 50.72%. Genes were predicted from assembled contigs using Augustus 3.1 and contains 12,003 predicted coding sequences (CDS). A total of 206tRNA genes were also predicted from the contigs using tRNAscan-SE. The predicted genes were annotated against UniProt, Pathway and other databases. A total of 11,532 genes (CDS) were annotated using BLASTP searches against Uniport-Fungi database. The general features of the genome are listed in Table 3.

Table.3. Features of *Penicillium janthinellum* NII-C-02 genome

Features	Value
Length (Mbp)	37 Mbp
GC content (%)	50.72%
Protein coding genes (No.)	12,003
Protein coding genes (No.) with annotation	11,532
tRNA genes (No)	206

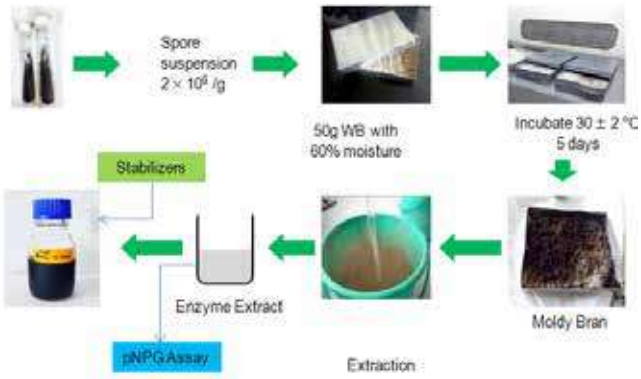
Scaling up of Beta glucosidase (BGL) production from *Aspergillus niger*

BGL is a critical component in biomass hydrolyzing enzymes and addition of it can improve the efficiency of acid cellulases used in textile industry and can upgrade them to biomass hydrolyzing enzymes. CSIR-NIIST has a process for production of BGL using the fungus *Aspergillus niger* (Fig.3.) and developing this into a full-fledged technology for commercial deployment was granted as an FTT project by CSIR where the aims is to deliver a technology for large scale production of the beta glucosidase enzyme with complete formulation for its storage stability; and with full performance data in blends with all leading cellulases for biomass hydrolysis, and with the techno-economic data.

- Process for BGL production under solid state fermentation optimized and evaluated in semi-pilot scale trials with 240 IU/gDS (24IU/ml) enzyme activity
- Formulation of enzyme for storage stability developed with no activity loss over 2 weeks

storage at room temperature

- Performance evaluation conducted at NIIST and third party labs proves the ability of enzyme for enhancing hydrolytic performance of acid cellulases in the market including that of the world's best enzyme.
- Discussions held with India's leading technology provider for bioethanol and the enzyme sample evaluated at their facility enhances hydrolytic potential of cellulase by 20%. Enzymes samples have been successfully evaluated by the industry.

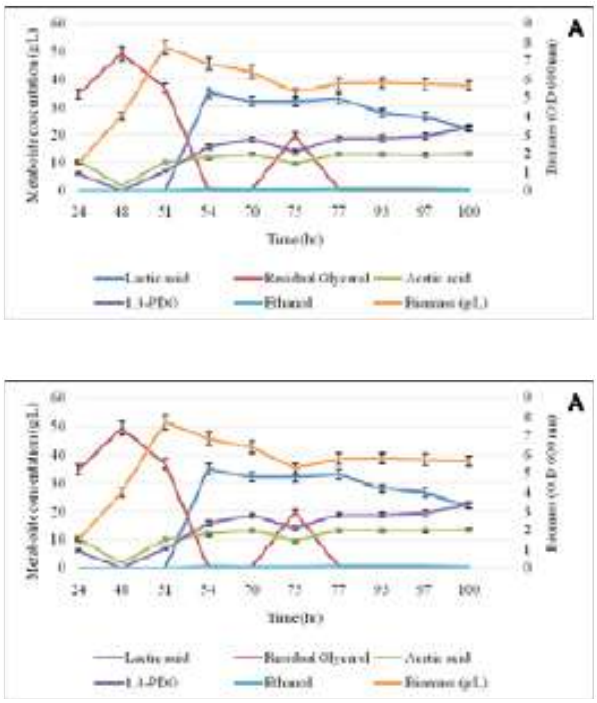


Process flow for Scaling up of Beta glucosidase (BGL) production

Microbial production of Biopolymers

Microbial production of 1, 3-propanediol from crude glycerol

In this study 1, 3-propanediol production was achieved from a non-pathogenic lactic acid bacterial strain *Lactobacillus brevis* N1E9.3.3 in suspended and immobilized form under batch, sequential batch and continuous modes of fermentation. The microorganism was immobilized in polyurethane foam cubes. The effect of initial glycerol concentration on suspended and immobilized cells was investigated in stirred tank reactor. The highest 1,3-PDO titers in batch fermentation was achieved at an initial glycerol concentrations of 80 g/l producing 51.5 $g_{1,3\text{-PDO}}$/l and 42.59 $g_{1,3\text{-PDO}}$/l with a yield of 0.64 $g_{1,3\text{-PDO}}/g_{Glycerol}$ and 0.53 $g_{1,3\text{-PDO}}/g_{Glycerol}$ using suspended and immobilized cells respectively. In repeated batch (self-cycling) fermentation at the end of 5th cycle produced 78.3 g/l 1, 3-PDO with 0.65 $g_{1,3\text{-PDO}}/g_{Glycerol}$ yield and 0.65 g/l/h productivity. A constant yield between 0.3-0.65 $g_{1,3\text{-PDO}}/g_{Glycerol}$ was observed with cell recycling using suspended and immobilized cells observed in three independent experiments. The highest productivity of 1.735 $g_{1,3\text{-PDO}}$/l/h was observed in chemostat with immobilized cells .



Time course of glycerol utilization and 1,3-propanediol production with suspended (A) and immobilized cells (B).

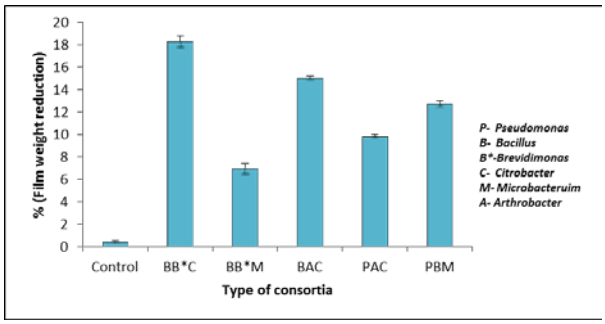
Production and characterization of microbial poly-γ-glutamic acid from renewable resources

The study evaluated the effectiveness of renewable resources for the production of γ-PGA

using an isolated *Bacillus sp*. Lignocellulosic biomass like rice straw, sugarcane trash, sugarcane bagasse, cotton stalk and sorghum stover were pretreated using 1.5 %w/w H_2SO_4 loading for rice straw and 2.5% w/w H_2SO_4 for other biomass, followed by enzymatic hydrolysis using cellulase enzyme. Comparative evaluation of sugar yield from various biomass was done and highest percentage of sugar obtained from rice straw hydrolysate. The rice straw hydrolysate was added as the carbon source for the fermentative production of γ-PGA. The γ-PGA produced has been characterized by NMR, FT-IR, gel permeation chromatography and amino acid analyzer.

Microbial process for e- plastics removal

High Impact polystyrene (HIPS) is a polymer resin which is widely used in electronic devices. Six newly isolated cultures identified as *Bacillus, Brevundimonas, Arthrobacter, Pseudomonas, Citrobacter, and Microbacterium* were used in five different combinations in order to select potential consortium for degrading this brominated e-plastic. Among Five consortia, *Bacillus, Brevundimonas, Citrobacter* (BBC) showed maximum weight loss of 18 % (w/w) within 30 days (Fig.5). The structural changes in treated HIPS film with consortia were confirmed by NMR, TGA, HPLC and FTIR. The morphological changes in HIPS were validated by scanning electron microscope (SEM). Depolymerase activity is detected among the consortial members to facilitate the HIPS degradation



Weight loss of HIPS film using different consortia after 30 days of incubation

Encapsulation of microorganisms for improved shelf-life

The present study aims at preparation of encapsulated microorganisms for the treatment of waste water containing phenol. *Acinetobacter seifertii* and *Bacillus pumilus* were found to be the potent organisms for degrading phenol. Various encapsulation methods have been tried. Among the different carrier materials used , corn-starch was found to be the best material with long shelf life. Based on cell viability spray drying was found to be an effective method compared to freeze drying.

BIOFUELS AND BIOREFINERIES

Alternative strategies for the pretreatment of lignocellulosic biomass for bioethanol production

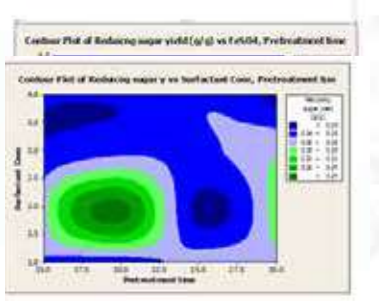
Ultrasound assisted alkali pretreatment of chili post-harvest residue for bioethanol and xylanase production

A novel ultrasound assisted alkali pretreatment was developed which could effectively remove hemicelluloses and lignin and improve the reducing sugar yield from chili post-harvest residue. Among the various alkalis screened ultrasound assisted sodium hydroxide pretreatment was found to be more effective. Under optimal pretreatment conditions, 0.428 g of reducing sugar was produced per gram of pretreated biomass. The conditions of pretreatment were 15% w/w of biomass loading, alkali concentration of 45 w/w, 30 min of sonication time and 15 min of pretreatment time in a laboratory autoclave at 121°C. The study revealed that major fermentation inhibitors like furfural and hydroxymethylfurfural were absent in all the samples. Organic acids like citric acid, succinic acid and propionic acid were absent indicating that the hydrolyzate can be used for fermentation without any detoxification. Utilization of pretreated biomass for SSF for xylanase production by *B. pumilus* and

Streptomyces sp. yielded 612 and 435 IU of xylanase respectively

Surfactant assisted transition metal pretreatment of chili post-harvest residue for bioethanol production

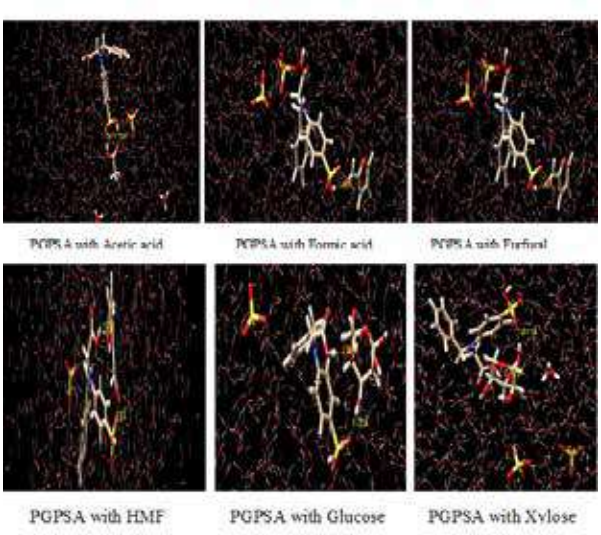
Surfactant assisted ferrous sulphate pretreatment was found to be more effective in terms of reducing sugar yield. The optimum conditions of pretreatment were surfactant concentration of 1% w/w, $FeSO_4$ concentration of 2% w/w, biomass loading of 5% w/w and pretreatment time for 20 min. Under optimized conditions 0. 245 g/g of reducing sugar per g of dry biomass (g/g) was observed. The hydrolyzate is devoid of major fermentation inhibitors like furfural, 5-hydroxymethylfurfural and organic acids like citric acid, propionic acid and succinic acid. Fermentation of the non-detoxified hydrolyzate yielded 1.84% of ethanol with a fermentation efficiency of 79



Contour plots showing interactions between different process parameters affecting surfactant assisted transition metal pretreatment of chili post – harvest residue.

Adsorptive Detoxification of fermentation inhibitors present in acid pretreated liquor using functionalized polymer designed by molecular simulation

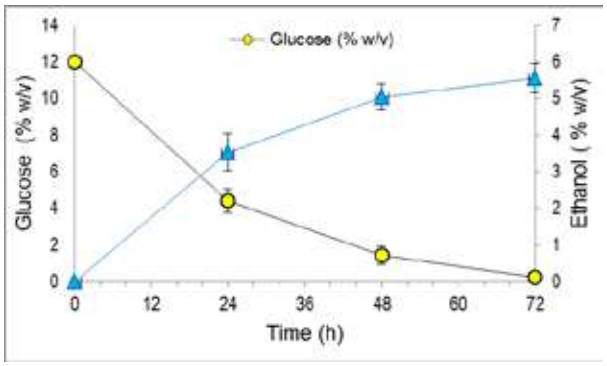
The aim of this study was to design functional groups on polymer matrix which are selective in their interaction with inhibitors with little or no specificity to sugars. The adsorption of fermentation inhibitors has been studied, a priori, by molecular modeling to design a suitable adsorbent for selective adsorption of inhibitors from a complex extract of acid pretreated liquor. MOPAC-2016 was used for semi-empirical molecular simulation, and GROMACS 5.1.2 was used for Molecular dynamics simulation using water as a solvent. (Fig.7). Phenyl Glycine-*p*-sulfonic acid (PGPSA) loaded on chloromethylated polymer was designed as an adsorbent for selective interaction with inhibitors. The complex of an inhibitor with the designed adsorbent was found to be thermodynamically more stable than sugar in terms of interaction energy and heat of formation values. Experimental verification of the selectivity of the PGPSA toward inhibitor was also successfully achieved.



Molecular dynamics simulation of inhibitors and sugars interacting with PGPSA loaded monomer in 0.1M sulphuric acid solution using Gromacs software.

Fermentation of Sugar Cane Trash hydrolysate By NIIST strain of yeast

NIIST has previously isolated two novel strains of yeast from silent valley national park and One of these isolates – *Saccharomyces cerevisiae* RPP 03 N was capable of fermenting sugar cane trash (SCT) hydrolysates with 90.51% efficiency.



Ethanol production by *Saccharomyces cerevisiae* RPP 03 N from sugar cane trash (SCT) hydrolysates

Experiments conducted in recycling of yeast cells of the NIIST strains indicated that though the cell counts were lower in second cycle, the cells could still effectively ferment the hydrolysates albeit with a lower efficiency of~ 80%

Biofuel Pilot Plant

Work on biofuels has led to the first of its kind plant for handling different biomass feedstock basically agricultural residues such as rice straw, sugarcane trash, sorghum stover, cotton stalk etc to ethanol conversion. The integrated process envisaged will be another step forward towards the Nation's plans on alternative transportation fuels. The process developed shall serve as basis to fine tune unit operations towards a cost effective future technology. Successful future technology will help sustainable and renewable fuel production and will be beneficial to society and environment as well. 70 kg/batch operation was demonstrated at pilot scale for bioethanol production. All the unit operations are exclusively studied for mass and energy balances at pilot scale, scale-up parameters have been studied which shall eventually lead to process economics and will provide a vast knowledge on plant operational, safety and maintenance requirements in future

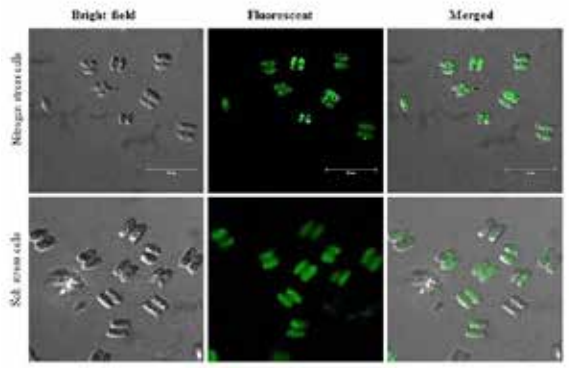
Unit operations in the Biofuel Pilot Plant

HEALTH AND GENOMICS

Algal nutraceuticals

Major lipid Body Protein: a conserved structural component of lipid body accumulated during abiotic stress in *S. quadricauda CASA-CC202*:

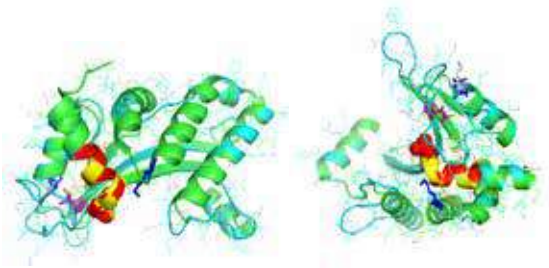
Abiotic stress in oleaginous microalgae enhances lipid accumulation and is stored in a specialised organelle called lipid droplets (LDs). Both the LDs or lipid body are enriched with major lipid droplet protein (MLDP). It serves as a major structural component and also plays a key role in recruiting other proteins and enzymes involved in lipid body maturation. In the present study, the presence of MLDP was detected in two abiotic stress condition namely nitrogen starvation and salt stress condition. Thus, the MLDP is highly conserved in green algae and the size and number are increased during the abiotic stress condition like nitrogen starvation and salt stress. Conclusively, MLDP like protein can be used as a marker for stress-mediated lipid accumulation during abiotic stress.



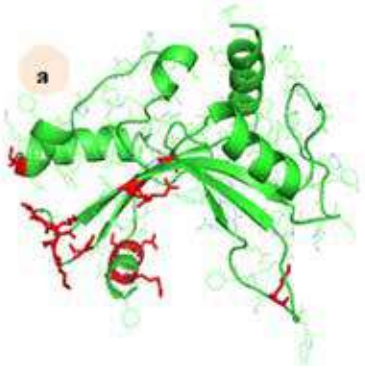
Immuno staining of lipid body structural protein (MLDP) under nitrogen starved and salt stress condition. Scale bar represent 20µm in each panel.

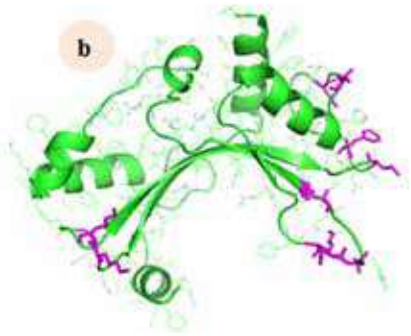
Identification and secondary structure of Stress associated protein 1 (SAP- 1):

Whole mitochondrial genome sequencing of *S. quadricauda* revealed the presence of LAGLIDADG motif in the microalgae. The LAGLIDADG motif was also present in the differentially expressed protein ie., SAP 1 of *S. obliquus* by MALDI TOF analysis. The annotated protein of *S. quadricauda* revealed that SAP 1 as ORF 42. The ORF 42 is identified as LAGLIDADG homing endonuclease I family of protein. The ORF 42 structure predicted using Swiss model and secondary structure alignment with template (Cre-I) using Pymol software. The LAGLIDADG motif was represented using spheres with yellow and red colour . The ORF 42 is a homing endonuclease family it will bind the double stranded DNA and specifically cut the DNA to break open. Thus the DNA binding and protein binding amino acids were predicted using the Predict protein software.



Homology modelling of SAP-1 using CreI as template. Green colour indicates Cre I and blue colour indicates SAP 1. The red and yellow spheres are the LAGLIDADG motif in both the structure.

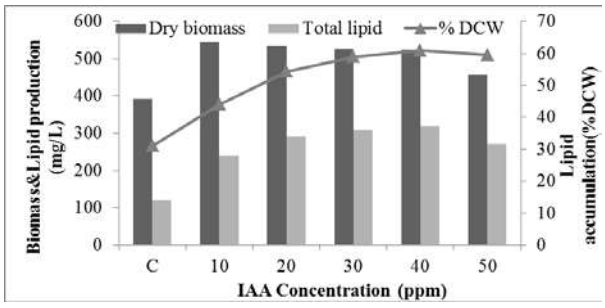




DNA binding (a) and Protein binding motif (b) of Stress associated protein 1 (SAP- 1)

Selective Enrichment of Eicosapentaenoic acid (20:5n-3) in *N. oceanica CASA CC201* by Natural Auxin Supplementation

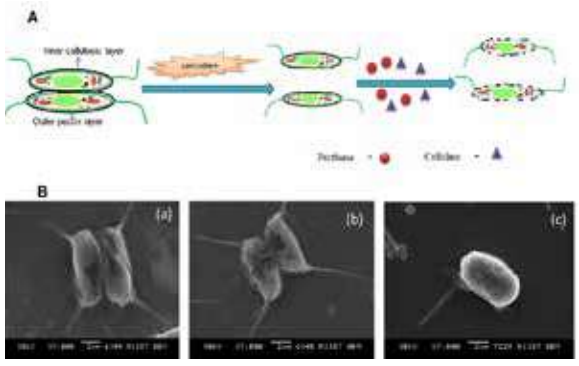
In the present study natural phytohormone, auxin is used as a biochemical agent for the selective enrichment of EPA in marine microalgae ***N. oceanica CASACC201.*** It was observed that the, treatment with IAA resulted in high cell number 579.5x10^6 cells/ml than the control (215.5x10^6 cells/ml). Treatment with IAA of particular concentration gives the highest cellular lipid accumulation of 60.9% DCW than the control 31.05% DCW). EPA percentage is increased to 10.76% by the addition IAA.



Growth and lipid production of *N.oceanica CASA CC201* grown under different concentrations of IAA. Abbreviations represent the ppm concentration of IAA and control (without IAA), and % DCW is the lipid content as % dry cell weight.

Selective degradation of recalcitrant cell wall of *Scenedesmus quadricauda CASA CC202* for various commercial applications.

A comprehensive ecofriendly method developed to selectively degrade the cell wall without making much damage to the cell integrity. The cell wall removal efficiency was evaluated by measuring Total Reducing Sugar , Tannic acid – Ferric Chloride staining, Calcoflour white staining , SEM and FTIR analysis . TRS yield of 129.82 mg/g obtained in 14 h from pectinase treatment alone has been increased to 352.44 mg/g by combined sonication and enzymatic treatment within 12 h. Thus the combination method was found to be effective for the selective degradation of *S. quadricauda* CASA CC202 cell wall. This study will form a base for our future works where this will help to enhance the digestibility and nutritional availability of nutraceutically important proteins. The developed cell wall digestion strategy will help to enhance the yield of endogenous nutraceutical proteins, omega-3 fatty acids; as well as enhance the efficiency of microalgae system as tool for cloning, transformation and expression of therapeutic proteins. This study will form a base for future application using enriched algal biomass for food and feed applications by increasing the bioavailability of the nutrients.



A. Selective cell wall degradation S. quadricuda CASA CC202. B. SEM images of (a) untreated, (b) Pectinase treated, (c) Sonicated- enzyme treated cell. SEM images were taken at 7000X magnification.Scale bars 2µm.

PROBIOTICS AND NUTRACEUTICALS

Molecular approaches to enhance folate production in probiotic lactic acid bacteria

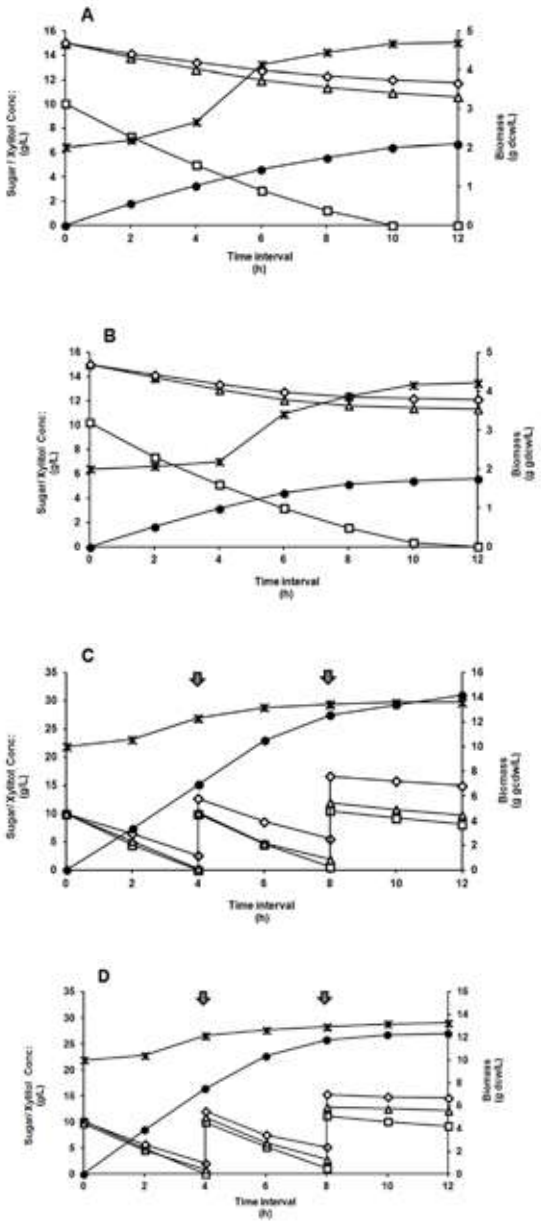
Two folate producing ***Lactococcus lactis*** strains isolated in NIIST were used for amplifying and isolating the genes responsible for folate biosynthesis. The cultures were identified by 16S RNA sequencing and the sequences were submitted in NCBI with accession numbers KJ742708 (CM 22) and KJ676682 (CM 28). Three genes, namely folKE (coding for 2-amino, 4-hydroxy, 6-hydroxymethyl dihydropeteridine pyrophospho kinase AND GTP cyclohydrolase I), folA (coding for dihydrofolate reductase) and folC (Polyglutamyl folate synthatase) and folP (dihydropteroate synthase enzyme) were amplified from both the strains using respective genomic DNAs. The PCR products were sequenced and confirmed the genes. The sequences were submitted to NCBI data as well (KU324892, KU214676, KX013556, and KX013557). A food grade, pNZ8148 vector is used for cloning the above genes and this vector can be used as a shuttle vector for lactobacilli as well as for ***E coli***. FolKE genes of both the isolates were successfully ligated in to pNZ 8148 and the ligated plasmid was successfully transformed in to ***E.coli*** MC1061 for further characterization. Further work is in progress.

An exopolysaccharide (EPS) from a *Lactobacillus plantarum* BR2 with potential benefits for making functional foods

Food grade Lactic acid bacteria (LAB) produce a great variety of EPSs with different chemical composition and structure, thus providing useful functional properties in food systems. A high molecular weight EPS of glucomannan nature was recovered and purified to an yield of 2.8 ± 0.5 g/L from ***Lb. plantarum*** BR2 (and it displayed potent antioxidant activity with 29.8% radical scavenging activity and 19 % total antioxidant capacity. At 100 µg/ml concentration, it is capable of inhibiting the alpha amylase activity by 10% and at 300 µg/ml, it drastically inhibited the alpha-glucosidase activity by 67% which indicates its antidiabetic potential. More interestingly, at a concentration level of 0.1%, it reduced the cholesterol level by a margin of 45 % in an ***in vitro*** assay. The sample didn't reveal any cytototoxicity against H9C2 normal cells indicating its potential for safe use as a food additive.

Engineering of Corynebacterium glutamicum for Xylitol Production from Lignocellulosic Pentose Sugars

Corynebacterium glutamicum ATCC13032 was metabolically engineered for xylitol production from the lignocellulosic pentose sugars xylose and arabinose. Direct conversion of xylose to xylitol was achieved through the heterologous expression of NAD(P)H-dependent xylose reductase (***xr***) gene from ***Rhodotorula mucilaginosa***. Xylitol synthesis from arabinose was attained through polycistronic expression of L-arabinose isomerase (***araA***), D-psicose 3 epimerase (***dpe***) and L-xylulose reductase (***lxr***) genes from ***Escherichia coli***, ***Agrobacterium tumefaciens*** and ***Mycobacterium smegmatis,*** respectively. Expression of ***xr*** and the synthetic ***araA-dpe-lxr*** operon under the control of IPTG-inducible P_{tac} promoter enabled production of xylitol from both xylose and arabinose in the mineral (CGXII) medium with glucose as carbon source. Additional expression of a pentose transporter ($araT_E$) gene enhanced xylitol production by about four-fold compared to the parent strain. The constructed strain ***Cg-ax3*** produced 6.7 ± 0.4 g/L of xylitol in batch fermentations and 31 ± 0.5 g/L of xylitol in fed-batch fermentations with a specific productivity of 0.28 ± 0.05 g/g cdw/h. The strain ***Cg-ax3*** was also validated for xylitol production from pentose rich, acid pre-treated liquor of sorghum stover (SAPL) and the results were comparable in both SAPL (27 ± 0.3 g/L) and mineral medium (31 ± 0.5 g/L).



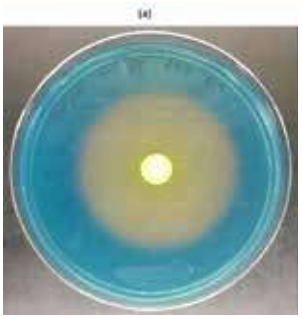
Fermentation profiles of final recombinant strain ***Cg-ax3*** (***pVWEx$_1$-apx*** and ***pEKEx$_3$-xrt$_F$***) having xylose and arabinose. (A) Batch fermentation profile in CGXII-AXG1 medium. (B) Batch fermentation profile in SAPL1 medium. (C) Fed batch fermentation profile in CGXII-AXG2 medium (D) Fed batch fermentation profile in SAPL2 medium. The graphs showing curves of biomass, sugar and xylitol concentrations during 12 h of incubation. Open squire (□) glucose; open triangle (Δ) xylose; open diamond (◊) arabinose; star (⋆) biomass and filled circle (●) xylitol. The downward arrows (↓) showing the time intervals of sugar additions.

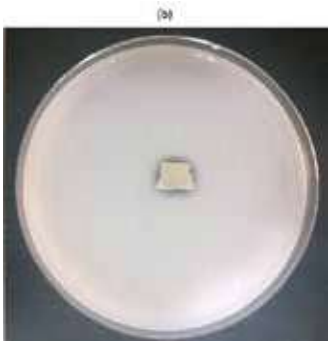
PLANT-MICROBE INTERACTION

PGPR tools for improving crop productivity in stressed agricultural systems:

This research study focuses on abiotically stressed rice fields of Kerala; Pokkali (Ernakulam), Kaippad (Kannur) and Kuttanad (Alapuzha) and the project was to screen for rhizobacterial population with plant beneficial properties complementing the host plant growth followed by plant-bacterial association under eco-specific conditions. During the course of the study, several novel and potential isolates belonging to the following genus: ***Flavobacterium, Azoarcus, Sphingomonas*** etc., were obtained through varied isolation strategies and their polyphasic characterization was followed by host-plant association studies which is still underway. Apart from these, few more potential strains have been isolated in 2016 and characterized for various functionalities as discussed below briefly,

- In-vitro plant growth promoting properties of potential strains shortlisted from 80 strains isolated in the previous year. 4 potential isolates producing high amount (eg; above 70 µg/ml) of phytohormone Indole-3-acetic acid (IAA) were detected
- **Bmkn7** – A potential isolate with high Siderophore production and good phosphate solubilisation ability belonged to the *Burkholderia* genus, identified through partial 16s rRNA gene sequencing





In-vitro PGP traits of BmKn7: (a) Siderophore production in Nutrient Agar + CAZ medium; (b) Phosphate solubilization in NBRIP medium

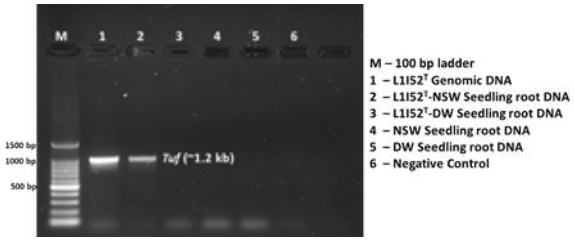
- **544** – A novel *Rhizobium* strain was observed to form very good biofilm in saline (eco-specific) conditions ie; in the presence of NaCl and Natural sea water. Formation of biofilm considered to be one of the important phenomenon in rhizosphere lifestyle of bacteria and moreover in this strain it is observed to form in saline conditions which is assumed to be an eco-specific character of the isolate.

Biofilm formation by 544 strain in YMA+NSW and YMA+0; 5% NaCl media

- **L1I52** – Novel *Flavobacterium* strain isolated from pokkali (VTL-8) exhibited specific attachment abilities to host-plant roots in the presence of saline conditions only. Below picture displays the comparative attachment of L1I52 in saline, natural sea water and distilled water clearly shows the influence of salinity in associating with the host plant.

Comparative attachment ability of L1I52 in saline (0.85% NaCl & Natural sea water) and non-saline (distilled water) conditions

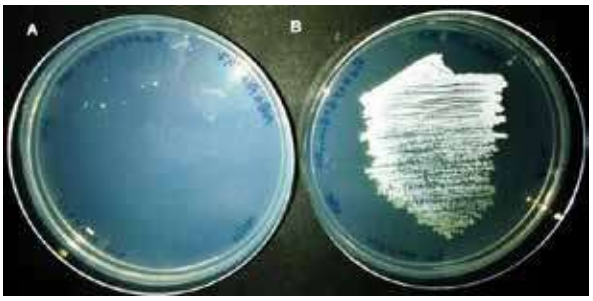
- The root attachment ability of L1I52 in saline conditions was further validated and supported with the amplification of *Flavobacterium* genus specific *tuf* gene targeting L1I52 from total root DNA of different treatment as indicated in the figure below.



PCR amplification of L1I52^T *tuf* gene (1.2 kb) using *Flavobacterium* genus specific *tuf* primer from washed L1I52^T-pokkali (VTL-6) total root DNA

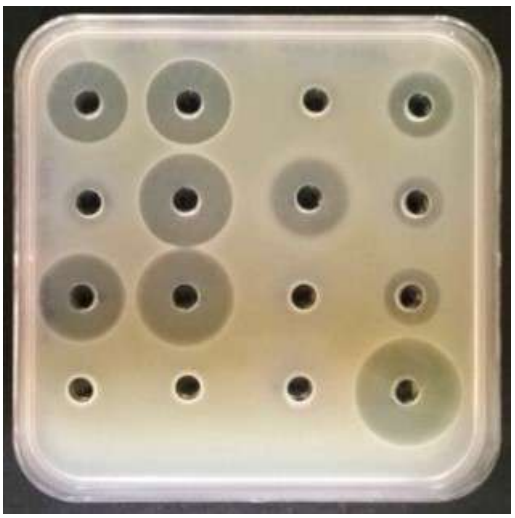
Bioprospecting and taxonomic studies of marine microorganisms in search if novel anti-infectives.

In order to isolate novel strain belong to actinomycete taxa, there are about 20 different soil samples were collected from various coastal regions of Kerala, India (2016). And 110 actinomycete strains were isolated, purified and preserved. Halophilic actinomycetes have an obligate requirement of salt for growth there are 8 potential halophilic actinomycete strains were isolated during the course of this study .



Halophilic actinomycete strain NRK Act 197 (A) growth in w/o Nacl medium (B) growth in Natural Seawater medium

12 potential actinomycete strains which shown maximum zone of inhibition against the quality control strains were taken and the crude extracts has been extracted, and the activity of the each extracts tested at 50 µg/ml. Only 7 extracts shown maximum (>20 mm Zone of inhibition) activity at 50µg/ml



Crude Extract's activity against ***S.aureus*** (MCC 2408) at 50 µg/ml, prepared from 12 potential actinomycete strains.

रसायन विज्ञान तथा प्रौद्योगिकी प्रभाग

रसायन विज्ञान तथा प्रौद्योगिकी प्रभाग द्वारा संस्थान के निम्नलिखित तीन प्राथमिकता क्षेत्रों पर ध्यान केंद्रित किया गया :-

1. कार्बनिक और हाइब्रिड इलेक्ट्रॉनिक्स (ऊर्जा उत्पादन और भंडारण, ठोस अवस्था प्रकाश व्यवस्था, वर्णजनक कोटिंग्स, स्मृति तत्वों और कम्प्यूटेशनल रसायन विज्ञान)
2. फ्लोरोसेंट सामग्री (सुरक्षा अनुप्रयोग, निदान और इमेजिंग जांच और पराद्रुत कैनेटीक्स)
3. फाइटोफार्मास्यूटिकल और ड्रग इंटरमीडिएट (औषधीय पौधों का जैव मूल्यांकन, उन्नत दवा मध्यवर्ती)

प्रभाग ने वर्ष 2016-17 के दौरान विभिन्न 12 वीं पंचवर्षीय योजना परियोजनाओं को पूरा किया । उपरोक्त परियोजनाओं के निष्पादन के दौरान विकसित तकनीकी जानकारियों और सुविधाओं पर भरोसा रखते हुये प्रभाग अक्षय ऊर्जा, सुरक्षा अनुप्रयोगों के लिए फ्लोरोसेंट सामग्री और प्राकृतिक उत्पादों जैसे क्षेत्रों में कई महत्वाकांक्षी परियोजनाओं का प्रारंभ कर रहा है। उच्च प्रभाव कारक के साथ अंतर्राष्ट्रीय स्तर पर प्रतिष्ठित सहकर्मी-समीक्षा पत्रिकाओं में प्रभाग से 60 से अधिक प्रकाशन हो चुके हैं । वर्ष 2016-17 के दौरान प्रभाग की गतिविधियों और उपलब्धियों की मुख्य विशेषताएं , साथ ही साथ महत्वपूर्ण घटनाओं का संक्षिप्त सार नीचे दिया गया है।

मुख्य विशेषताएं

- डीएसएससी फैब्रिकेशन प्रोटोकॉल को अनुकूलित किया, नए चार्ज परिवहन परतों का विकास किया, ओपीवी के लिए एफआरईटी सक्षम नैनोहाइब्रिड और सफेद ओएलइडी उपकरणों का प्रदर्शन किया
- स्मार्ट ग्लास के लिए हाइब्रिड इलेक्ट्रोक्रोमिक डिवाइस का निदर्शन किया
- प्रयोगशाला स्तर पर कम लागत वाली पिल्टियर कूलर और थर्माइलेक्ट्रिक जनरेटर का निदर्शन किया
- पीवीसी- -जिंक ऑक्साइड नैनोकंपोजिट्स पर आधारित गैर-वाष्पशील स्मृति डिवाइस
- सुरक्षा अनुप्रयोगों के लिए फ्लोरोसेंट स्याही के फार्मूलों का विकास
- संकर परोव्स्कीट्स सामग्रियों के साथ ऊर्जा प्रवासन गतिशीलता और मेमोरी डिवाइस पर अध्ययन
- प्रकाश गतिक चिकित्सा के लिए ग्रेफेन क्वांटम डॉट-बॉडीपी संकरों का संश्लेषण
- गहरी ऊतक रेश्योमीट्रिक Zn2+ इमेजिंग के लिए तीन फोटोन सक्रिय कार्बनिक फ्लोराफोर्स
- फुलरीन और नैनोट्यूब की सुव्यवस्था के लिए **π**-जलीकर
- एक प्रोटीन-डाई हाइब्रिड सिस्टम का, सीमित श्रृंखला ट्यूनबल इन्ट्रासेलुलर पीएच सेंसर के रूप में प्रदर्शन
- अपोप्टोसिस के दौरान इंट्रासेल्यूलर रेडॉक्स स्थिति के रीयल टाइम दृश्य के लिए एक रेश्योमीट्रिक निकट इन्फ्रारेड फ्लुरोजेन
- लापोनिटेस और अमिडोडिओल के बहु-स्तरीय पदानुक्रमित स्वत: समुच्चयन के माध्यम से कार्यात्मक तरल क्रिस्टलीय जेल
- एरील डाइजोनियम केमिस्ट्री द्वारा कार्बनिक नैनोकणों के सहसंयोजक कार्यात्मकरण और उनके सॉल्वेंट निर्भर स्वत: समुच्चयन
- प्रकाश उत्तेजित हीम मॉडल यौगिकों की अतिद्रुत विश्रांति गतिशीलता
- प्रकाश प्रेरित अति द्रुत इंट्राआण्विक चार्ज ट्रांसफर गतिशीलता के कास्केड का प्रत्यक्ष निरीक्षण
- हाइड्रोजन भंडारण सामग्री के क्षेत्र में उन्नत स्तर का सैद्धांतिक अध्ययन- कार्बनिक रसायन में हाइड्रोजन बांड के सिद्धांत और प्रतिस्थापन प्रभाव
- डायहाइड्रॉपाइराइजीन वलयित रेखीय पॉलीएसेन्स- एक सैद्धांतिक अध्ययन
- बेहतर जैवसक्रियता के लिए प्राकृतिक रूप से पाये जाने वाले अणुओं का कार्यात्मकरण
- सोलनम निग्राम लिइन से अलग किये उत्तरसाइड बी को हेपेटोसेल्यूलर कार्सिनोमा के खिलाफ एक आशाजनक कीमोथेराप्टिक एजेंट पाया गया
- चयनात्मक कैंसर सेल ऑप्टिकल इमेजिंग के लिए ग्लाइको कन्जुगटेड रंगों का विकास किया गया
- कार्बनिक अभिक्रियाओं के लिए पुनर्चक्रणयोग्य और पर्यावरण हितैषी उत्प्रेरक सिस्टम

CHEMICAL SCIENCES AND TECHNOLOGY DIVISION

The Chemical Sciences and Technology Division has been focusing on the following three priority areas of the Institute:

1. Organic and Hybrid Electronics (Energy generation and storage, solid state lighting, chromogenic coatings, memory elements and computational chemistry)
2. Fluorescent materials (Security applications, diagnostics and imaging probes and ultrafast kinetics)
3. Phytopharmaceuticals and Drug Intermediates (Bio-evaluation of medicinal plants, Advanced pharmaceutical intermediates)

The Division completed various 12th five year plan projects in 2016-17. Banking on the technical know-how and facilities developed during the execution of the above projects, the division is embarking on several ambitious projects in the areas of renewable energy, fluorescent materials for security applications and natural products. There has been more than 60 publications from the division in internationally reputed peer-reviewed journals with high impact factor. The highlights of the activities and achievements of the division during the year 2016-17 along with brief abstracts of important developments are given below.

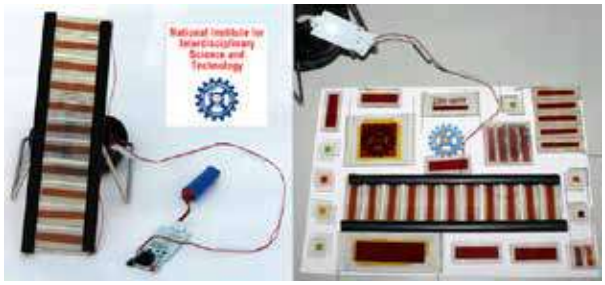
Highlights

- Optimized DSSC fabrication protocols, developed new charge transport layers, FRET enabled nanohybrids for OPV and demonstrated white OLED devices
- Demonstrated hybrid electrochromic devices for smart glass
- Demonstrated lab level low-cost Peltier coolers and thermoelectric generators
- Nonvolatile memory devices based on PVC-ZnO nanocomposites
- Development of fluorescent ink formulations for security applications
- Study of energy migration dynamics and memory devices with hybrid perovskite materials
- Synthesis of graphene quantum dot-BODIPY hybrids for photodynamic therapy
- Three-photon active organic fluorophores for deep tissue ratiometric Zn2+ imaging
- π-Gelators for organizing fullerenes and nanotubes
- Demonstrated a protein–dye hybrid system as tunable intracellular pH sensor
- A ratiometric NIR fluorogen for real time visualization of intracellular redox status during apoptosis
- Liquid crystalline gels through multi-scale hierarchical self-assembly of LAPONITE and amidodiol
- Covalent functionalization of organic nanoparticles by aryl diazonium chemistry and their solvent-dependent self-assembly
- Ultrafast relaxation dynamics of photoexcited heme model compounds
- Direct observation of cascade of photoinduced ultrafast intramolecular charge transfer dynamics
- Advanced level theoretical studies in the area of hydrogen storage materials, the theory of hydrogen bonds and substituent effects in organic chemistry
- Dihydropyrazine annulated linear polyacenes – A theoretical study
- Functionalization of naturally occurring molecules for improved bioactivity
- Uttroside B isolated from Solanum nigrum Linn identified as a promising chemotherapeutic agent for hepatocellular carcinoma
- Developed glycoconjugtaed dyes for selective cancer cell optical imaging
- Recyclable and environmentally benign catalytic systems for organic reactions

ORGANIC AND HYBRID ELECTRONICS

PHOTOVOLTAICS & LIGHTING

Renewable Energy Activities at Chemical Sciences and Technology Division comes in one of the core identified areas of the lab – Organic and Hybrid Electronics, which constitutes of cutting edge research activities in the areas of Dye-Sensitized Solar Cells (DSSCs) and Organic Light Emitting Devices (OLEDs).



DYE SENSITIZED SOLAR CELLS

As part of solar photovoltaic initiatives at CSIR-NIIST, we have developed solar modules (DSSCs) which are made from locally available materials and equipments. Major initiatives currently being undertaken in this area are

- Development of novel dyes, semiconductor materials, electrolytes and counter electrodes
- Detailed advanced characterizations
- Development of a range of equipments essential for DSSC module fabrication indigenously
- Fabrication of DSSC modules and development of integrated applications

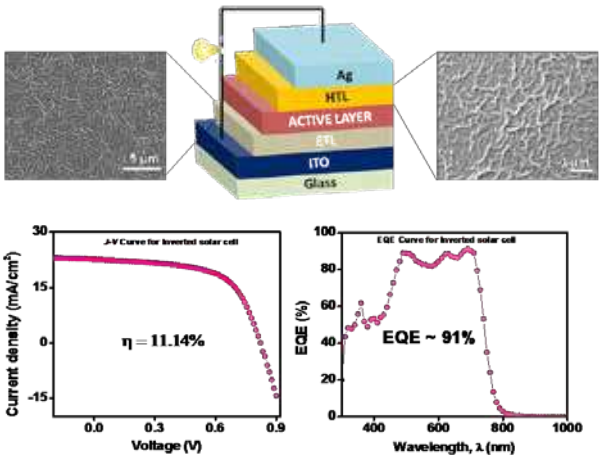
When it comes to low light conditions the recombination from the FTO to electrolyte is considerably high. In a way to alleviate this issue we developed ultrathin ZnO blocking layers to prevent back electron recombination from FTO leading to enhanced photovoltaic performance.

ORGANIC PHOTOVOLTAIC CELLS

Following the TRMC Trail: Optimization of Photovoltaic Efficiency and Structure–Property Correlation of Thiophene Oligomers

Semiconducting conjugated oligomers having same end group (*N*-ethylrhodanine), but different central core (thiophene: **OT-T**, bithiophene: **OT-BT**, thienothiophene: **OT-TT**) connected through thiophene pi-linker (alkylated terthiophene) were synthesized for solution processable bulk-heterojunction solar cells. The effect of the incorporation of an extra thiophene to the central thiophene unit either through C-C bond linkage to form bithiophene or by fusing two thiophenes together to form thienothiophene on the optoelectronic properties and photovoltaic performances of the oligomers were determined in detail using various techniques including Flash photolysis time-resolved microwave conductivity (FP-TRMC), UV–vis absorption, atomic force microscopy, bright-field transmission electron microscopy, photoluminescence quenching analysis and two-dimensional grazing incidence X-ray diffraction.

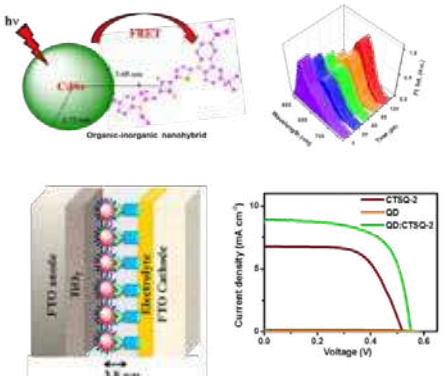
Developing Nanoengineered Charge Selective Intermediate Layers for Organic Photovoltaics



The performance and shelf-life of a solar cell strongly depends on the constituent materials and their transport (both bulk and interfacial) properties. From the engineering point of view, controlled processing of these materials that have better compatibility with cell fabrication techniques offers a significant value addition. A suitable screening tool that can be quickly optimized for an individual molecular system will have tremendous impact in developing practical OPVs. In NIIST, we developed a solution processing method for fabricating inorganic intermediate materials that are compatible with the organic components in an OPV. Previously these materials were typically fabricated using inconvenient vacuum techniques. These specially designed layers offer huge advantage in terms of device stability and shelf-life. Also, the band positions can be chemically tuned to match operational requirements of the novel molecules. We achieved a good control over the transport activities of these charge selective intermediate layers that resulted in much improved efficiency in the fabricated solar cells. Owing to the higher thermal and chemical stabilities of these layers and due to fact that they offer a protection to the underlying organic components, even the air-processed solar cell offer much higher stability compared to the standard techniques.

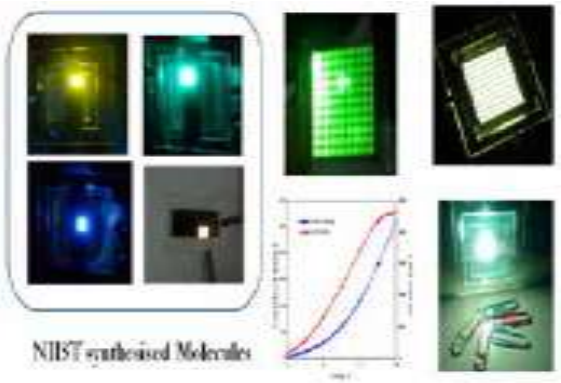
Improving Solar Cell Efficiencies Through FRET Enabled Organic–Inorganic Nanohybrids

Earlier attempts from the institute to fabricate DSSCs with squaraine dyes had yielded device with power conversion efficiency of 2.1%. Our newly developed a panchromatic light absorbing organic inorganic nanohybrids when applied to dye sensitized solar cells showed distinctive properties and resulted in an overall 43% increase in DSSC performance. It is found that direct linkage of dyes with QDs via carboxylic group along with the high extinction coefficient of dyes and unique match of donor emission and acceptor absorption spectral profiles ensured the smallest donor-acceptor distance thereby offering highest FRET efficiency of 93 %.



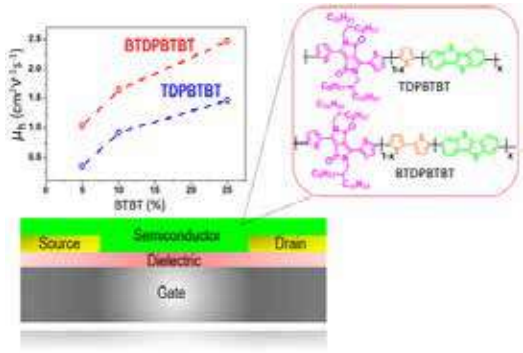
Organic Light Emitting Diodes (OLEDs)

Organic light emitting diodes (OLEDs) are the next generation lighting sources whose aesthetic appeal and the resemblance to the natural light make it more suitable for lighting application. In line with the developments in OLEDs worldwide, we focus on synthesizing new emitters, developing inexpensive doping techniques and light extraction technologies. White OLED with brightness more than 20000 cd/m^2 has been developed in NIIST. These have maximum current efficiency of 40 cd/A and max power efficiency of 26 lm/w. At 10000 cd/m^2 the values are 38 cd/A and 16 lm/w. Further, We developed a light extraction technique which when applied improved the performance to 62 cd/A and 48 lm/w. At 10000 cd/m^2 brightness the values are 52 cd/A and 24 lm/w.



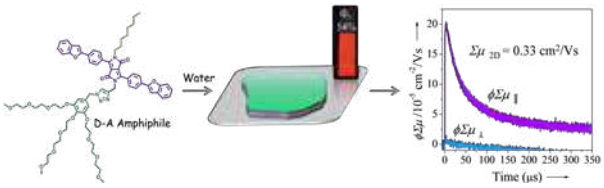
Conjugated Random Donor–Acceptor Co-polymers of [1] Benzothieno[3,2–*b*]benzothiophene and Diketopyrrolopyrrole Units for High Performance Polymeric Semiconductor Applications

Three-component random copolymers having different ratios of [1]benzothieno[3,2-*b*] benzothiophene (BTBT) and diketopyrrolopyrrole (DPP) units were synthesized, and their application in organic field effect transistors (OFET) has been discussed. These low band gap polymers exhibit p-type semiconducting properties, and it has been observed that increase in the percentage composition of the fused chalcogenophene (BTBT) in the polymer backbone significantly improves the charge carrier mobility (μh) up to 2.47 $cm^2 V^{-1} s^{-1}$. The Grazing Incidence X-ray Diffraction (GIXRD) technique and atomic force microscopy (AFM) have been used to explain the influence of BTBT on the nature of molecular packing in the polymer thin films. These results unveil the role of the effective conjugation length as well as the intermolecular ordering of the polymer chains on the charge carrier transport in OFET.



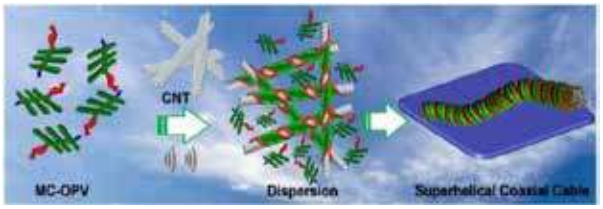
Nanosheets of an Organic Molecular Assembly from Aqueous Medium Exhibit High Solid-State Emission and Anisotropic Charge-Carrier Mobility

Water being inexpensive, ubiquitous and environmentally benign, it forms the most ideal choice of solvent for self–assembly.The preparation and properties of two-dimensional (2D) semiconducting nanosheets by the self-assembly of a diketopyrrolopyrrole oligomer in water medium have been identified. They exhibited high solid-state fluorescence quantum yield of 0.54 with superior anisotropic charge carrier mobility of 0.33 cm^2/Vs. This value is among the highest reported for various supramolecular assemblies and the observed anisotropy is attributed to the preferential edge-on orientation of the molecule as concluded from the linear dichroism and Grazing Incidence X-ray Diffraction



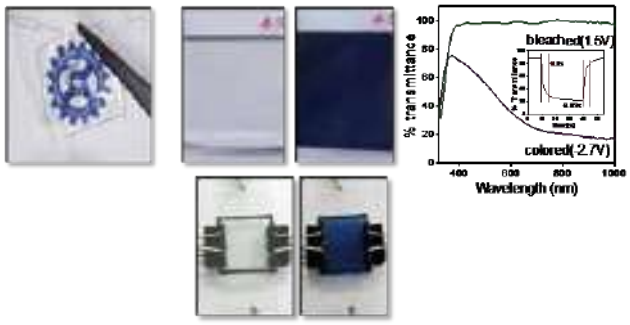
Formation of Coaxial Nanocables with Amplified Supramolecular Chirality Through an Interaction between Carbon Nanotubes and a Chiral π-Gelator

In an attempt to gather experimental evidence for the influence of carbon allotropes on supramolecular chirality, we found that carbon nanotubes (CNTs) facilitate amplification of the molecular chirality of a π-gelator (MC-OPV) to supramolecular helicity at a concentration much lower than that required for intermolecular interaction. For example, at a concentration 1.8 x 10^{-4} M, MC-OPV did not exhibit a CD signal; however, the addition of 0–0.6 mg of SWNTs resulted in amplified chirality as evident from the CD spectrum. Surprisingly, AFM analysis revealed the formation of thick helical fibers with a width of more than 100 nm. High-resolution TEM analysis and solid-state UV/Vis/NIR spectroscopy revealed that the thick helical fibers were cylindrical cables composed of individually wrapped and coaxially aligned SWNTs. Such an impressive effect of CNTs on supramolecular chirality and cylindrical-cable formation has not been reported previously

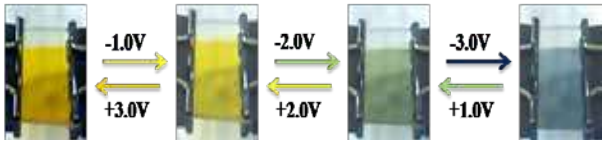


CHROMOGENIC COATINGS

Electrochromic Devices for "Smart" Tunable Glass and Energy Efficient Display Applications



We initiated a research program to develop low-cost smart windows that can cut down the radiation losses (Intelligent coatings, 12th FYP). In addition, these tunable glasses are widely used for constructing smart mirror and energy efficient displays. During this program, our research group developed a variety of nanomaterials based electrochromic systems, which are highly efficient and compatible/better than the current state of the art. The devices we developed have the advantages that are matching the industry requirements, such as

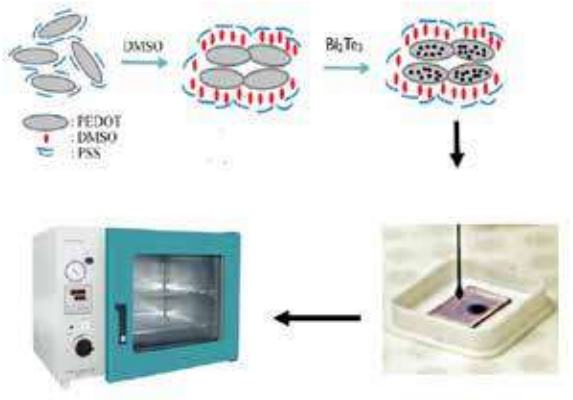


Cheap and scalable processing

- High modulation of light throughput (better than the current state of art/standard imported device)- We attained a high "effective" coloration efficiency of 210 cm^2/C at 600 nm wavelength for WO3 based devices (>highest reported)
- High switching speed (better than SOA/ standard imported device)
- Uniformity of coating and good cycling performance

THERMOELECTRICS

Low Cost Thermoelectric Refrigeration Modules Based on Organic-Inorganic Hybrids



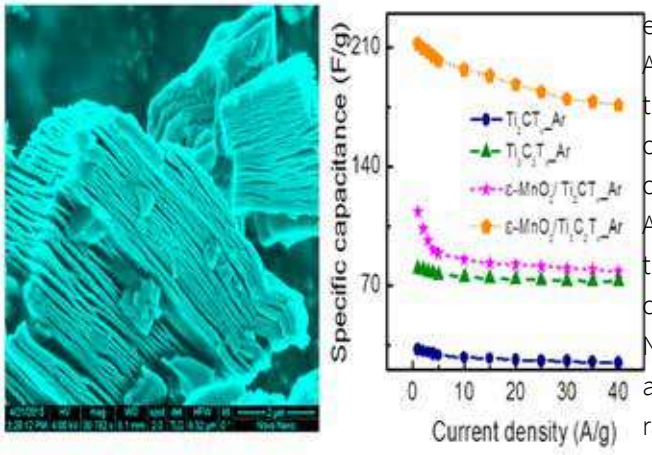
Cheap refrigeration would be useful in the rural areas for the preservation of agricultural produce, and hence saving loss of hundred crores worth of wastage every year. Power rating of a thermoelectric refrigerator is low and can be operated in tandem

with low cost dye sensitized solar cell. Incidentally, the same material can generate power in the reverse mode of operation and harvest waste heat to produce electricity which could ensure significant social benefits by producing clean energy and reducing fuel cost. Most industrial and many natural processes produce a large volume of warm fluid that contains large amount waste heat energy that can be harvested through easily processable, environment friendly and large area modules. Traditional TE modules are solid-state inorganic devices having no moving parts and are silent, reliable, lightweight, and durable. These modules are already being heavily used in the automobile industry. In contrast, in NIIST we are engaged in the R&D to cater the rising need of cheaper and lighter TE materials, preferably flexible, and working at low temperature range with a specific goal to achieve low grade refrigeration.

While still in infancy, we have obtained global standard performances for organic based hybrid TE materials that are extremely new class of functional materials. The major portion of this activity is sponsored by GAIL India Ltd.

ENERGY STORAGE

Metal Oxide/Mxene Composite Electrodes for High Performance Supercapacitors

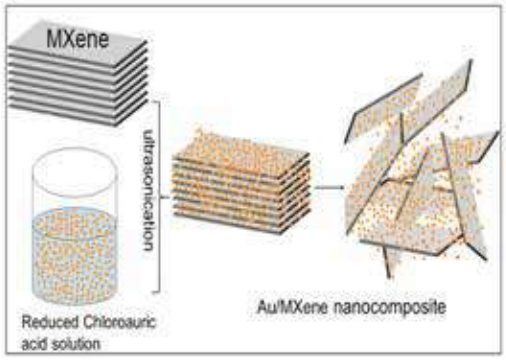


Transition metal carbides (MXenes) are an emerging class of two dimensional (2D) materials with promising electrochemical energy storage performance. In NIIST, nanocrystalline ε-MnO_2 whiskers were formed on MXene nanosheet surfaces (ε-MnO_2/Ti_2CTx and ε-MnO_2/Ti_3C_2Tx) to make nanocomposite electrodes for aqueous pseudocapacitorsn by direct chemical synthesis. The ε-MnO_2 nanowhiskers increase the surface area of the composite electrode and enhance the specific capacitance by nearly ***three orders of magnitude*** compared to pure MXene based symmetric supercapacitors. Combined with enhanced pseudocapacitance, the fabricated ε-MnO_2/MXene supercapacitors exhibited excellent cycling stability with ~88% of the initial specific capacitance retained after 10000 cycles which is much higher than pure ε-MnO_2 based supercapacitors (~74%). The proposed electrode structure capitalizes on the high specific capacitance of MnO_2 and the ability of MXenes to improve conductivity and cycling stability

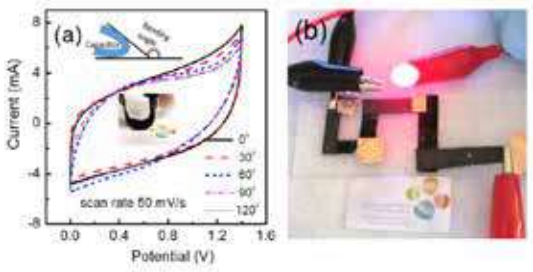
Novel Amperometric Glucose Biosensor Based on MXene Nanocomposites

A biosensor platform based on Au/MXene nanocomposite for sensitive enzymatic glucose detection has been developed in NIIST and it is a potential candidate for electrochemical transducer in electrochemical biosensors. The biosensor leverages the unique electrocatalytic properties and synergistic effects between Au nanoparticles and MXene sheets. An amperometric glucose biosensor is fabricated by the immobilization of Glucose Oxidase (GOx) enzyme on Nafion solubilized Au/ MXene nanocomposite over glassy carbon electrode (GCE). The biomediated Au nanoparticles play a significant role in facilitating the electron exchange between the electroactive center of GOx and the electrode. The GOx/Au/MXene/Nafion/GCE biosensor electrode displayed a linear amperometric response in the glucose concentration range from 0.1 to 18mM with a relatively high sensitivity of 4.2μAmM^{-1} cm^{-2} and a detection limit of 5.9μm (S/N = 3). Furthermore, the biosensor exhibited

excellent stability, reproducibility and repeatability. Therefore, the Au/MXene nanocomposite reported in this work is



Supercapacitors Based on Two Dimensional VO_2 Nanosheet Electrodes in Organic Gel Electrolyte

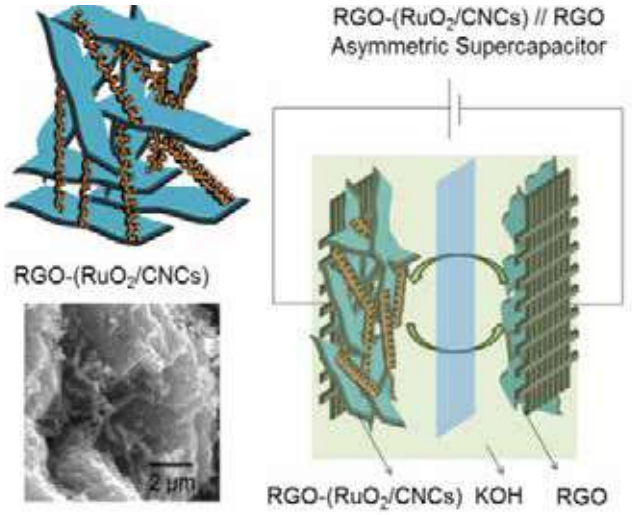


VO_2 is a low band-gap semiconductor with relatively high conductivity among transition metal oxides, which makes it an interesting material for supercapacitor electrode applications. In NIIST, two-dimensional nanosheets of VO_2 are prepared by the simultaneous solution reduction and exfoliation from bulk V_2O_5 powder by hydrothermal method. The performance of VO_2 as supercapacitor electrode in organic electrolytes is being determined for the first time. A specific capacitance of 405 Fg^{-1} is achieved for VO_2 based supercapacitor in an organic electrolyte, in three electrode configuration. The symmetric capacitor based on VO_2 nanosheet electrodes and the liquid organic electrolyte exhibits an energy density of 46 Wh kg^{-1} at a power density of 1.4 kW kg^{-1} at a constant current density of 1 Ag^{-1}. Furthermore, flexible solid-state supercapacitors are fabricated using same electrode material and Alumina-silica based gel electrolyte. The solid-state device delivers a specific capacitance of 145 Fg^{-1} and a device capacitance of 36 Fg^{-1} at a discharge current density of 1 Ag^{-1}. Series combination of three solid state capacitors is capable of lighting up a red LED for more than 1 minute.

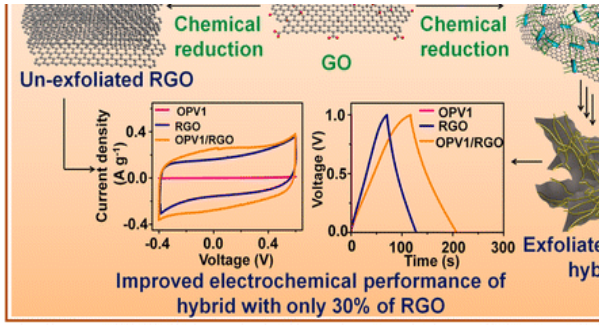
- CVs of solid state device measured at different angles (inset shows the schematic for the measurement of the bending angles and the optical image of the flexible supercapacitor device).
- Optical images displaying lighting up of an LED using three flexible supercapacitors connected in series

Reduced Graphene Oxide Based Ternary Nanocomposite Cathodes for High-Performance Aqueous Asymmetric Supercapacitors

Ternary nanocomposites have attracted increasing attention as efficient supercapacitor electrode materials. NIIST has synthesized a ternary hybrid nanocomposite by the introduction of crystalline RuO_2 nanoparticles loaded carbon nanocoils (CNCs) as spacers in reduced graphene oxide (RGO). The RGO-(RuO_2/CNCs) composite electrode exhibits a high specific capacitance of 725 F g^{-1} at a scan rate of 20 mV s^{-1} in three-electrode configuration. When used in symmetric two electrode configuration, it shows a specific capacitance of 436 F g^{-1} at a constant current density of 1 A g^{-1}, which is nearly three times higher than that of pure RGO based electrode. An aqueous asymmetric supercapacitor fabricated using RGO-(RuO_2/CNCs) as the positive electrode and RGO as the negative electrode is operational in an electrochemically stable potential window of 2V. The asymmetric capacitor exhibits a high energy density of 45 Wh Kg^{-1} at a power density of 1 kW kg^{-1} and retains an energy density of 41 Wh Kg^{-1} even at a high power density of 40 kW kg^{-1}

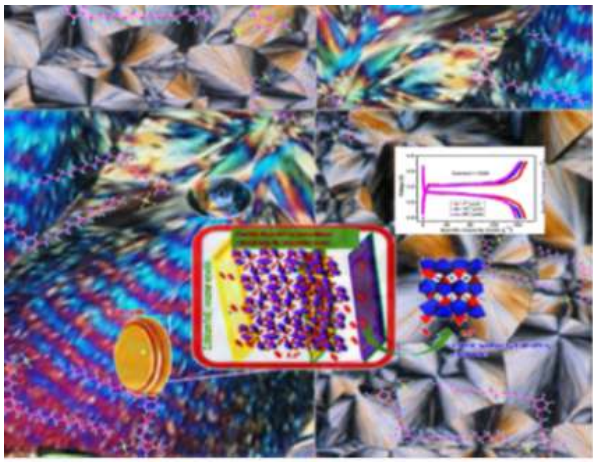


Exfoliation of Reduced Graphene Oxide with Self-Assembled π-Gelators for Improved Electrochemical Performance



Among several methodologies to improve the solution processing of graphene based materials, noncovalent functionalization has been considered as the simplest and nondestructive method. NIIST could prove that molecular self-assembly process can be used as a useful tool to exfoliate reduced graphene oxide (RGO), resulting in hybrid materials with improved physical properties. Upon interacting with a π-gelator, the dispersing ability of the RGO increased significantly in most of non-polar and polar aprotic solvents when compared to the bare one. The amount of RGO dispersed was 1.7-1.8 mg mL^{-1} in solvents such as toluene, *o*-dichlorobenzene (ODCB) and tetrahydrofuran (THF). Morphological studies revealed that aggregation of π-gelator over RGO helps to exfoliate graphene layers to remain as individual sheets with higher surface area. Experimental studies revealed enhanced surface area (250 $m^2 g^{-1}$) and better conductivity (3.7 S m^{-1}) of the hybrid materials with 30% of RGO content resulting in excellent electrochemical performance (specific capacitance of 181 F g^{-1}) as electrodes for supercapacitors

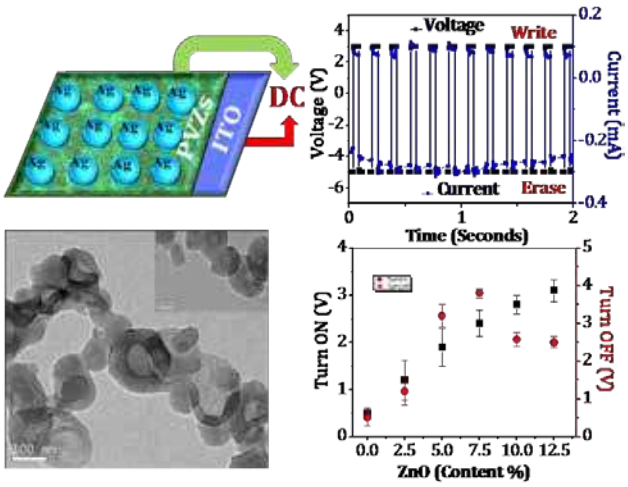
Studies on the Solid Ionic Liquid Crystalline Electrolyte Membranes with Anisotropic Channels for Efficient Li-Ion Batteries



A low-cost sustainable electrolyte which can function harmoniously with different electrode systems with negligible drop in the performance is one of the long term goals of current energy research. NIIST has demonstrated a bio-based ionic liquid crystal derived solid polymer electrolyte membrane, consisting of polymeric backbone, lithium salt and PMIMP along with conventional plasticizer through a facile and simple strategy for the fabrication of lithium-ion battery. Promising results obtained regarding compatibility of cell components, excellent specific capacity, appreciable coulombic efficiency and cycling stability of the lithium-ion cell investigated with BILC-SPE developed from the low-cost industrial waste not only revolutionizes the performance of energy storage devices but also renders a platform to create cleaner environment.

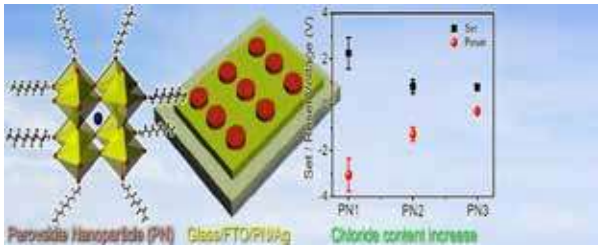
NONVOLATILE MEMORY

Non-Volatile Bistable Memory Devices Based On Semiconducting Polyvinylcarbazole Zinc Oxide Nanocomposites



NIIST has developed semiconducting polyvinylcarbazole-zinc oxide nanocomposites comprising electron donor carbazole moiety (p-type) and electron acceptor zinc oxide (n-type) through a facile strategy and has demonstrated its application as an active layer in the fabrication of non-volatile memory device. Effect of zinc oxide on the various properties were evaluated by UV-visible absorption, photoluminescence, Raman, FT-IR, XRD, SEM, HR-TEM, and AFM. PVZs exhibited good solubility in dichlorobenzene and memory devices were fabricated by sandwiching PVZs nanocomposites between indium tin oxide and silver electrode (ITO/PVZ/Ag). By fitting the data to various charge transport models, the conduction mechanisms of the device were proposed as Ohmic, Poole–Frenkel emission, and trap filled space charge limited conduction that depends on the applied voltage. Endurance performances of the devices were stable for more than 100 cycles with ON/OFF current ratio of 5.2×10^3 and retention time of 10^5 seconds.

Hybrid Perovskite Nanoparticles for High-Performance Resistive Random Access Memory Devices: Control of Operational Parameters Through Chloride Doping



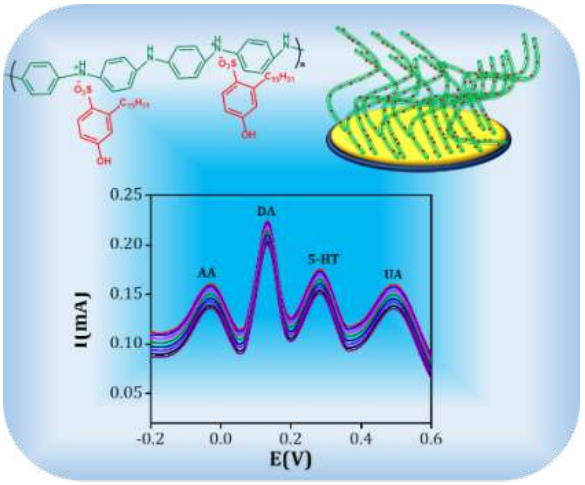
NIIST could establish the use of hybrid lead halide perovskite in nanoparticle form for high-performance, air-stable, non-volatile memory devices. The resistive random-access memory devices fabricated from $CH_3NH_3PbBr_{3.0}$ exhibited remarkable bipolar and bistable resistive switching behavior with small on-off voltage (2.66 V). Interestingly, the write-erase voltages of the devices were reduced to 1.04 V and further to 0.53 V by replacing bromide with chloride ions in the basic structure of the nanoparticles ($CH_3NH_3PbBr_{2.54}Cl_{0.46}$ and $CH_3NH_3PbBr_{1.97}Cl_{1.03}$, respectively). Though the on-off voltage dropped, the on/off ratio, retention and endurance of the devices enhanced on chloride doping. Our studies proved that hybrid perovskites are excellent candidates for developing low-cost non-volatile memory devices. It also illustrates the possibility to control the operational parameters of the devices through chemical modifications.

RELATED DEVICES

Gold Nanoparticle Patterned on PANI Nanowire Modified Transducer for the Simultaneous Determination of Neurotransmitters in Presence of Ascorbic Acid and Uric Acid

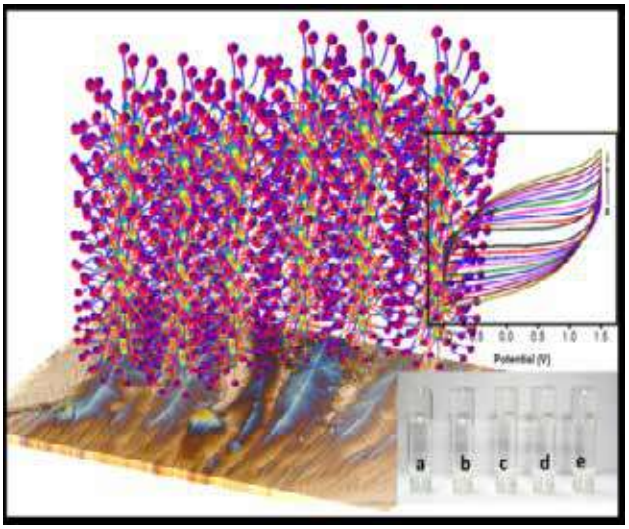
Research and development in NCPs are receiving lots of interest in the present scenario due to its unique tunable optoelectronic properties, flexibility, large surface-to-volume ratio, high charge carrier

mobility etc. We have electrochemically deposited polyaniline nanowires on GCE from LC template of anilinium-PDPSA. Further, the electrode was modified by electrochemical patterning of gold nanoparticles through chronoamperometry. Modified electrode was characterized for its electrochemical impedance, morphology, XRD, effective electroactive surface area and later demonstrated its efficacy for the individual and simultaneous sensing of dopamine, ascorbic acid, serotonin, and uric acid. Finally, we have validated its performance in the blood serum



Functional Liquid Crystalline Gels Through Multi-Scale Hierarchical Self-Assembly of LAPONITEs and Amidodiol

We designed and synthesised liquid crystalline gels through multi-scale hierarchical self-assembly of laponite and AMD (FLAG) in water. They are found to interact with each other through various non-covalent interactions such as hydrogen bonding and ion-dipole interactions to form highly ordered super structures in different dimensions and length scales. Effect of concentration of AMD and time scale on the specific modes of packing was studied using various techniques such as PLM, SEM, TEM, XRD, rheology and FT–IR spectroscopy. The amount of hydroxyl functional groups in FLAG was estimated by chemical analysis. A plausible mechanism is proposed for the formation of superstructures in FLAG. Electrochemical impedance studies of the FLAG showed low charge transfer resistance (245Ω) with a stable electrochemical window (-0.4V – 1V). Galvanostatic studies revealed good cycling stability with a specific capacitance of 1856 mF/g

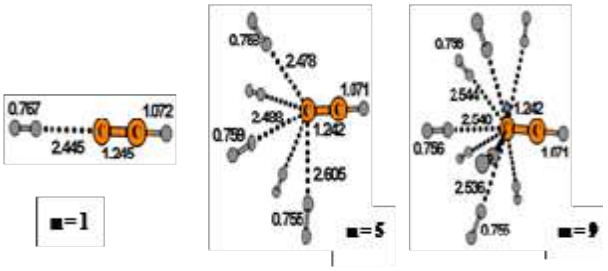


COMPUTATIONAL CHEMISTRY

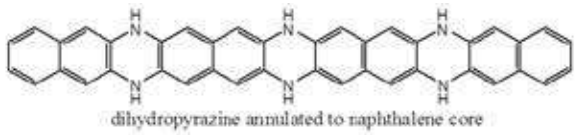
This activity deals with *ab intio* quantum mechanical (QM) and density functional theory (DFT) based modelling of the catalytic activity of transition metal complexes, small organic molecule-catalyzed organic transformations and rational design of functional molecules and materials. Accuracy of reasonably big systems is now guaranteed with the use of advanced QM methods implemented on high performance computing resources. The *ab initio* Möller Plesset perturbation theory of order two (MP2) is generally applied as a reasonably accurate model for modelling organic molecular systems. For more complex systems involving metal atoms, the popular DFT method is largely utilized. The DFT methodology has triggered extensive modelling in metal-complexes, leading to a very consistent increase in the area of applicability together with a

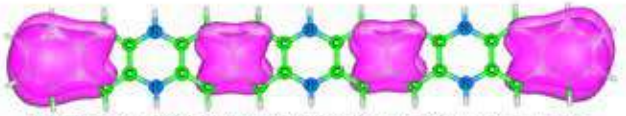
consistent reduction in the computer time needed. For large systems, the hybrid methodology, QM-MM is adopted in our research.

Massive Dihydrogen Uptake by Anionic Carbon Chains. Acetylene and polyyne carbon chains show a negligible ability to bind even a single dihydrogen molecule. DFT calculations corroborate that these carbon chains in the first deprotonated anionic and second deprotonated dianionic forms display massive dihydrogen uptake capabilities (45.3 to 62.8 wt%). The coordinatively saturated complexes of these anions and dianions with chain lengths of up to six carbons hold 20–32 H_2 molecules with interaction energy (E_{int}) 44.5–50.0 kcal mol^{-1}) and dianions (79.8–87.4 kcal mol^{-1} which indicate substantial energetic stabilization per H_2 molecule adsorbed.



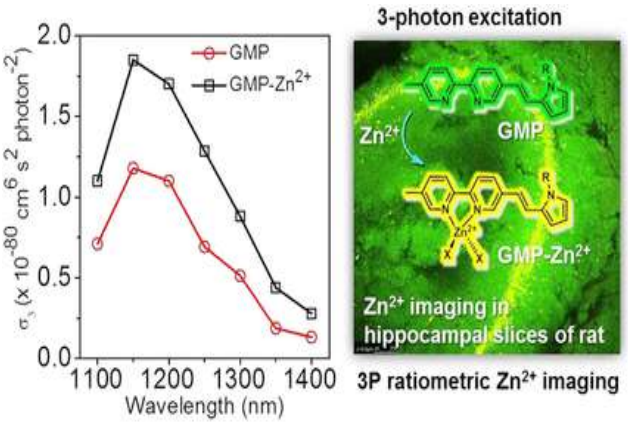
Dihydropyrazine Annulated Linear Polyacenes: Aromaticity: Linear polyacenes (LPAs) beyond pentacene are highly unstable and their application potential in the optoelectronics field is very limited. DFT calculations show that annulating dihydropyrazine units to LPA cores can yield large LPA mimics. This strategy enhances the aromaticity of the LPA core and also provides a way to modulate the HOMO–LUMO energy gap by choosing an appropriate LPA core and extending dihydropyrazine annulation. The electronic features of the LPA mimics assessed by analysing molecular electrostatic potential topography and molecular orbitals have shown that the LPA cores retain the reactivity of the parent LPA. Furthermore, significant mixing of the N-lone pairs of the heterocycle with carbon π-orbitals improves aromaticity and decreases the HOMO–LUMO energy gap


dihydropyrazine annulated to naphthalene core


Electrostatic potential reveals electronic features of naphthalene core

FLUORESCENT MATERIALS

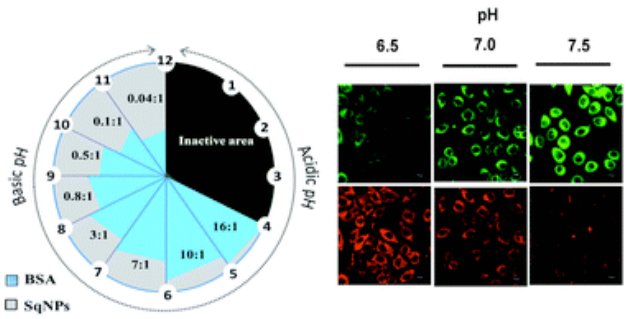
Three-Photon Active Organic Fluorophore for Deep Tissue Ratiometric Imaging of Intracellular Divalent Zinc



Deep tissue bioimaging with three-photon (3P) excitation using near-infrared (NIR) light in the second IR window (1.0–1.4 μm) could provide high-resolution images with an improved signal-to-noise ratio. In line with this, we have developed a photostable and nontoxic 3P excitable donor-π-acceptor system (GMP) having 3P cross-section (σ_3) of 1.78 x 10^{-80} cm^6 s^2 $photon^{-2}$ and action cross-section ($\sigma_3\eta_3$) of 2.31 x 10^{-81} cm^6 s^2 $photon^{-2}$, which provides ratiometric fluorescence response with divalent zinc ions in aqueous conditions has been. The probe signals the Zn^{2+} binding at 530 and 600 nm, respectively, upon 1150 nm excitation with enhanced σ_3 of 1.85 x 10^{-80} cm^6 s^2 $photon^{-2}$ and $\sigma_3\eta_3$ of 3.33 x 10^{-81} cm^6 s^2 $photon^{-2}$. The application of this probe is demonstrated for

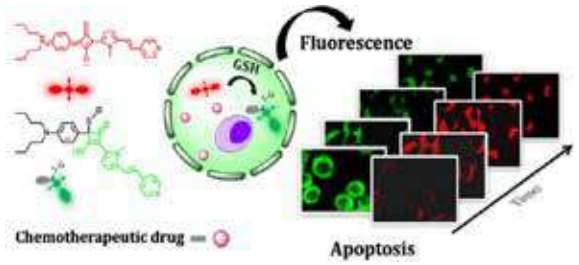
ratiometric 3P imaging of Zn2+ in vitro using HuH-7 cell lines. Furthermore, the Zn^{2+} concentration in rat hippocampal slices was imaged at 1150 nm excitation after incubation with GMP, illustrating its potential as a 3P ratiometric probe for deep tissue Zn^{2+} ion imaging.

A Protein–Dye Hybrid System as a Narrow Range Tunable Intracellular pH Sensor



Accurate monitoring of pH variations inside cells is important for the early diagnosis of diseases such as cancer. Even though a variety of different pH sensors are available, construction of a custom-made sensor array for measuring minute variations in a narrow biological pH window, using easily available constituents, is a challenge. NIIST derived a two-component hybrid sensor from a protein and organic dye nanoparticles whose sensitivity range can be tuned by choosing different ratios of the components, to monitor the minute pH variations in a given system. The dye interacts noncovalently with the protein at lower pH and covalently at higher pH, triggering two distinguishable fluorescent signals at 700 and 480 nm, respectively. The pH sensitivity region of the probe can be tuned for every unit of the pH window resulting in custom-made pH sensors. These narrow range tunable pH sensors have been used to monitor pH variations in HeLa cells using the fluorescence imaging technique

A Ratiometric Near Infrared Fluorogen for the Real Time Visualization of Intracellular Redox Status during Apoptosis

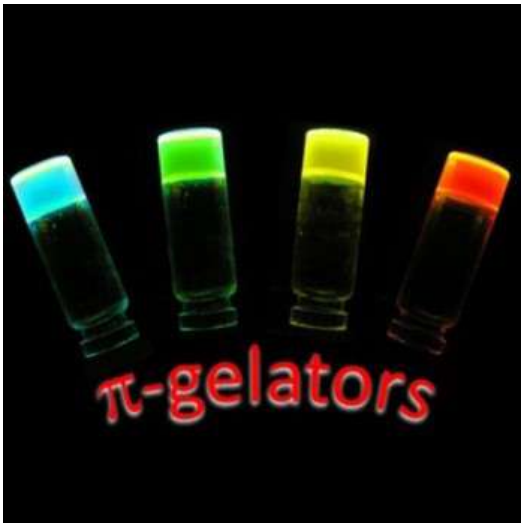


Direct monitoring of apoptotic progression is a major step forward for the early assessment of therapeutic efficacy of certain treatments and the accurate evaluation of the spread of a disease. Here, the regulatory role of glutathione (GSH) is explored as a potential biomarker for tracking apoptosis. For this purpose, a near-infrared (NIR) squaraine dye is introduced that is capable of sensing GSH in a ratiometric manner by switching its emission from NIR (690 nm) to visible region (560 nm). The favorable biocompatible attributes of the probe facilitated the real-time monitoring of apoptotic process in line with the conventional apoptotic assay. Furthermore, the robust nature of the probe was utilized for the quantitative estimation of GSH during different stages of apoptosis. Through this study, an easy and reliable method of assaying apoptosis is demonstrated, which can provide valuable insights in translational clinical research.

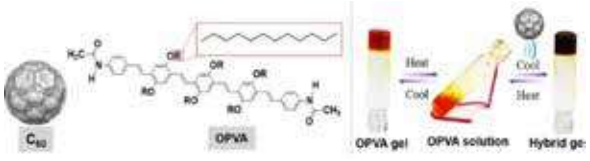
The Chemistry and Applications of π-Gels

π-Gels are a promising class of functional soft materials formed out of short π-conjugated molecules. By utilizing the chemistry of noncovalent interactions, researchers in NIIST have created a wide range of π-gels that are composed of supramolecular polymers. During the last two decades, supramolecular gel chemistry has been pursued with the hope of developing new materials for applications in, for example, organic electronics,

energy harvesting, sensing, and imaging. The high expectations for π-gels were centered mainly around their electronic properties, such as tunable emission, energy transfer, electron transfer, charge transport, and electrical conductivity; such properties are amenable to modulation through size and shape control of molecular assemblies. Although a large number of exciting publications have appeared, a major technological breakthrough is yet to be realized. In this review, we analyze the recent advancements in the area of functional π-gels and their scope in future applications.

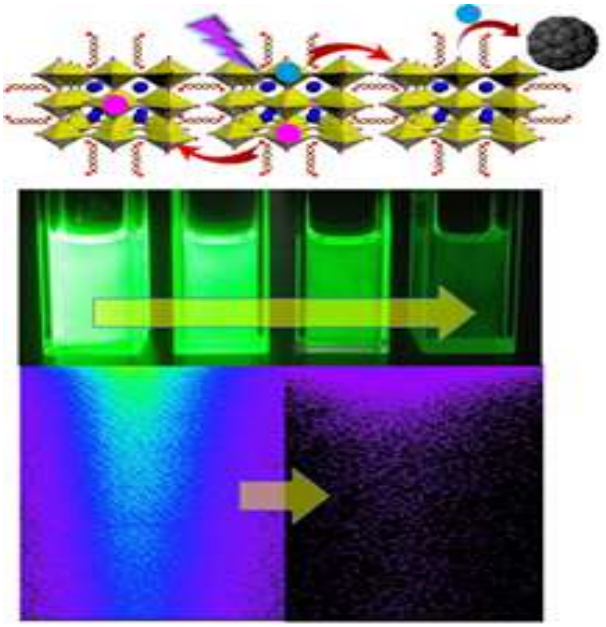


A π-Gel Scaffold for Assembling Fullerene to Photoconducting Supramolecular Rods



Nonequilibrium self-assembly of molecules holds a huge prospect as a tool for obtaining new-generation materials for future applications. Crystallization of neutral molecules within a supramolecular gel matrix is one example in which two nonequilibrium processes occur orthogonal to each other. On the other hand, electronically interacting donor-acceptor two-component systems are expected to form phase-miscible hybrid systems. Contrary to the expectation, NIIST has we reported the behavior of a π-gel, derived from oligo(*p*-phenylenevinylene), OPVA, as a scaffold for the phase separation and crystallization of fullerene (C_{60}) to supramolecular rods with increased transient photoconductivity ($\phi\mu_{max}$ = 2.4 × 10^{-4} cm^2 V^{-1} s^{-1}). The C_{60} supramolecular rods in the p-gel medium exhibited high photocurrent in comparison to C_{60} loaded in a non-π-gel medium. This finding provides an opportunity for large-scale preparation of micrometer-sized photoconducting rods of fullerenes for device application.

Channeling Exciton Migration into Electron Transfer in Formamidinium Lead Bromide Perovskite Nanocrystal/Fullerene Composites

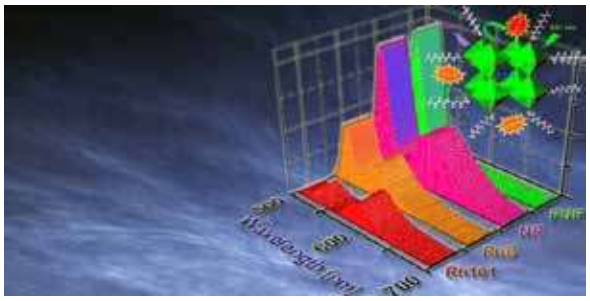


NIIST researchers could establish that Hydrophobically capped nanocrystals of formamidinium lead bromide (FAPbBr3) perovskite (PNC) show bright and stable fluorescence in solution and thin-film states. When compared with isolated PNCs in a solution, close packed PNCs in a thin film show extended fluorescence lifetime (ca. 4.2 μs), which

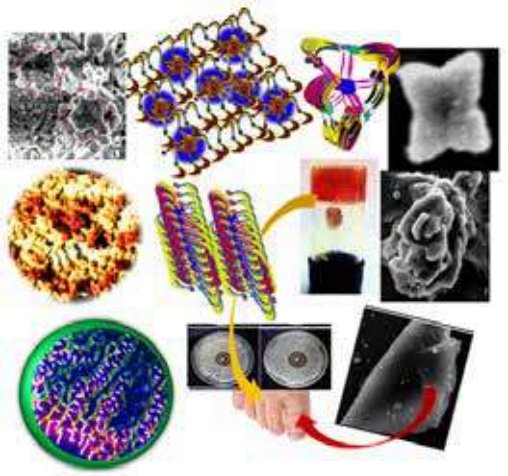
is due to hopping or migration of photogenerated excitons among PNCs. Both fluorescence quantum efficiency and lifetime decrease in a PNC thin film doped with fullerene (C_{60}), which is attributed to channelling of exciton migration into electron transfer to C_{60}. On the other hand, quenching of fluorescence intensity of a PNC solution is not accompanied by any change in fluorescence lifetime, indicating static electron transfer to C_{60} adsorbed onto the hydrophobic surface of individual PNCs. Exciton migration among close-packed PNCs and electron transfer to C_{60} places C_{60}-doped PNC thin films among cost-effective antenna systems for solar cells

$CH_3NH_3PbBr_3$ Perovskite Nanocrystals as Efficient Light-Harvesting Antenna for Fluorescence Resonance Energy Transfer

CH3NH3PbBr3 nanocrystals are found to be excellent light-harvesting antennas, and efficient fluorescence resonance energy transfer occurs from the nanocrystals to fluorescent dyes. Further, the energy transfer efficiency is found to be highly dependent on the number of anchoring groups and binding ability of the dyes to the surface of the nanocrystals. This is observed while light-harvesting antenna properties of luminescent methylammonium lead bromide (CH3NH3PbBr3)-based perovskite nanocrystals was studied using fluorescent dyes (rhodamine B, rhodamine 101, and nile red) as energy acceptors. These observations may have significant implications for perovskite-based light-harvesting devices and their possible use in artificial photosynthesis systems



Design of Macroscopically Ordered Liquid Crystalline Hydrogel Columns Knitted With Nanosilver for Topical Applications

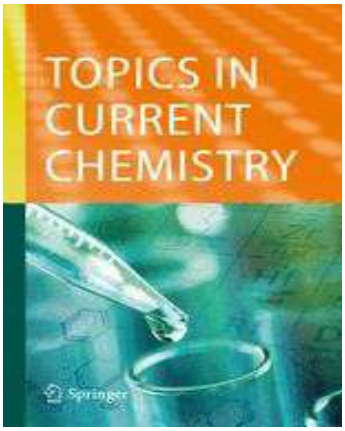


Design of liquid crystalline hydrogels knitted with silver nanoparticles in macroscopic ordering is becoming a subject of research interest due to their promising multifunctional applications in biomedical and optoelectronic applications. Self-assembled silver columns decorated with macroscopically ordered networks were developed in NIIST in a single step of *in situ* condensation and a reduction/complexation process. The antifungal studies were screened using species of Candida, The MIC and MFC values, in vitro antifungal studies, reactive oxygen species production, and propidium iodide uptake results suggest that the present macroscopically ordered liquid crystalline hydrogel system can be considered an excellent candidate for topical applications

The Rise of Near-Infrared Emitters: Organic Dyes, Porphyrinoids, and Transition Metal Complexes

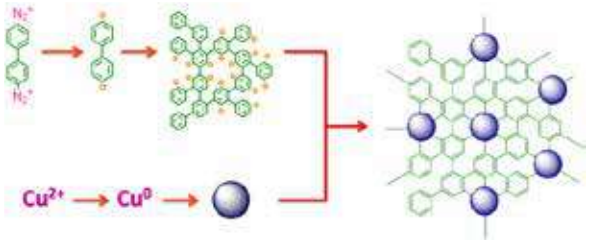
In recent years, the interest in near-infrared (NIR) emitting molecules and materials has increased significantly, thanks to the expansion of the potential technological applications of NIR luminescence in several areas such as bioimaging, sensors,

telecommunications, and night-vision displays. This progress has been facilitated by the development of new synthetic routes for the targeted functionalization and expansion of established molecular frameworks and by the availability of simpler and cheaper NIR detectors. Recent developments in NIIST are focussed on three major classes of systems—i.e., organic dyes, porphyrinoids, and transition metal complexes—exhibiting the maximum of the emission band at λ> 700 nm. In particular, we focus on the design strategies that may increase the luminescence efficiency, while pushing the emission band more deeply in the NIR region. This overview suggests that further progress can be achieved in the near future, with enhanced availability of more robust, stronger, and cheaper NIR luminophores

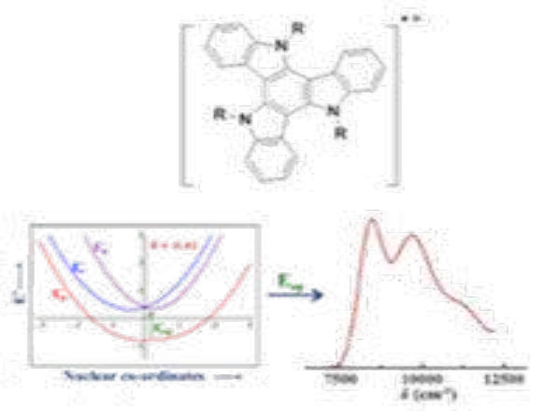


PHOTONICS & ULTRAFAST KINETICS

Highly Stable Copper Nanoparticles Linked to Organic Frameworks as Recyclable Catalyst for Three-Component Click Cycloaddition in Water



NIIST established the synthesis, characterization and catalytic applications of highly stable copper-nanoparticles linked to aromatic frameworks. Synthesis of these nanoparticles was achieved in a one-pot reaction which involved the simultaneous reduction of $CuCl_2.2H_2O$ and 4,4'-biphenylene-bis-diazonium tetrafluoroborate using sodium borohydride. Four different types of nanoparticles were prepared by varying the concentration of the metal salts and the ligands. The structure and morphology of these materials were studied using XRD, XPS, SEM and HRTEM analysis. The materials were found to be very good catalysts for click reactions between azides and alkynes and exhibited TOF values as high as 305400 h^{-1}.They also efficiently catalyzed the one-pot click reactions involving azide precursors, sodium azide and alkyne. TOF up to 99000 h^{-1} were observed for these reactions.

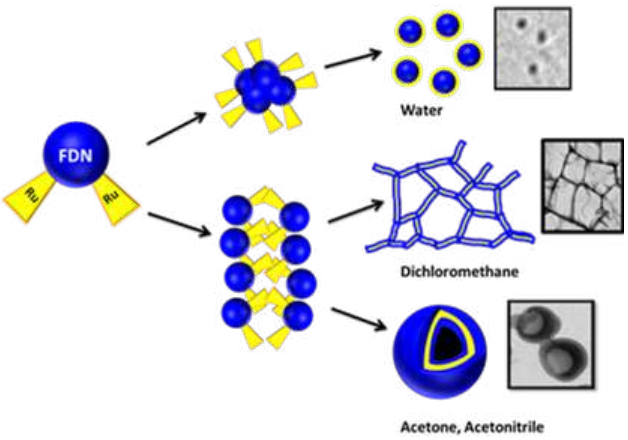


Triazatriangulene Radical Cation. A Trigonal Class III Mixed Valence System

NIIST could generaye chemically for the first time Triazatruxene radical cation, which is highly symmetric and and found to be very stable,. Intervalence charge transfer (IV-CT) absorption band of the radical cation was observed at 7500 – 12500 cm^{-1}. The IV-CT band exhibited well-resolved, solvent independent vibrational structure which prompted us to classify the radical cation as a Robin and Day class

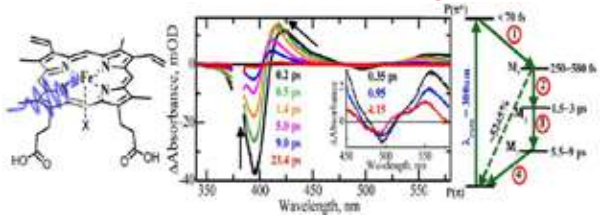
III IV-CT compound. The assignment was examined in the light of two previously reported semi-classical models for three-center IV-CT systems.

Covalent Functionalization of Organic Nanoparticles by Aryl Diazonium Chemistry and their Solvent-dependent Self-assembly



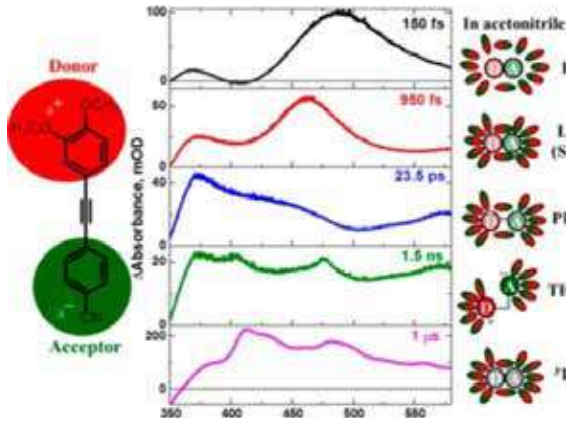
A simple method for covalent functionalization of Fréchet-type dendron nanoparticles (FDN) by *tris*-bipyridylruthenium(II) was developed by NIIST. Covalent functionalization is achieved by chemically reducing the diazo derivative of a ruthenium(II) bipyridine complex in the presence of FDNs wherein the radical species generated gets covalently linked to the nanoparticle surface. The nanoparticles, post functionalization, were characterized by transmission electron microscopy (TEM), energy dispersive X-ray analysis (EDX), thermogravimetric analysis (TGA), and IR, UV-visible, and NMR spectroscopic techniques. Depending on the solvent the ruthenium complex-linked FDN displays a range of morphologies, including nanoparticles, fiber-networks and nanocapsules. In nanocapsules and fiber-networks observed in organic solvents, the ruthenium complex is confined within the interior domain of the aggregate, whereas in the nanoparticles observed in water, they are present on the periphery. The characterization of these nano-aggregates using different spectroscopic and microscopic techniques is also described.

Ultrafast Relaxation Dynamics of Photoexcited Heme Model Compounds: Observation of Multiple Electronic Spin States and Vibrational Cooling



Hemin is a unique model compound of heme proteins carrying out variable biological functions. NIIST researchers investigated the excited state relaxation dynamics of heme model compounds in the ferric form are systematically investigated by changing the axial ligand (Cl/Br), the peripheral substituent (vinyl/ethyl–meso), and the solvent (methanol/DMSO) using femtosecond pump–probe spectroscopy upon excitation at 380 nm. Excited state deactivation pathway of the model compounds comprising the decay of the porphyrin excited state (S^*) to ligand to metal charge transfer state (LMCT, τ_1), back electron transfer from metal to ligand (MLCT, τ_2), and relaxation to the ground state through different electronic spin states of iron (τ_3 and τ_4) are proposed along with the vibrational cooling processes. The observation of an increase of all the relaxation time constants in DMSO compared to the methanol reflects the stabilization of intermediate states involved in the electronic relaxation. The transient absorption spectra of met-myoglobin are also measured for comparison. Thus, the transient absorption spectra of these model compounds reveal the involvement of multiple iron spin states in the electronic relaxation dynamics, which could be an alternative pathway to the ground state beside the vibrational cooling processes and associated with the inherent features of the heme *b* type

Direct Observation of Cascade of Photoinduced Ultrafast Intramolecular Charge Transfer Dynamics in Diphenyl Acetylene Derivatives: Via Solvation and Intramolecular Relaxation.



The femtosecond transient absorption spectra of the chromophores upon ultrafast excitation conducted in NIIST revealed the dynamics of intermediates involved in transition from initially populated Frank–Condon state to local excited state (LE). The cascade of photoinduced ICT processes is directly observed by investigating the excited state relaxation dynamics of cyano and mono/di methoxy substituted diphenyl acetylene derivatives using femtosecond pump–probe spectroscopy and nanosecond laser flash photolysis. It also provides the dynamic details of the transition from the LE to the charge transfer state yielding the formation of the radical ions. Finally, the charge transfer state decays to the triplet state by geminate charge recombination. The latter dynamics are observed in the nanosecond transient absorption spectra. It is found that excited state relaxation pathways are controlled by different stages of solvation and intramolecular relaxation depending on the solvent polarity.

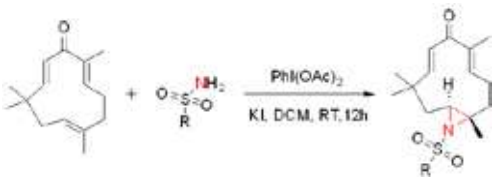
PHYTOPHARMACEUTICALS AND DRUG INTERMEDIATES

India's rich biodiversity related to the food and health security has become the point of discussion amongst the concerned experts worldwide today. Of the two biodiversity hot spots in India, viz., The Western Ghats and the North East, the Western Ghats has the highest number of endemic species (those that are found nowhere else). At NIIST, natural product chemists, medicinal chemists and biologists work together to produce evidence based knowledge that will help to take better decisions for the sustainable management of this dying biodiversity of India. The goal of this activity is the bio-evaluation of a selected group of high priority plants of Kerala for food, nutrition and health, with special emphasis on plants known for its usage in Ayurveda and traditional medicine.

The quest for sustainable development in chemistry has tempted both organic chemists and environmental chemists to search for green and environmentally friendly methodologies. Hence, the second major focus of the section is on the generation of facile synthetic routes towards Chemical Intermediates (CI) or Advanced Pharmaceutical Intermediates (API) by following green chemistry approaches. In this line, the section has made important advances in devising novel synthetic routes towards important medicinal scaffolds and also has fabricated cheap and efficient heterogeneous catalysts for organic reactions.

The summary of the findings from both the activities are given below.

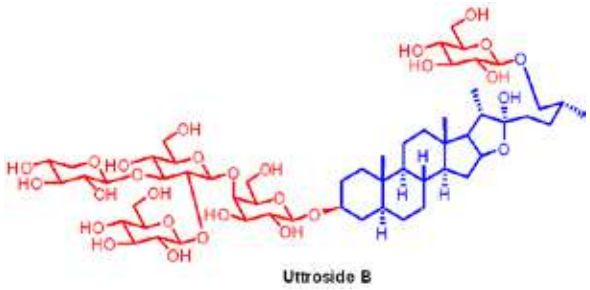
Metal-Free trans-Aziridination of Zerumbone: Synthesis and Biological Evaluation of Aziridine Derivatives of Zerumbone



We have employed a metal-free one pot strategy for the trans- aziridination of zerumbone using

sulphonamides as the reaction partners for the first time and the derivatives were screened for anti-proliferative as well as anti-diabetic activities. Among the zerumbone-aziridine derivatives screened, some of the displaced superior anti-proliferative activity than the parent compound towards Human colon carcinoma and Human breast adenocarcinoma cell lines. Also, in the anti-diabetic screening studies, most of the derivatives exhibited promising α- glucosidase inhibition properties than the parent zerumbone molecule

Evaluation of uttroside B, a saponin from *Solanum nigrum* Linn, as a promising chemotherapeutic agent against hepatocellular carcinoma



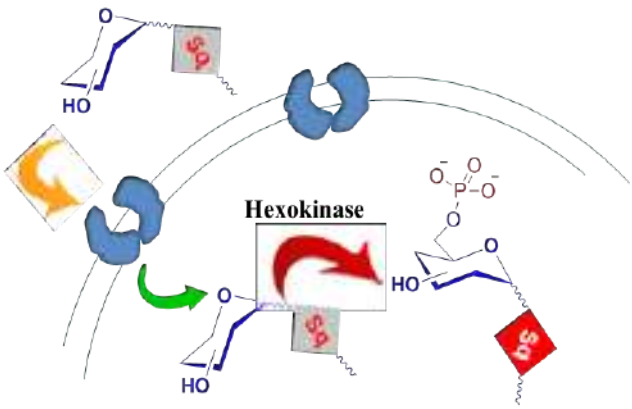
In the area of natural products, a complex saponin which was isolated from *Solanum nigrum* was identified as uttroside B and it was found to be potent against liver cancer, a work carried out in collaboration with Rajiv Gandhi Centre for Biotechnology. Efforts in isolating more quantities of uttroside B and its semi-synthetic derivative are currently being pursued. Uttroside B, that comprises of β-D-glucopyranosyl unit at C-26 of the furostanol and β-lycotetraosyl unit at C-3, is ten times more cytotoxic to the liver cancer cell line HepG2 (IC_{50}:0.5 μM) than sorafenib (IC_{50}:5.8 μM), the only FDA-approved drug for liver cancer. The drastic reduction in HepG2-xenograft tumour size achieved by uttroside B in NOD-SCID mice and substantiation of its biological safety through both acute and chronic toxicity studies in Swiss albino mice warrants clinical validation of the molecule against hepatic cancer

Guanidinium Rich Dendron-Appended Hydnocarpin ExecutesSuperior Anti-Neoplastic Effects Through Caspase Mediated Apoptosis

Hydnocarpus wightiana Blume is a popularly known medicinal plant and the acetone extract of the seeds demonstrated superior free radical scavenging property with a high total phenolic and flavonoid content. Hydnocarpin (Hy), which has been isolated and purified from the acetone extract, promotes moderate cytotoxicity on cancer cells. In an attempt to increase the efficiency of Hy as an anticancer agent, chemical coupling with a highly efficient, non-toxic cell penetrating guanidinium rich poly-(propylene imine) dendron (G8) was attempted in NIIST. The resultant modified construct (Hy-G8) executes superior cytotoxicity preferentially on cancer cells through the induction of apoptosis mediated by caspases. The hybrid construct was also found to be a promising anti-metastatic agent. Therefore, Hy-G8 exhibited primarily as a hit compound which requires extensive interdisciplinary approaches and

legitimate engineering to accomplish a futurastic lead candiadate in cancer chemotherapy.

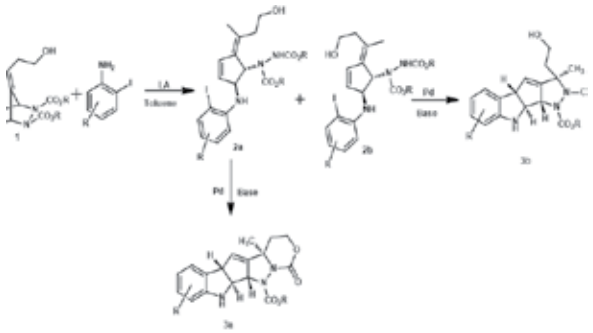
Novel Glycoconjugtaed Squaraine Dyes For Selective Cancer Cell Optical Imaging



Novel glycoconjugated squqraine dyes were synthesized in NIIST, which exhibited excellent internalization in tumour cells and are potent fluorogenic imaging probes for tumour specific optical imaging. Cancer cell selectivity was achieved with sq-glucose conjugates by targeting the Warburg effect. the unsymmetrical sq dye-Asqαgl exhibited superior imaging properties. the fluorescence "turn-on" occurring for the internalised squaraine dyes was exploited to obtain wash free imaging of the tumor cells.

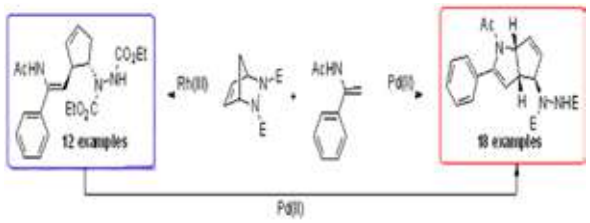
Palladium/Lewis Acid Mediated Reaction of Pentafulvene Derived Diazabicyclic Olefins: Efficient Access to Pentacyclic Motifs

We have synthesised a novel pentacyclic framework having cyclopentene fused to indoline, pyrazolidine and 1,3-Oxazinan-2-one skeletons via Lewis acid/palladium mediated strain release of pentafulvene derived bicyclic hydrazines.This protocol relies on the effective utilization of exocyclic nucleophiles of the fulvene derived diazabicyclic olefins to generate 1,3-Oxazinan-2-one moiety

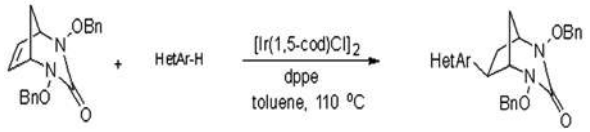


Pd-Catalyzed Oxidative Annulation of Enamides with Diazabicyclic Olefins: A Rapid Access to Cyclopentene Fused 2-Pyrrolines

2,3-Dihydropyrrole and its derivatives belong to an important class of five membered heterocycles due to their wide prevalence in natural products, pharmaceuticals and also due to their role as key building blocks for the synthesis of functionalized heterocycles. Enamides are versatile synthons towards N-containing heterocycles *via* transition metal catalyzed reactions. Synthetic potential of enamides were thoroughly investigated by various research groups for the development of different transition metal-catalyzed C-H activation/ oxidative cyclization with internal alkynes towards functionalized N-heterocycles.Our continued interest in the chemistry of transition metal catalyzed synthetic manipulation of strained bicyclic systems coupled with the aim of constructing biologically significant fused heterocycles prompted us to investigate the reactivity of diazabicyclic olefins with aromatic enamides under palladium catalysis.The developed methodology provides a versatile route for the synthesis of biologically significant fused pyrroline core skeletons under mild reaction conditions. The suggested mechanism involving two stages was successfully proved by isolating the proposed *trans*-3,4-disubstituted cyclopentene intermediate by a Rh(III) catalyzed C-H activation

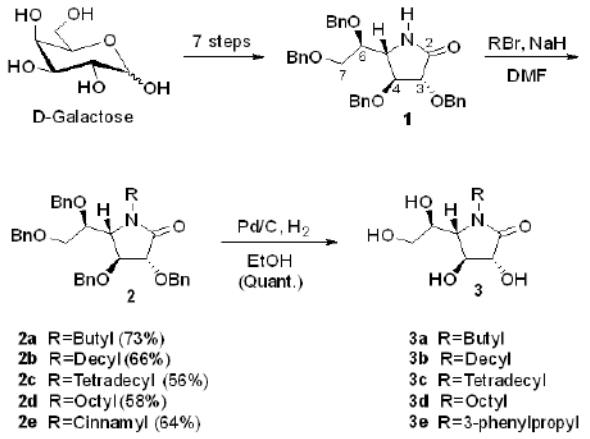


Iridium-Catalyzed Hydroheteroarylation of Urea Derived Bicycloalkenes



We have developed an efficient strategy for the Hydroheteroarylation of urea derived bicyclic adduct via the C-H activation of heteroarenes.The reaction conditions were compatible with a number of different substituents. The evaluation of the biological properties of these synthesized urea derivatives is underway in our laboratory.

Synthesis and Biological Evaluation of Novel Polyhydroxy N-Alkyl-2-Pyrrolidinone Derivatives

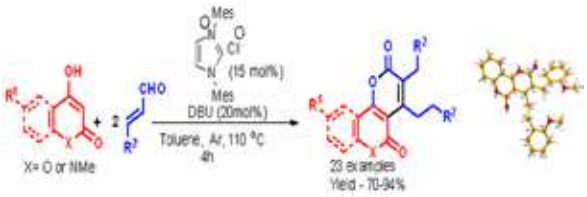


We have synthesized a focused library of novel polyhydroxy N-alkyl-2-pyrrolidinone derivatives were synthesized starting from D-galactose employing multistep chiron approach. The novel glycolipids exhibited LPS mediated splenocyte proliferation with no apparent toxicity against murine splenocytes. Various immunological assays on dendritic cell, macrophages and human PBMCs (peripheral blood mononuclear cells) have proved the immunostimulatory activity of glycolipids, the biology work was performed in collaboration with IICT. Compound 3e is found to be effective in stimulating the production of IL-12 in murine dendritic cells with significant expression of IFN-γ in human PBMCs.Taken together; the novel class of glycolipids presented here demonstrates their potential as immunostimulators which warrants further investigation of their potential utility as immunotherapeutic agents.

Novel Carbon-Carbon and Carbon-Heteroatom Bond Forming Reactions Mediated By *N*-Heterocyclic Carbenes

Organocatalysis can be defined as the acceleration of chemical reactions by the addition of a substoichiometric quantity of organic compound which does not contain an inorganic element. Organocatalysis has several advantages over transition metal catalysis and enzymatic transformations. Presently organocatalysis is an area of great interest in synthetic organic chemistry. The catalysts are usually robust, inexpensive and readily available small organic molecules. In this scenario, *N*-heterocyclic carbenes (NHCs) have been studied for their ability to catalyze organic reactions. In recent years NHCs have assumed importance due to the progress made in umpolung reactivity of aldehydes and especially in generating homoenolates, a species containing anionic carbon β- to a carbonyl group. Several research groups including our own have employed this three carbon synthon in the synthesis of various carbo– and heterocycles. In the context of our continuing interest in the chemistry of NHCs, we have carried out a detailed and systematic investigation of the reactivity of the homoenolate, generated in situ from enals and NHCs, towards various electrophiles.

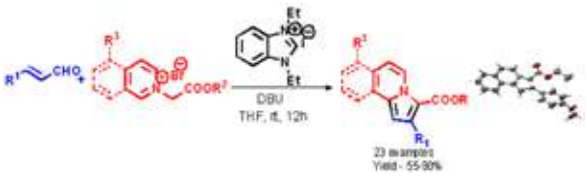
Sequential NHC-Catalyzed Reaction of Enals and Cyclic Aryldiene-1,3-Diones: Efficient Synthesis of Tricyclic Chromenones and Related Compounds.



Coumarin derivatives are known to display impressive anticoagulant, antimicrobial, anti HIV, anticancer, anti-inflammatory and antioxidant activities. We have developed an NHC-catalyzed synthesis of highly functionalized pyrano[3,2-c] chromene-2,5-dione derivatives, pyrano[3,2-c] quinoline-2,5(6H)-dione derivatives and pyrano[4,3-b] pyran-2,5-dione derivatives with potential biological activities. The reaction proceeds through a one-pot, Knoevenagel condensation followed by NHC-catalyzed enolate addition reaction pathway. The simple and mild reaction conditions and the high yields of products are likely to make the reaction attractive for its application in the synthesis of a variety of natural and unnatural chromenones

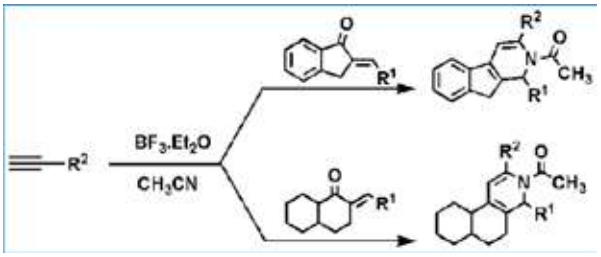
Novel NHC-Mediated Synthesis of Pyrrolo[2,1-A]Isoquinolines and Their Photophysical Investigations

Pyrrolo[2,1-a]isoquinoline derivatives constitute an important class of heterocyclic compounds, primarily due to the remarkable biological properties of the lamellarine group of alkaloids that are endowed with this framework. Inter alia, they have been reported to inhibit topoisomerase, HIV and integrase. Some other members of the group have been shown to possess anti-inflammatory, cardiovascular and antidepressant properties.



In the context of the recent discovery of NHC-mediated annulation of enals to a variety of electrophiles resulting in the synthesis of a wide range of carbo- and heterocyclic compounds in several laboratories, including our own, it was of interest to explore such a strategy for the construction of pyrrolo-[2,1-a]isoquinolines. We have developed a facile NHC-mediated synthesis of pyrrolo[2,1-a]isoquinolines and indolizines with potential biological activities. The preliminary photophysical studies revealed that these compounds have potential application in the sensing of VOCs which are biomarkers present in the exhaled breath of cancer patients

Lewis Acid Mediated One-Pot Synthesis Of Indenopyridines And 5,6-Dihydroisoquinolines



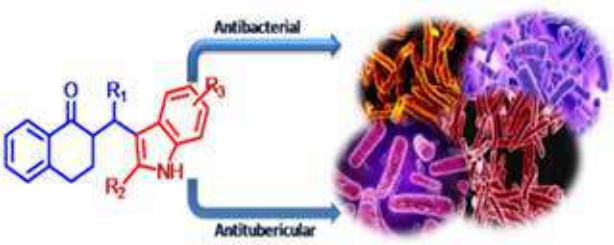
Fused pyridines and isoquinolines are of high pharmaceutical relevance.For instance, dopamine receptor agonists like glaucine and apomorphine are clinically active drug candidates which are explored against bronchitis, inflammation and Alzheimer's, Parkinson's disease respectively. ARC 111 (Topovale) is presently under clinical trials as topoisomerase I targeting antitumor drug. Numerous synthetic methods have been reported for the preparation of functionalized pyridines and isoquinolines. Despite considerable advancement made in this field, the

existing methods often require the use of expensive metal catalysts, ligands or starting materials that are not readily available and in some cases require multi-step procedures. Therefore, novel synthetic approaches to the functionalized pyridines and dihydroisoquinolines, with simple substrates, inexpensive catalysts, utilizing mild conditions are highly desirable.

In a continuation of our efforts to develop new synthetic protocols for heterocyclic frameworks and valuable polycyclic building blocks, we reported the $BF_3.Et_2O$ mediated one-pot synthesis of indenopyridines and 5,6-dihydroisoquinolines from readily available arylidene ketones and phenyl acetylenes

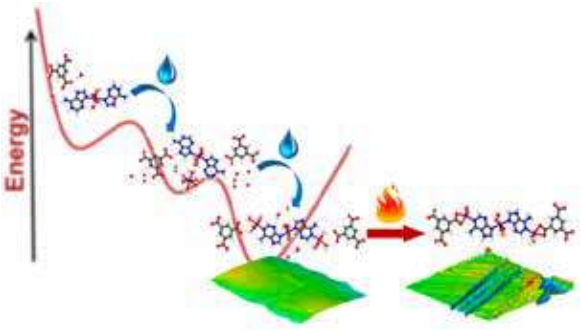
Antibacterial and Anti-Tubercular Evaluation of Dihydronaphthalenone-Indole Hybrid Analogues

Antibiotics and other antimicrobial drugs have saved millions of lives and relieved patients suffering from various diseases. Over the time, bacteria have developed resistance to existing drugs, and antibiotic resistance continues to spread like wildfire. Especially in India, the situation is quite alarming. In the past one and half decades, tuberculosis (TB) has been recurred as one of the foremost causes of human death worldwide (nearly 3 million deaths per year). Astonishingly, almost 0.23 million cases of multi drug resistant (MDR-TB) reports found only in India per year. In the recent decades, continued attention has been focused on the heterocyclic compounds owing to their major roles in biological processes and pharmaceuticals. Indole hybrids have showed promising MIC against both gram positive, gram negative bacteria and also against *Mycobacterium tuberculosis.*



Prompted by the above consideration and as a part of our ongoing research on developing novel molecular templates with enhanced antimicrobial activity, we assumed that incorporating indole scaffold into arylidene and hetero arylidene naphthalenones through the molecular hybridization approach might be an effective strategy for discovering novel hybrid nucleus with potential bioactivity. We successfully identified a novel structural class, which inhibits the set of organisms with very low minimum inhibition concentrations. Our studies complement new and exciting findings which strongly suggest that the indolyl naphthalenones have real potential in finding suitable “Leads” for development of antitubercular therapeutics

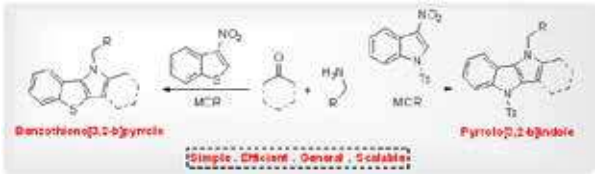
Structural Snapshots of Metastable Intermediates Reveals Sequential Addition of Growth Units in the Structure Evolution



Kinetically trapped partially preassembled metastable structures afford vital inputs on the reaction progression and the formation mechanism of technologically promising coordination assemblies. NIIST has established the structural and transformational relations in a series of coordination

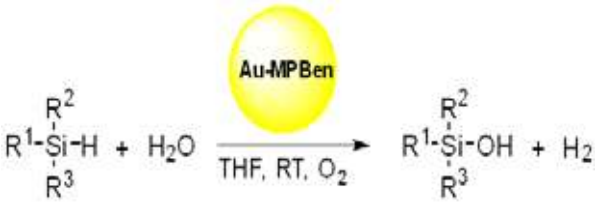
complexes, $[Co(ad)_2(H_2O)_4](btc\text{-})_2(H_2O)_2$ (**1**), $[Co\text{-}(ad)_2(H_2O)_4][Co(H_2O)_6](btc\text{-})_2(H_2O)_{10}$ (**2**), $[Co_3(ad)_2(H_2O)_{14}](btc\text{-})_2(H_2O)_4$ (**3**), and $[Co_3(ad)_2(btc\text{-})_2(H_2O)_8]$ (**4**), in which ad = adenine and btc = 1,3,5-benzenetricarboxylic acid, to provide insights on sequential structure evolution in an archetypal coordination assembly. Crystals of **3** undergo solid-state thermochromic transformation to a glassy phase **5** consequent to dehydration and anation reaction. With carefully optimized thermal treatment, we obtained a transient crystalline phase 4, which unambiguously proves a restructuring in the Co(II) coordination geometry from octahedral to trigonal bipyramidal. With the 3 → 4 transformation, the crystal surface undergoes drastic modification. Surface reconstruction events associated with photoreactions in the molecular crystals are noted, but analogous observations for thermally induced events are exceptional and unprecedented for coordination complexes. Correlative atomic force microscopy, nanoindentation, and structural inputs provide insights on the surface reconstruction events brought about by anisotropic long-range layer migration subsequent to 3 → 4 transition. The slip plane ($01^{-}1$) that crosses the crystal face (010) at an optimal angle offers an energetically viable route for layer reorientation and migration.

Heteroannulation of 3-Nitro-Indoles & 3-Nitro-Benzo[b]thiophenes: A Multi-component Approach Toward Pyrrole-Fused Heterocycles

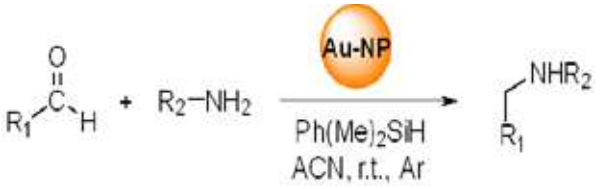


A simple, efficient and general multi-component reaction involving an enolizable ketone, a primary amine and an N-protected 3-nitroindole was developed in NIIST for the synthesis of a range of functionalized pyrrolo[3,2-b]indoles. The methodology was efficaciously utilized for the 'pyrroloindolisation' of natural products, the pyrrolization of 3-nitro-benzo[b]thiophene and for the gram-scale synthesis of pyrroloindole. Furthermore, a 'one-pot' approach for accessing indolo[3,2-b]indoles was realized

A Bentonite-Gold Nanohybrid Green Catalyst For Various Organic Reactions



A highly efficient, environmentally benign and reusable heterogeneous bentonite-gold nanohybrid catalyst, Au-MPBen was developed from readily available cheap reagents, under mild reaction conditions through simple processes. This catalyst effectively oxidised various aromatic, aliphatic and sterically hindered silanes to silanols in excellent yields without the formation of disiloxanes as byproduct. The silane oxidation methodology with Au-MPBen nanohybrid catalyst is environmentally benign, 98.7% atom economic and proceeded with low catalyst loading. This catalyst was also applicable for the gram scale preparation of silanols



The Au-MPBen nanohybrid catalyst also affords a variety of secondary amines in excellent yield under ambient reaction conditions in the presence of phenyldimethylsilane as mild hydride donor. The catalyst is recyclable, selective and is well applicable for the gram scale preparation of secondary amines. This reaction is applicable to a wide variety of aldehydes and primary amines.

पदार्थ विज्ञान और प्रौद्योगिकी प्रभाग

पदार्थ विज्ञान तथा प्रौद्योगिकी प्रभाग का अनुसंधान मुख्य रूप से सामरिक, ऑटोमोबाइल, ऊर्जा और सामाजिक अनुप्रयोगों के लिए उन्नत कार्यात्मक सामग्री और कॉम्पोनेंट्स के विकास पर केंद्रित है। वर्ष 2016-17 के दौरान प्रभाग के प्रमुख अनुसंधान क्षेत्रों में शामिल है (i) ऊर्जा बचत अनुप्रयोगों के लिए बहु कार्यात्मक पिगमेंट, (ii) प्रकाश व्यवस्था के लिए संदीप्तिशील सामग्री, (iii) पर्यावरणीय अनुप्रयोगों के लिए कार्बन डाइऑक्साइड अधिशोषण के लिए छिद्रपूर्ण सिरेमिक सामग्री, (iv) डाई-क्षरण के लिए नैनो फोटो उत्प्रेरक, (v) मुद्रित इलेक्ट्रॉनिक्स (vi) चुंबकीय और चुंबक प्रशीतन सामग्री, (vii) पॉलिमर और पॉलिमर नैनो कंपोजिट, (viii) खनिजों का इष्ट तमीकरण और औद्योगिक स्लैग के लिए मूल्य संवर्धन और (ix) सामरिक और ऑटोमोबाइल अनुप्रयोगों के लिए एल्यूमीनियम और मैग्नीशियम आलाय्स और कंपोजिट।

प्रभाग ने एस.सी.आई. पत्रिकाओं में 78 शोधपत्रों का प्रकाशन किया है और 2 विदेशी पेटेंट भी प्राप्त किए हैं और एक इंडियन पेटेंट फाइल किया गया है और 11 शोधार्थियों को पी.एच.डी. प्रदान किया गया। रिपोर्ट अवधि के दौरान प्रभाग के अनुसंधान के मुख्य आकर्षणों में से कुछ नीचे दिए जाते हैं:

मुख्य विशेषताएं

- ऊर्जा बचत अनुप्रयोगों के लिए उच्च आई.आर. परावर्तकता के साथ बहुप्रकार्यात्मक अकार्बनिक कोलोरंट्स।
- औद्योगिक परिसर में एन.आई.आई.एस.टी. नीले रंग का प्रदर्शन।
- एल.ई.डी. अनुप्रयोगों के लिए एकल चरणबद्ध सफेद और लाल फोस्फार्स का विकास।
- कुशल ऑक्सीजन उपचयन अभिक्रिया (ओ.आर.आर.) इलक्ट्रोकैटलिसीस के लिए ग्राफीन ऑक्साइड लिपटा इज्ड.आई.एफ़-8 माइक्रोक्रिस्टलो का जोड़ तोड़।
- जलीय प्रदूषण को प्रभावी ढंग से हटाने के लिए सी 3 एन 4 आधारित अधिशोषक फोटो कैटलिट्स।
- कैटलिटिक गैर-चुंबकीय पीडी-फ़्लाई एश और चुंबकीय Pd-Fe_3O_4-फ्लाईएश कम्पोजिट कणों का उपयोग करके जलीय सोल्यूशन्स से बुनियादी और औद्योगिक एज़ो रिएक्टिव रंजकों का हटाव ।
- पीवीबी लेपित हाइड्रोफोबिक पालिएस्टर फैब्रिक पर स्क्रीन मुद्रित वस्त्र एंटिना।
- लगभग कमरे के तापमान में थर्मोइलेक्ट्रिक अनुप्रयोगों के लिए कम तापमान रिफ्लक्स तकनीक का उपयोग करके संश्लेषित एन-टाइप Bi_2Te_3 नैनोस्ट्रक्चर का विकास।
- पॉलीप्रोपाइलीन/स्तरित डबल हाइड्रोक्साइड (एल.डी.एच.) नैनोकॉपोसाइट्स: लिप्रोपिलिन के गुणधर्म पर एल.डी.एच. अंतर परत धातु घटकों का प्रभाव।
- केले के पौधों के कचरे से रासायनिक सेंसर।
- तांबे के लावा कचरे से उच्च मूल्य लोहे की पुन: प्राप्ति पर जांच।
- वीवी मिनरल्स के लिए निम्न ग्रेड इल्मेनाइट के उन्नयन पर प्रारंभिक संयंत्र पैमाने पर परीक्षण।
- चयनित भारतीय मिट्टी से दवा और कॉस्मेटिक ग्रेड की तैयारी के लिए लाभप्रदता फ्लोशीट का विकास।
- अगली पीढ़ी के मोटर वाहनों में अनुप्रयोग के लिए (उच्च शक्ति सैन्य टैंकों के लिए पिस्टन) उच्च शक्ति एल्यूमिनियम मिश्र धातु उत्पाद का विकास।
- अनुक्रमिक कास्टिंग तकनीक द्वारा कार्यात्मक रूप से वर्गीकृत द्विधात्वीय एल्यूमिनियम मिश्र धातु।
- जलीय सोडियम क्लोराइड सोल्यूशन में संक्षारण प्रतिरोध के लिए मैग्नीशियम मिश्रों पर लांथानम फॉस्फेट कोटिंग्स।

MATERIALS SCIENCE AND TECHNOLOGY DIVISION

The research of Materials Science and Technology Division is mainly focused on the development of Advanced Functional Materials and Components for Strategic, Automobile, Energy and Societal Applications. The major research areas of the division during the period 2016-17 were (i) Multifunctional Pigments for Energy Saving Applications, (ii) Luminescent Materials for Lighting Applications, (iii) Porous Ceramic Materials for CO_2 Adsorption for Environmental Applications, (iv) Nano Photo catalysts for dye-degradation, (v) Printed Electronics, (vi) Magnetic and Magneto-Refrigeration Materials, (vii) Polymers and Polymer Nano-composites, (viii) Beneficiation of Minerals and Value Addition to the Industrial Slag and (ix) Aluminium and Magnesium Alloys and Composites for Strategic and Automobile Applications.

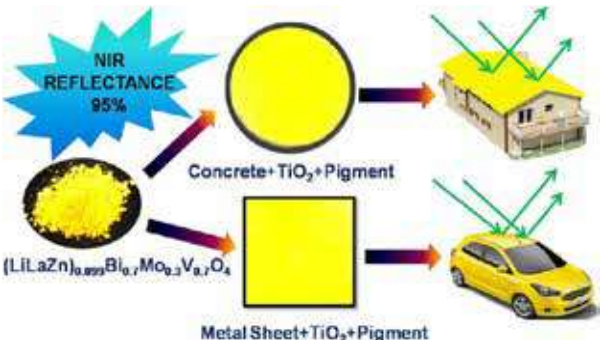
This division has published 78 papers in SCI Journals, was granted two Foreign Patents and filed one Indian patent and has produced eleven PhDs. Some of the research highlights of the division during the period are given below

Highlights

- Multifunctional inorganic colorants with high IR reflectance for energy saving applications
- Demonstration of NIIST blue pigment in the Industrial premises
- Development of single phased white and red phosphors for LED applications
- Manipulating graphene oxide sheathed ZIF-8 microcrystals for efficient oxygen reduction reaction (ORR) electro catalysis
- C3N4 based adsorptive photo catalysts for the effective removal of aquatic pollutants
- Removal of basic and industrial azo reactive dyes from aqueous solutions using Catalytic Non-Magnetic Pd-Flyash and Magnetic Pd-Fe_3O_4-Flyash Composite Particles
- Screen Printed Textile Antenna on PVB Coated Hydrophobic Polyester Fabric
- Development of n-type Bi_2Te_3 nanostructures synthesized using low-temperature reflux techniques for thermoelectric applications in near-room temperature
- Polypropylene/Layered Double Hydroxide (LDH) Nanocomposites: Influence of LDH Intralayer Metal Constituents on the Properties of Polypropylene
- Chemical sensors from Banana plant waste
- Investigations on the recovery of high value iron from copper slag waste
- Pilot plant scale trials on up gradation of low grade ilmenite by V V Minerals
- Development of Beneficiation flow sheet for the preparation of pharmaceutical and cosmetic grade clays from selected Indian clays
- High Strength Aluminum Alloy Product Developments for Next Generation Automotive Applications (Piston for high power military tanks)
- Functionally Graded Bimetallic Aluminum Alloy by Sequential Casting Technique
- Lanthanum phosphate coating on magnesium alloys for corrosion resistance in aqueous NaCl solution

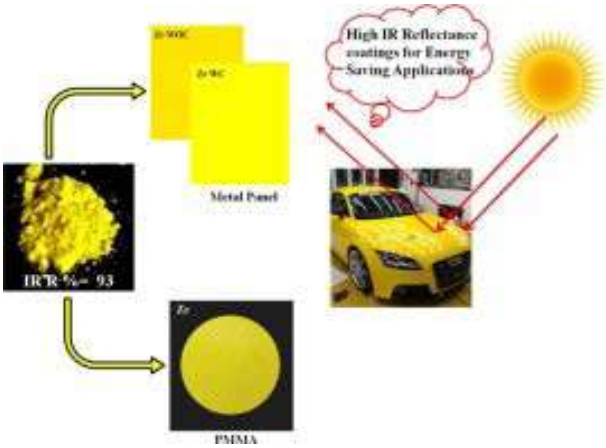
MULTIFUNCTIONAL INORGANIC PIGMENTS

Enhanced Near Infrared Reflectance with Brilliant Yellow Hues in Scheelite Type Solid Solutions, $(LiLaZn)_{1/3}MoO_4$–$BiVO_4$ for Energy Saving Products



NIIST synthesized enhanced near infrared (NIR) solar reflectance with interesting yellow hues in a new series of scheelite-type solid solutions, $[(LiLaZn)_{x/3}Bi_{1-x}][Mo_xV_{1-x}]O_4$ (x = 0, 0.1,0.2, 0.3, 0.4) via conventional solid state reaction (SSR) method and planetary ball milling assisted solid state reaction (PBM) method. The solid solutions undergo a phase transformation from a monoclinic to a tetragonal phase. The compounds exhibit strong absorption in the UV and blue regions of the visible spectrum displaying high NIR reflecting intense yellow shades ranging from reddish to greenish. The yellow hue and NIR reflectance is enhanced by the morphological modifications through PBM method. Typically, the pigment $[(LiLaZn)_{0.099}Bi_{0.7}][Mo_{0.3}V_{0.7}]O_4$ displayed intense yellow color (b* = 86.63) with NIR reflectance of 95% much better values than the commercial sicopal yellow. The applicability studies of these pigments on concrete cement block and metal sheet imparts good coloring performance with high NIR solar reflectance. Chemical and light resistance tests indicate their durability in the extreme weathering conditions. Thus, the prepared compositions consisting of less toxic elements demonstrate sustainable use of the present pigments in exterior surface coating applications as energy saving products

Terbium doped Sr_2MO_4 [M = Sn and Zr] yellow pigments with high infrared reflectance for energy saving applications



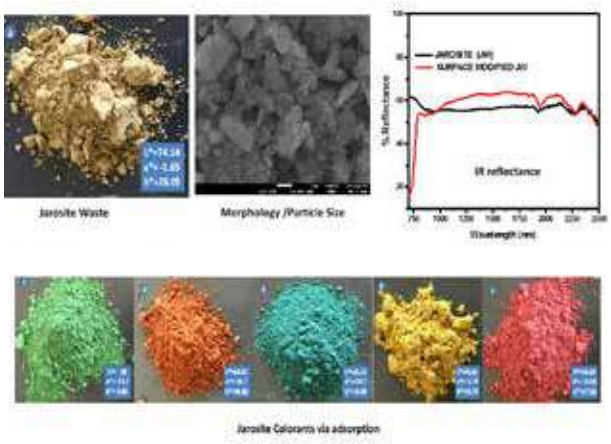
Synthesis, characterization and optical properties of Co-$MgWO_4$ blue inorganic pigments

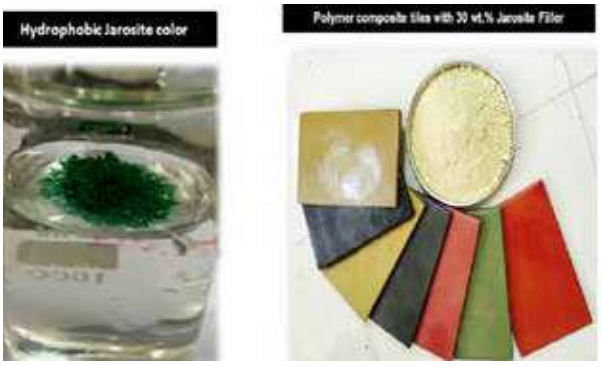
New inorganic blue pigments based on $Mg_{1-x}Co_xWO_4$ (x = 0.1, 0.2 and 0.3) have been prepared by the solid state reaction and flux added method. The synthesized samples show intense blue color with very low doping concentration of cobalt. Raising cost and toxicity make a critical need to reduce the consumption of cobalt in the ceramic industry, trying to improve efficiency and sustainability of pigments. The present investigations help us to minimize the cobalt consumption and cost of production than that of the conventional blue ceramic colorants. Interestingly the doping of Co^{2+} ions in the monoclinic $MgWO_4$ produces most vivid hue with 20 mol % of cobalt. Intense blue hue was obtained at relatively low doping concentration of Co^{2+} (20 mol %) with –b* value of -46.97. Increasing the amount of cobalt induces a change in the local symmetry of MgO_6 octa hedra witnessed by the change of the metal-ligand bond distances. The changes are attributed to the large ionic radius and electro negativity of Co^{2+} ions

compared to the Mg^{2+} ions in the host lattice. The observations suggested that structural distortions, which were dependent on the ionic radii and the electronegativity difference between the dopant and host cations. UV- visible absorption properties strongly are related to the coordination environment of the Co^{2+} ions. Optical absorption bands reveal the presence of octahedral coordination of Co^{2+} ions.

Ceramic Colorants from Inorganic Industrial Solid Waste, 'Jarosite': A low cost Corrosion Resistant pigment for Paints and coatings

Processing of automobile grade Zn alloys from zinc ore through hydrometallurgy route discharge voluminous amount of inorganic waste named 'Jarosite' in India. A typical zinc alloy processing plant annually produced 0.25 million ton jarosite which is chemically a sodium and sulphate containing iron silicate. Jarosite solid residue is expressed as [M $(Fe_3(SO_4)(OH_6)]$ where M= Na^+,K^+,NH_4^+). Jarosite being a natural yellow pigment has >60% IR reflectivity. A chemical modification strategy is first employed for achieving hydrophobic surface that eventually prevent the leaching of hazardous impurities. A hydrophobic contact angle of 108° is seen over the chemical modification. Such surface engineered jarosite was found to offer exceptional adsorption to range of inorganic stains and hence it is examined to prepare series of 'adsorptive-pigments' to produce green, yellow, orange and brown colors. The newly developed colorants were systematically characterized for color index, particle size, morphology and NIR reflectance property. Subsequently, the hydrophobic, NIR reflective jarosite colorants were coated on traditional tile bodies to obtain cool-tiles. Further it is also investigated for the anticorrosion property over metallic iron sheet. This work describes an innovative process for obtaining high-value, mineral-pigment from the highly economical source, ***jarosite,*** for the first time.



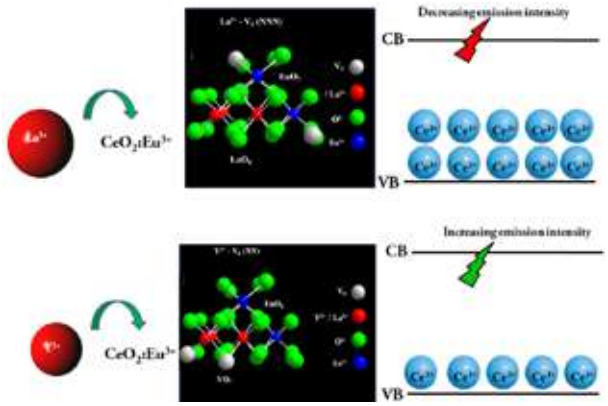


LUMINESCENT MATERIALS

Influence of local structure on photoluminescence properties of Eu^{3+} doped CeO_2 red phosphors through induced oxygen vacancies by contrasting lanthanide substitutions

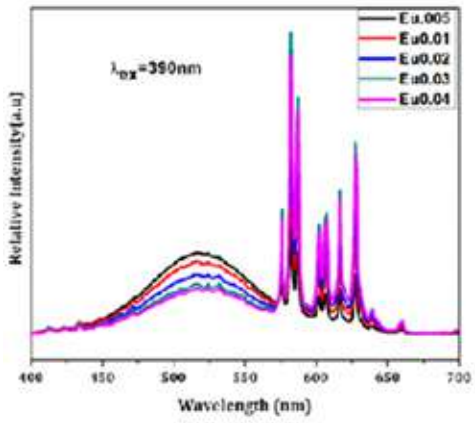
A new family of red phosphors: $Ce_{0.9-x}RE_xO_7$:***0.1***Eu^{3+} (RE = Y and La) (***x*** = 0, 0.20, 0.40, 0.60, 0.80, and 0.90) was synthesized by a conventional solid state route. The influence of contrasting lanthanide substitutions (Y and La) in the system were investigated on the local structure and associated photoluminescence properties by various characterization techniques. Both the trivalent ion substitution lead to same kind of variation in the average crystalline structure from a fluorite to the respective parent oxide structure

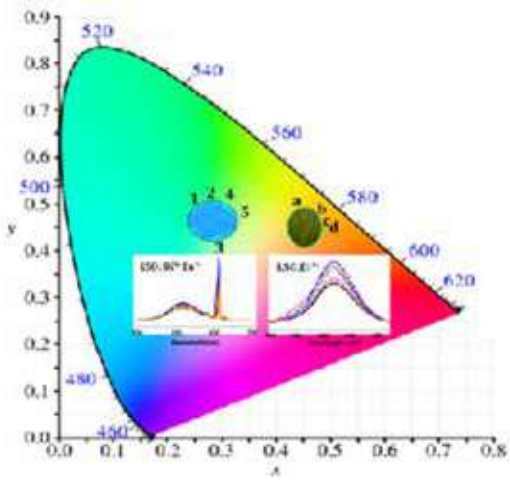
($x \geq 0.6$). On the other hand, the substitution has a distinct effect on the local structure, absorption, luminescence and life times. The smaller Y^{3+}ion substitution conduces the ordering of oxygen vacancy in the lattice inhibiting the defect formation of Ce^{3+} oxidation states. Contrastingly the larger La^{3+}ion substitution liberates oxygen vacancy allowing the defect formation. Consequently, the formation of Ce^{3+} concentration is dependent on the ionic radius of the lanthanides and its concentration has a bearing on the band gap and luminescence properties in the system. The $Ce_{0.1}Y_{0.8}O_2$:0.1Eu^{3+}phosphor exhibited maximum red emission intensity at 612 nm which is 8 times higher than the $Ce_{0.9}O_2$:0.1Eu^{3+} and also better than the commercial red phosphor whereas the La substitution yielded poor emission intensities with higher concentrations. The co-substitution of contrasting lanthanides with Eu^{3+} would allow understanding the local structure and the smaller ion like Y^{3+} greatly functionalize the CeO_2:Eu^{3+} phosphor.



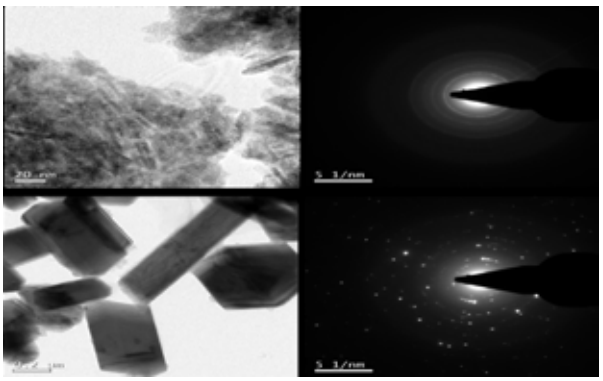
Structural and Photoluminescence Properties of $La_{3-x-y}SbO_7$: xBi^{3+}, yEu^{3+} white phosphor for LED Applications

In this study Bi^{3+} doped yellow phosphor were obtained using La_3SbO_7 host. Here we have carried out structural, optical as well as morphological studies for different concentrations of Bi^{3+}(x=0.025, 0.04, 0.05, 0.06, 0.075) and then by keeping Bi^{3+} concentration constant we have varied the Eu^{3+} concentration(y=0.005, 0.01, 0.02, 0.03, 0.04). Structural studies show that the Bi^{3+} alone doped samples are crystallized into orthorhombic crystal system with Cmcm space group and it is observed that addition of Eu^{3+} does not alter the crystal structure. Photoluminescence studies show that the Bismuth single doped samples give broad, single peaked emission spectra peaked around 517 nm for excitation at 320 nm. But Europium co-doped samples shows broad emission peak around 517nm and characteristics peaks of Eu^{3+} around 616nm due to $^5D_0$ to $^7F_2$ transitions. Luminescence life time measurements evidence the effective energy transfer from Bi^{3+} to Eu^{3+}. CIE color coordinates of the samples shows a variation from (0.29, 0.48) to (0.44, 0.44) with increasing Eu^{3+} concentration. From all these studies, it is demonstrated that the prepared phosphor could be a potential candidate for WLED applications.



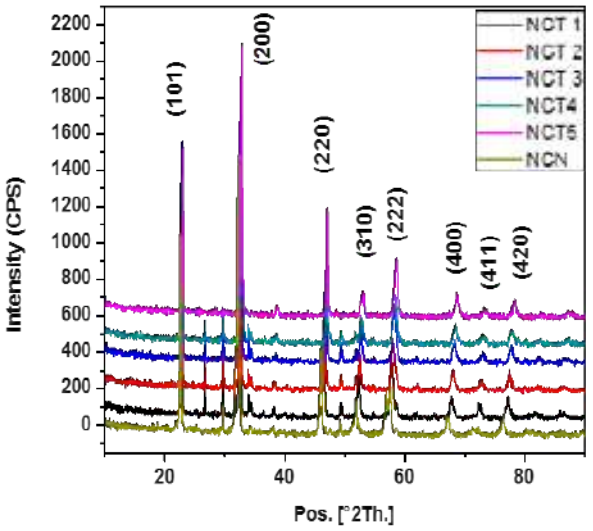


Improvement in Morphology and Luminescence Properties of Xenotime-Type Nanophosphors $NaYP_2O_7:Eu^{3+}$ Synthesized via Solid State and Citrate-Gel Route



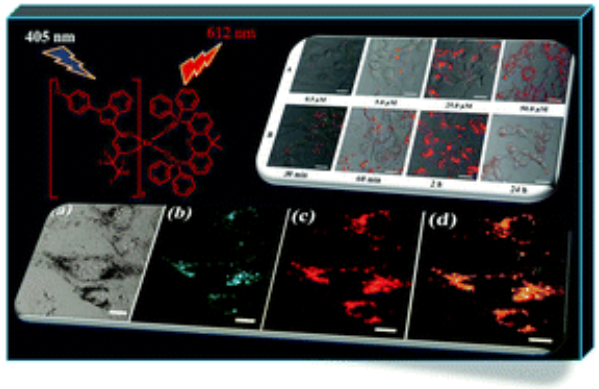
Eu^{3+} activated xenotime type rare earth phosphate $NaYP_2O_7$ have been prepared via solid state (SS) and citrate gel (CG) methods. Evaluation of the textual properties of the materials with XRD and scanning electron microscopy has demonstrated that synthesis pathway can greatly influence the morphology of the materials. Particle morphology of the phosphors prepared by the CG route reveals that they are less agglomerated, more spherical, and homogenous in nature with uniform particle size. Investigations on photoluminescence properties show that these phosphors exhibit intense orange-red emission under 394nm near UV excitation having full width half maximum ~ 2nm. The morphological variation of the developed phosphors with respect to synthesis method and heat treatment played an important role in their luminescence enhancement. The phosphors prepared via CG route were characterized by enhanced and sharper orange-red emission with longer life time compared to that of phosphors synthesized via SS route. The developed narrow red emitting nano-phosphors have better emission intensity in comparison with commercially available $Y_2O_3:Eu^{3+}$ red phosphors. Thus, these phosphors could be a promising red candidate for the phosphor converted white light emitting diode applications.

Investigation on Novel Perovskite Red Phosphors: $Na_{(1.1)}Ca_{(0.8)}Eu_{0.1}SnNbO_6$ prepared by Planetary Ball Milling Methodfor WLED Application



$Na_{(1.1)}Ca_{(0.8)}Eu_{0.1}Sn_{(1-x)}Ti_xO_6$ were synthesized by the planetary ball milling method. The stoichiometric amount of the powder mixture of the reagents was ball milled in a pulveriser with a rotation speed of 250 rpm for 12hrs with acetone as the mixing medium. Ball milling improves the reactivity of the reagents and reduces the reaction temperature, thus the calcination temperature was fixed at 1000 °C. All the samples exhibit higher absorption in UV region, but the intensity of absorption is found to decrease with increase in Ti concentration. The Photoluminescent excitation spectra exhibit strong characteristic f-f transition peak of Eu^{3+} at 393 nm ($^7F_0$-$^5L_6$) and 463 nm ($^7F_0$-$^5D_2$). It is also observed that these phosphors emit strong red light (614 nm) under both near UV (393 nm) and blue (463nm) excitations, which can be attributed to the forced electric dipole transition ($^5D_0$-$^7F_2$)of Eu^{3+}. With the increase in Ti concentration Photoluminescence intensity is found to be increased considerably. These phosphors are found to be suitable for WLED applications.

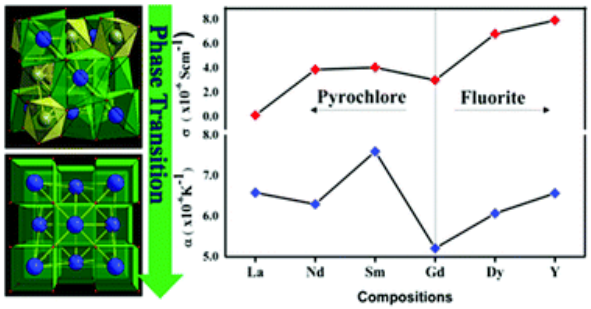
A lysosome targetable luminescent bio-probe based on a europium β-diketonate complex for cellular imaging applications



NIIST has developed a novel lysosome targetable luminescent bioprobe derived from a europium coordination compound, namely $Eu(pfphOCH_3IN)_3(DDXPO)$ **4** [where $HpfphOCH_3IN$ =4,4,5,5,5-pentafluoro-3-hydroxy-1-(1-(4 methoxyphenyl)-1*H*-indol-3-yl)pent-2-en-1-one and DDXPO = 4,5-bis(diphenylphosphino)-9,9-dimethylxanthene oxide]. Notably, the newly designed europium complex exhibits significant quantum yield ($\Phi_{overall}$ = 25 ± 3%) and $^5D_0$ excited state lifetime (τ = 398 ± 3 μs) values under physiological pH (7.2) conditions when excited at 405 nm. Hence the developed europium complex has been evaluated for live cell imaging applications using mouse pre-adipocyte cell lines (3T3L1). Colocalization studies of the designed bio-probe with commercial Lysosome-GFP in 3T3L1 cells demonstrated the specific localization of the probe in the lysosome with a high colocalization coefficient (*A* = 0.83). Most importantly, the developed bioprobe exhibits good cell permeability, photostability and non-cytotoxicity.

OXIDE IONIC CONDUCTORS FOR SOFC APPLICATIONS

Influence of phase transition from order to disorder and Philip's ionicity on the thermal expansion coefficient of pyrochlore type compositions with a multivalent environment



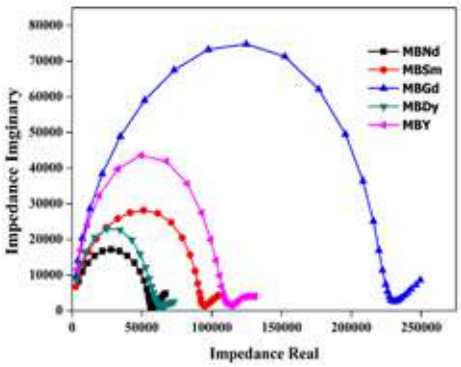
Detailed investigations were conducted on interrelationships among Philip's ionicity, thermal expansion coefficient and ionic conductivity in a new series of pyrochlore type compositions, $RE_2Y_{2/3}Zr_{2/3}Nb_{2/3}O_7$ (RE = La, Nd, Sm, Gd, Dy, Y) using high temperature X-ray diffraction studies, a transmission electron microscope, a Raman spectroscopic technique, electrical conductivity measurements and crystal chemistry principles. The system undergoes structural transition from an ordered pyrochlore structure to a disordered defect fluorite structure in the series with a phase boundary upon Gd substitution. The ionicity difference of M–O bonds follows the thermal expansion trend in the fluorite phase but opposes it in the pyrochlore phase. The ionicity of the A–O bond contributes more to the thermal expansion coefficient in the pyrochlore system unlike in perovskites where it is due to the cumulative effect of the A–O and B–O bonds. On the contrary, the ionic conductivity increases with the decrease in the ionicity difference associated with the charge carrier concentrations. The best conductivity obtained in the series is 7.9356 × 10^{-6} S cm^{-1} for

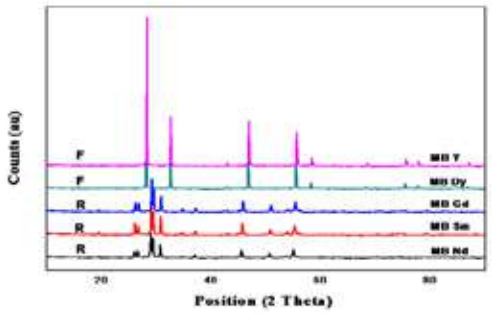
$Y_2(Y_{1/3}Zr_{1/3}Nb_{1/3})_2O_7$ at 1023 K. The minimum thermal expansion coefficient is obtained at the phase boundary for $Gd_2Y_{2/3}Zr_{2/3}Nb_{2/3}O_7$ and the value is 5.2 × 10^{-6} K^{-1}. Furthermore, the anomalous behaviour of Sm and Nd compounds is explained based on the ionicity of M–O bonds. These results demonstrate that the ionicity difference plays a great role in determining the thermal expansion and ionic conductivity of pyrochlore based materials

Structural and Electrical Studies of the Bismuth Oxides Doped with the Simultaneous Aliovalent and Isovalent Substitution ($Mg_{1/3}Bi_{0.5}RE_{1/6}O_{2-\delta}$, M=Nd, Sm, Dy, Gd, Y)

Anion deficient Fluorite structured compositions such as yttria stabilized Zirconia and δ-Bi_2O_3 exhibits the highest known oxygen-ion conductivity. δ-Bi_2O_3 has high ionic conductivity due to its availability of large number of highly mobile oxygen vacancies. The high mobility is attributed to the weak Bi-O bond and the high polarizability of Bi^{3+} with its lone-pair $6s^2$ electrons. However, δ-Bi_2O_3 is stable upto a narrow range of temperature of 723-825°C. It is therefore interesting to stabilize the high conducting δ-Bi_2O_3 to room temperature using *alio*- and *iso* valent substitutions. It has been reported that iso valent rare earth elements such as Y^{3+}, Er^{3+} and Yb^{3+} stabilize the δ-Bi_2O_3 down to room temperature. The substitution of divalent ions such as Ca, Sr, Ba and Pb stabilize the system to β-rhombohedral structure which is having good oxide ion conductivity.

In our work we developed bismuth oxide electrolytes doubly doped with isovalent RE_2O_3 and aliovalent MgO (RE=Nd, Sm, Gd, Dy, Y). However, the effect of total dopant concentration and dopant ratio on structure and conductivity of bismuth oxide based electrolytes was still not fully investigated. In this study, different dopants are selected for maximum conductivity. The $Mg_{1/3}Bi_{0.5}RE_{1/6}O_2$–δ where RE=Nd, Sm, Gd, Dy, Y compositions exhibit a phase transition from rhombohedral to fluorite with decrease in the ionic radius. The compositions are in very well agreement with Vegard□s law. The conductivity of the compositions shows an abrupt change as the structure changes from rhombohedral to fluorite structure. The activation energy increases as the radius of the dopant ion decreases. The lower activation energy and high lattice volume in $Mg_{1/3}Bi_{0.5}Dy_{1/6}O_{2-}\delta$ does favour the ionic conductivity since the minimum dopant concentration to keep the bismuth oxide in fcc structure is high for Dy ions and this may cause a phase transition fluorite to rhombohedral in $Mg_{1/3}Bi_{0.5}RE_{1/6}O_{2-}\delta$ as the temperature increases.

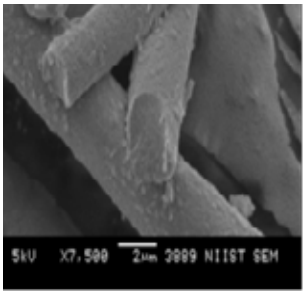


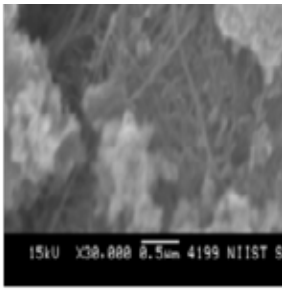


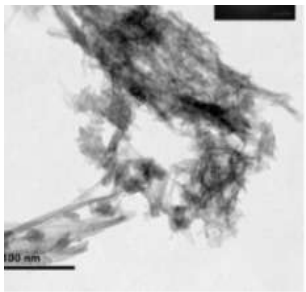
One dimensional $La_{(1-x)}A_xTiO_{3-\delta}$ (A= Ba, Ca, Sr, Li, Mg) nano perovskite for intermediate temperature solid oxide fuel cell applications

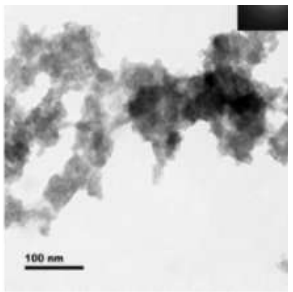
Metal oxides with 1D nanostructure are considered to be promising candidates in applications of energy conversion and storage devices. This is because of their high surface areas, porosities, and fast charge

transport. Such 1D metal oxides can be fabricated by various techniques, including top-down synthesis and bottom-up synthesis. Along with them, solution route is particularly simple, inexpensive technique, which allows fabrication of metal oxides and advanced functional materials on a large scale which can be applied in energy storage devices. NIIST has prepared $LaTiO_{3-\delta}$ by a conventional hydrothermal (CH) method maintained at 100°C for various durationsof 10 h , 20 h. The SEM images of the 10 h and 20 h reacted $LaTiO_{3-\delta}$ are shown in Fig. SEM analysis of as-prepared powders confirmed that one dimensional titanate structure is obtained after 10 hours of hydrothermal reaction, Fig. Morphology of these forms depends on reaction time and in order to investigate it more precisely and try to obtain information on the formation mechanism. The TEM images show the presence of highly ordered nano rods for 10 h and 20 h reacted samples. TEM images reveal the important information that some nanoparticles of about 20-80 nm occasionally attach inside and outside the nanorods, which is similar to those nanoparticles existing at the tip of rod-bundles (Figure). The phenomenon is consistent with Ostwald ripening process, in which larger particles are formed at expense of the smaller particles owing to their high reactivity.









POROUS AND NANO CERAMIC MATERIALS FOR ENERGY AND ENVIORNMENTAL APPLICATIONS

Graphene Oxide Sheathed ZIF-8 Microcrystals: Engineered Precursors of Nitrogen-doped Porous Carbon for Efficient Oxygen Reduction Reaction (ORR) Electrocatalysis

Fuel cells are believed to be the greener solutions for next generation power sources. Among the different types of fuel cells, alkaline fuel cells are widely pursued due to their high electrical efficiency, low operational temperatures, increased durability and the use of a liquid fuel like ammonia. The electrochemical cell reactions are normally catalysed by a noble metal catalyst like platinum due to the high overpotential requirements and the sluggish kinetics of oxygen reduction reaction (ORR).However, high cost and scarcity of platinum have necessitated the quest for alternate catalysts that are affordable and stable under electrochemical conditions. This has led to the emergence of affordable materials like porous carbon, transition metal catalysts etc. for ORR catalysis. The doping of carbon by heteroatoms of N, B, P and S is an effective strategy to promote ORR reactions as it creates catalytically active sites by a modulation of charge and spin densities of carbon near the dopant atoms. N-doping, by virtue of its size similarity with carbon, provides favorable improvements in electron transport properties of the carbon matrix and is therefore a preferred dopant for realising highly efficient electro catalysts for applications in fuel cells. Moreover, the high electro negativity of nitrogen induces increased positive charge density in carbon, creating active sites for electrochemical reduction of O_2. In alkaline fuel cells, the ORR kinetics is relatively faster compared to that of acidic fuel cells and hence N-doped carbon

(NDC) is perceived to be a possible replacement for the precious metal (Pt, Pd) electro catalysts.

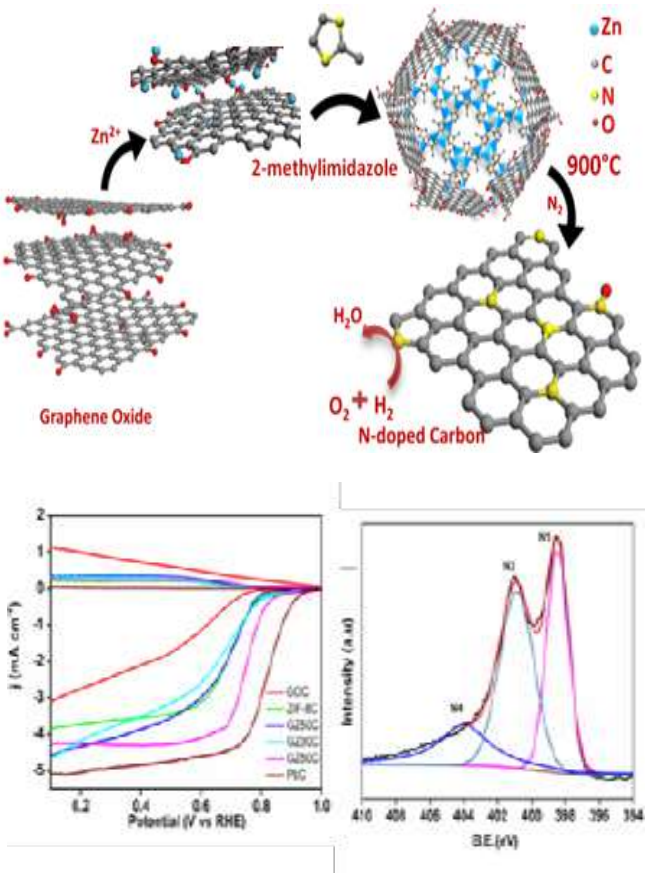


Figure: schematic showing the formation of N-doped Carbon from GO sheathed ZIF 8 crystals. LSV plots depicting the elctrocatalytic behaviour in comparison with Pt/C catalyst and XPS analysis showing N doping

Graphene oxide wrapped ZIF-8 microcrystals could be employed as efficient precursors for N-doped interconnected porous network of carbon with appreciable ORR activity and enhanced cyclic stability. The sheathed precursors developed by a simple one pot room temperature synthesis of ZIF-8 in GO dispersions lead to the formation of porous carbons with significant nitrogen doping as the GO sheets wrapped around ZIF-8 crystals prevented larger loss of nitrogen on carbonisation.

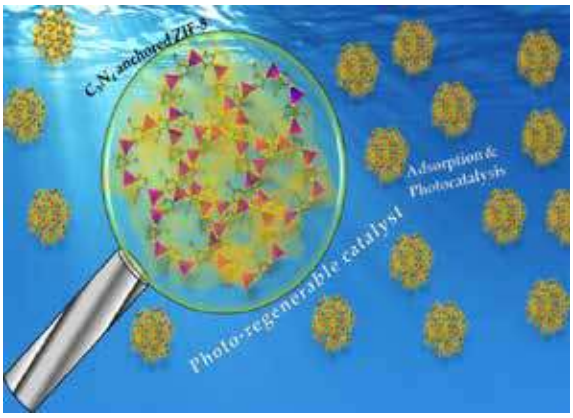
The heteroporous nature of the carbons thus formed was an added advantage of the synthetic methodology that favourably contributed towards oxygen reduction reaction in providing active sites.

ZIF-8 synthesis in the presence of GO sheets helped to realise layers of graphene oxide over ZIF-8 microcrystals and the sphere like structures thus obtained, on heat treatment, transformed to highly porous carbon with a nitrogen content of about 6.12 % and surface area of 502 m^2/g. These catalysts with a typical micro-meso porous architecture exhibited an onset potential of 0.88 V*vs* RHE in a four electron pathway and also demonstrated superior durability in alkaline medium compared to that of the commercial Pt/C catalyst. The N-doped porous carbon derived from GO sheathed ZIF-8 core shell structures could therefore be employed as an efficient electrocatalyst for fuel cell applications.

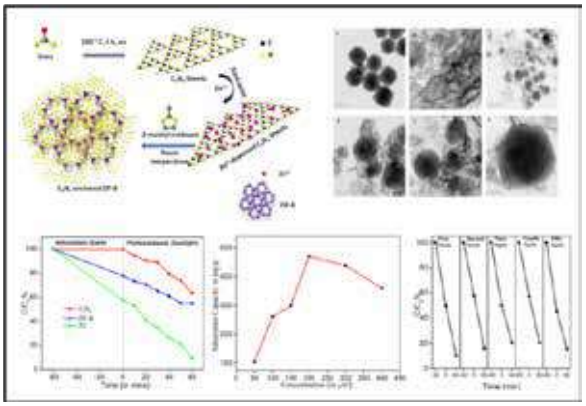
C_3N_4 based adsorptive photocatalysts for the effective removal of aquatic pollutants

Graphitic carbon nitride (g-C_3N_4), a n-type semiconductor, with a medium band gap of about 2.7 eV, is relatively a new entrant in the domain of visible light active photocatalysts. The ease of synthesis from inexpensive precursors, high chemical and thermal stability, and the band gap compatibility with other semiconductors impart diverse applications ranging from photocatalytic water splitting to sensors. Despite such appealing potential, C_3N_4 suffers from the major shortcomings of low visible light utilization, fast recombination of photo-generated excitons and low specific surface area. Various methods are therefore attempted to address these deficiencies and strategies like surface modification, morphological advancements, doping of metal species, composite formation, sensitizing with organic dyes etc are explored currently. Amongst these methods, composite formation and creation of

porous architectures have shown promises through improved photophysical and textural properties.



Adsorptive photocatalysts, combining the dual functions of adsorption and photocatalysis offer great potential for water treatment applications as secondary remediation measures are unwarranted for regeneration of the catalyst during multiple cycles. C_3N_4 suffers from the inherent disadvantage of having low surface area and hence is not a suitable adsorbent. Creation of high surface area porous architectures through granulation is a viable method for imparting adsorption. Thus C_3N_4nanosheets were converted to micron sized granules through a template free aqueous spray drying process employing PVA binder. The incomplete binder burn out during the calcination process facilitated ***in situ*** carbon doping leading to enhanced visible light absorption. The high surface area granules (150 m^2/g) displayed significant adsorption (78%) and faster degradation of tetracycline antibiotic under sunlight irradiation. The photo-regenerable, bi-functional materials herein obtained can thus be employed for the adsorption and subsequent degradation of harmful organic pollutants without any secondary remediation processes. Another strategy to develop adsorptive photocatalyst is the synergistic combination of high surface area materials like MOF with C_3N_4. C_3N_4-ZIF-8 adsorptive photocatalysts are developed by a room temperature reaction of zinc nitrate with 2- methyl imidazole in presence of C_3N_4. C_3N_4nanosheets are anchored on to ZIF-8 microcrystals leading to the formation of highly stable micro-meso porous architecture that displayed high adsorption capacity (420 mg/g) for tetracycline antibiotic. The adsorbed tetracycline was subsequently degraded to greater than 90% of the initial concentration within 60 minutes of sunlight irradiation. The π-π and electrostatic interactions between the aromatic components of TC and the composite combined with appropriate pore configurations of the developed adsorbents yielded high adsorption capacity.

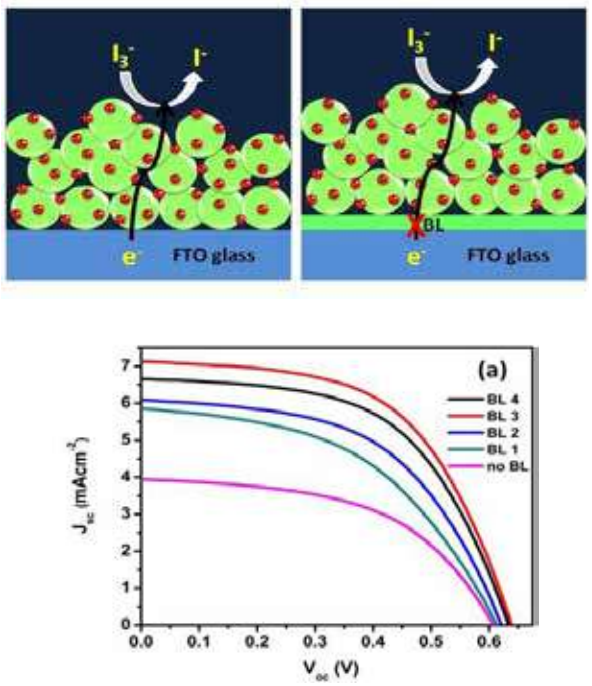


Synthesis, microstructural characterization and pollutant degradation studies of ZIF- C_3N_4

ZnO blocking layers for enhanced photovoltaic performance in ZnO based DSSC:

Dye-sensitized solar cells (DSSCs) are recognized as efficient, renewable and economic photovoltaic devices with potential for mass energy production. Recombination of photo-injected electrons is one of the major limiting parameters in the performance of DSSCs and occurs either through recombination from FTO with the oxidized dye molecules or with the electrolyte at the FTO/electrolyte interface. The widely adopted strategy to tackle this issue is to deposit blocking layers (BLs) over FTO/active layer interface. Studies reveal that incorporation of a blocking

or barrier layer between FTO and mesoporous nanoparticle film can significantly reduce the back electron transfer thereby enhancing the power conversion efficiencies.



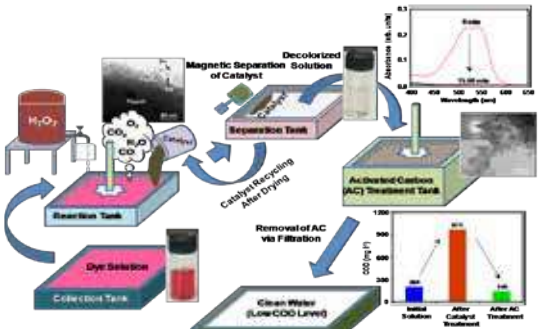
Schematic representation of ZnO blocking layers to prevent back electron recombination leading to enhanced photovoltaic performance and JV curve for the fabricated solar cells with blocking layers (coded as BL1, BL2, BL3 and BL4 representing dispersions of concentrations 1, 2, 5 and 10 mg/ml) in comparison with cells without blocking layers.

NIIST studied the effect of compact ZnO BLs, deposited using a simple low-temperature solution processing technique, on the recombination mechanism of ZnO based dye-sensitized solar cells. The thickness of the blocking layers is adjusted using dispersions of varying concentrations (BL1 to BL4). The performance of all devices fabricated on bare FTO and FTO with ZnO pre-blocking layers is tested under AM 1.5G irradiation (100 mW/cm^2). Fig. shows the photocurrent density-voltage characterization curves (*J–V*) for all the devices. Devices fabricated on bare FTO exhibited short-circuit current density of (J_{SC}) of 3.95 mAcm^{-2}, open-circuit voltage (V_{OC}) of 0.61 V and a fill factor (*FF*) of 0.53 leading to an energy conversion efficiency of 1.27%. There is a systematic improvement in performance of DSSC devices by the application of compact ZnO blocking layers deposited on FTO. DSSC devices with BL3 ZnO layer showed the best performance, with a short-circuit current density (J_{SC}) of 7.13 mA/cm^2, an open-circuit voltage (V_{OC}) of 0.64 V, a fill factor (*FF*) of 0.56, and a consequent efficiency of 2.57% which is more than double the improvement in performance in comparison with the devices without blocking layers. The improved performance with application of blocking layers is mainly attributed to the increase in photocurrent density from 3.95 mAcm^{-2} to 7.13 mAcm^{-2}. The enhancement in current density is mainly attributed to the improvement in charge collection efficiency which is directly influenced by the interfacial recombinations at FTO/electrolyte and ZnO/electrolyte interfaces.

Removal of Basic and Industrial Azo Reactive Dyes from Aqueous Solutions via Fenton-Like Reactions using Catalytic Non-Magnetic Pd-Flyash and Magnetic Pd-Fe_3O_4-Flyash Composite Particles

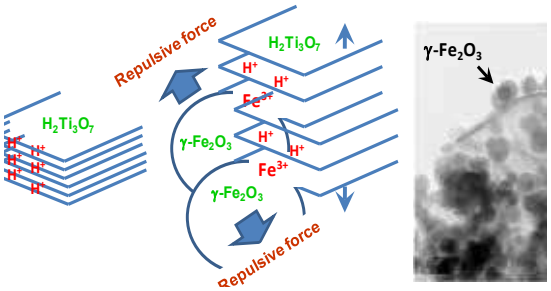
Palladium (Pd)-flyash composite particles have been conventionally used for obtaining copper (Cu) or silver (Ag)-coated flyash particles as fillers for manufacturing the conducting polymers. NIIST could demonstrate that the involvement of Fenton-like reactions (advanced oxidation processes (AOPs)), makes the same composite particles useful as catalyst for the decoloration of aqueous solutions containing organic synthetic-dyes. The magnetic Pd-magnetite (Fe_3O_4)-flyash composite particles have been processed for this purpose, for the first time, using the combination of electroless and inverse co-precipitation techniques. It has been demonstrated that the present catalyst can decompose the basic and industrial azo reactive dyes in the aqueous solutions under the dark-condition via Fenton-

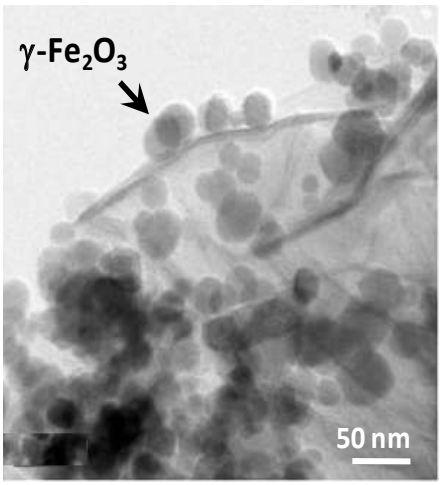
like reactions involving the activation of hydrogen peroxide (H_2O_2) to generate the hydroxyl radicals (OH) which attack and degrade the dye molecules. Pd-Fe3O4-flyash composite particles exhibit effective magnetic separation after the dye-decomposition process which is not possible without the presence of intermediate layer of Fe_3O_4. The chemical oxygen demand (COD) level of decolorized aqueous solution is observed to be increased after the catalyst-treatment of initial dye-solution. Nevertheless, the increased COD level is easily controlled by the post treatment with high surface-area activated carbon (AC) which strongly adsorbs the intermediate products of dye-decomposition and carbon leached out from the surface of flyash particles. Hence, Fenton-like reactions backed up with AC-based adsorption process appear to be effective combination for the fast and efficient removal of organic synthetic-dyes from the aqueous solution (Sep. Purif. Technol. 2017, 172, 338-349)



Ion-Exchange Bonded $H_2Ti_3O_7$ Nano-sheets-Based Magnetic Nanocomposite for Dye Removal via Adsorption and Its Regeneration via Synergistic Activation of Persulfate

The magnetic nanocomposites (HTNSF) consisting of hydrogen titanate ($H_2Ti_3O_7$) nanosheets (HTNS) and maghemite (γ-Fe_2O_3) nanoparticles with varying weight-fraction (5-25 wt%) of latter have been successfully synthesized by simple mechanical mixing of precursors in an aqueous solution having neutral solution-pH. A new model has been proposed to explain the typical attachment of γ-Fe_2O_3 nanoparticles to the edges of HTNS via an ion-exchange bond formation. The dye-adsorption properties of HTNSF magnetic nanocomposites have been investigated using the cationic methylene blue (MB) dye. The new model satisfactorily explains a strong dependence of positive deviation (relative to the variation governed by the law-of-mixture) observed in the variation of dye-adsorption capacity on the similar variation observed in the pore volume of HTNSF magnetic nanocomposite as a function of weight-fraction of γ–Fe_2O_3 nanoparticles. The maximum MB adsorption capacity of 76 mg g^{-1} is exhibited by HTNSF-10 sample which is higher than that (67 mg g^{-1}) of HTNS sample. The MB adsorption on the surface of HTNSF magnetic nanocomposite follows the pseudo-second-order kinetics and Langmuir and Dubinin-Kaganer-Radushkevich (DKR) isotherm models. The variation in the regression correlation coefficient ($<r^2>$) values as a function of initial MB concentration strongly supports the Azizian analysis.



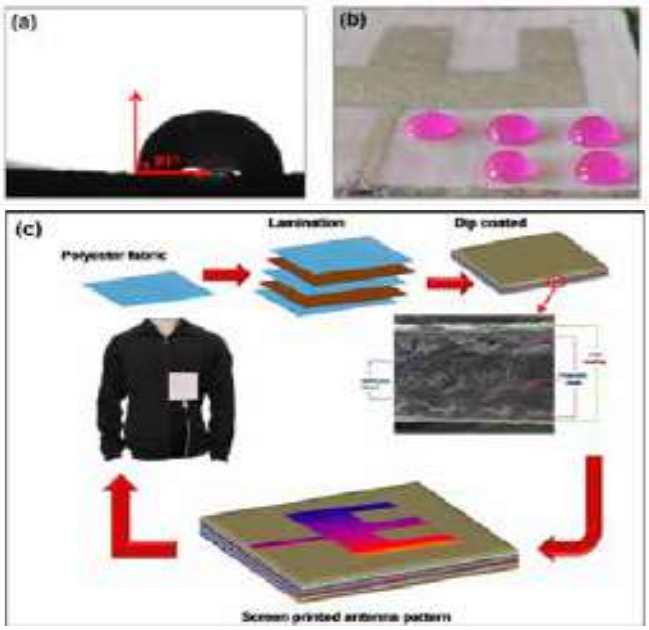


ELECTRO CERAMIC MATERIALS

Screen Printed Textile Antenna on PVB CoatedHydrophobic Polyester Fabric

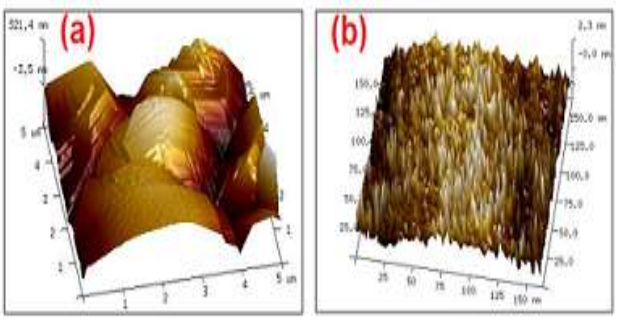
Wearable electronic devices help to improve the quality of our lives through continuous monitoring of the wearer by enabling the wireless communication between wearer and the nearby base station. Wearable antennas are usually made by directly integrating antennas into the textile products like shirts and jackets. In these days, textile antennas get greater attention, particularly in the areas of healthcare, defence, space, rescue operations etc.

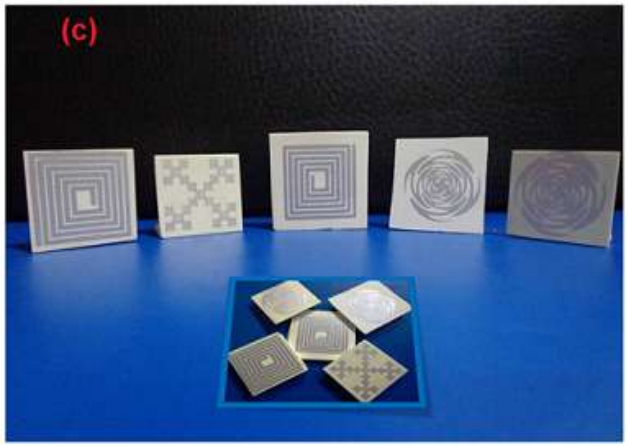
Against this background, an E-shaped microstrip patch antenna was designed and fabricated at NIIST, on polyester fabric for WiMAX applications. In order to examine the phase purity of the commercial polyester, the wide angle XRD analysis was done. The insufficient hydrophobicity and inadequate thickness of a single layer polyester fabric is way inferior for it to act as substrate for antenna applications. Hence three layers of polyester fabrics were hot pressed along with polyacrylate sheets in between them, which acted as an efficient adhesive. The effect of water absorption on the electromagnetic properties of the textile antenna was reduced to a greater extent by providing a coating of PVB using dip coating technique. This surface modification is found to be resulted in significant improvement in their surface smoothness and hydrophobicity. Contact angle measurement of coated polyester fabric showed a hydrophobic nature with a contact angle of 91°. The proposed E-shaped antenna was simulated using Ansys HFSS software. In order to develop a stable operation of textile antenna, the radiative patch and ground plane was screen printed on either side of the substrate using commercial silver ink. The fabricated antenna successfully radiated at 3.37 GHz with a return loss of -21 dB. The measured and simulated results matched well within the experimental error limits. The fabricated textile antenna gives a maximum measured gain of 3.6 dB and it is adequate for practical wearable electronic applications. Since the fabricated antenna is thin, flexible and water resistant, it can be easily integrated into new generation clothings like jackets that can sense and communicate data in a non-intrusive way



(a) Contact angle of surface modified textile substrate and (b) Water droplets sitting over the modified textile substrate (c) Schematic of fabrication process of the textile antenna

Zinc Aluminate-Titania Composite: An Alternative for Alumina as Microelectronic Substrates





3D view of tapping mode AFM images of (a) unpolished and (b) polished ZAT sintered tape after sintering at 1500 °C and (c) Antenna patterns screen printed on sintered ZAT tapes

Alumina (Al_2O_3) is the most widely used substrate because of its low cost, but in fact, its thermal conductivity is only about 24.5 $Wm^{-1}K^{-1}$. Aluminium nitride (AlN), though having high thermal conductivity (TC > 200 $Wm^{-1}K^{-1}$), is rather expensive due to the difficulty in synthesis under special atmospheric conditions. BeO, on the other hand, has good thermal performance (TC >100 $Wm^{-1}K^{-1}$), but is being avoided by many manufacturers due to its toxicity when the powder is inhaled or ingested. Several alkali metal oxide free glass-ceramics have been reported to possess the ultra-low dielectric losses, which can be suggested as an alternative to alumina. However, in order to achieve high thermal conductivity the material must contain at least one alkali-ion containing phase, which aggravates thermal management issues. More importantly, in applications where the thermal stability of the substrates matter, one has to look for alternative materials other than the three popular choices mentioned above, because all of them have higher temperature coefficients of resonant frequencies. Looking from an industrial perspective, temperature cycling reliability and mechanical stability in specific applications such as automotive, avionics and space are the driving force for the development of a new type substrate with promising thermal properties

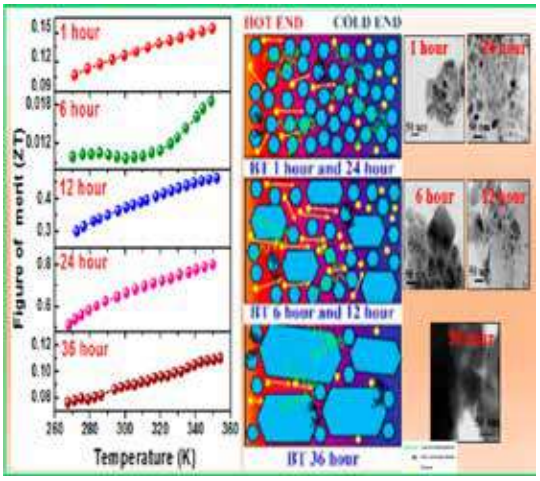
Against this background, low dielectric loss ceramic tapes based on $0.83ZnAl_2O_4$ -$0.17TiO_2$ (ZAT) were developed at NIIST using organic tape casting technique, and their microstructural, thermal, dielectric and mechanical properties were evaluated, in comparison to alumina substrates synthesized through a similar technique. ZAT substrates show an average CTE value of about 6.59 $ppmK^{-1}$,which is compatible with the CTE values of the semiconductor devices embedded in electronic circuits, and possess a relatively high thermal conductivity of 31.3 $Wm^{-1}K^{-1}$ at room temperature. The microwave dielectric properties of this substrate material (ε_r = 9.6 and $\tan\delta$= 8.4×10^{-4} at 5 GHz) are comparable to that of alumina, while $\tau_f$is +3.9 $ppmK^{-1}$, which is close to zero, a feature that cannot be met with any of the alumina-based HTCC substrates. In automotive, avionics and space applications where the thermal stability of dielectric constant of substrates matter, the development of a new type of substrate with promising thermal and dielectric properties can be beneficial.

MAGNETIC MATERIALS

Development of n-type Bi_2Te_3 nanostructures synthesised using low-temperature reflux techniques for thermoelectric applications near room temperature

NIIST has investigated, cost-effective, surfactant assisted, and aqueous-based low-temperature reflux method using de-ionized water as the solvent to synthesize n-type Bi_2Te_3 nanocrystals. Tuning the reflux time from 1 to 36 h enables the phase transformation from BiTe with a hexagonal crystal structure to

Bi_2Te_3 with a rhombohedral crystal structure. The nanocrystals inherited from the optimized reaction conditions and high densification of nanoparticle interfaces contribute to the considerable reduction of thermal conductivity. Highly crystalline, uniformly distributed nano-crystals of Bi_2Te_3 formed for 24 h reaction time demonstrate a promising figure of merit of 0.81 at 350 K. Grain boundaries scattering along with fine and coarse structures could successfully explain the thermoelectric properties of the synthesized Bi_2Te_3. This findings would provide new possibilities in low-temperature synthesis where structural, compositional, and morphological tuning of Bi_2Te_3 nanostructures could promote practical thermoelectric applications near room temperature

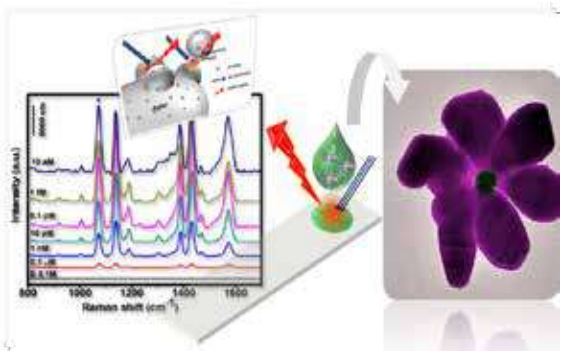


Speciality Polymers and Nanomaterials

NIIST focuses on development of efficient, easy to use, mass-producible sensor platforms using polymer-inorganic micro/nano systems for healthcare, commodities and environmental applications.

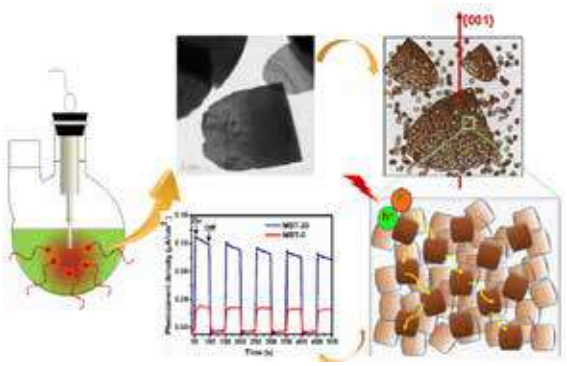
Chemical sensors from Banana plant waste

We have developed a synthetic approach that involves the use of eco-friendly, bio-degradable nano-cellulose fibers extracted from Banana plant waste for the preparation of aqueous silver colloid with excellent colloidal stability and longer self-life. Here nanocellulose fiber derived from Banana plant waste acted as both reducing and capping agents that controls the anisotropic growth of silver particles. These silver colloids were used as Surface Enhanced Raman Scattering (SERS) substrate for the rapid, label-free and ultra-sensitive detection of harmful chemicals in less than parts-per-million (ppm) levels. The bio-supported synthesis of stable aqueous silver colloids may find potential applications as a sensing platform for the trace level detection of harmful chemicals like pesticides, food adulterants, early diagnosis of cancer, etc



Nanocellulose-directed stable aqueous colloid of plasmonic flower-like silver nanoconstruct for ultra-trace detection of analytes

Low temperature synthesis of high energy facets exposed sheet–like anatase TiO_2



Low temperature, fluorine-free synthesis of anatase TiO_2 with sheet-like morphology is having exposed {001} facet that resulted in enhanced photocatalytic and biocidal activities.

A facile low temperature microwave-assisted sonochemical method was demonstrated for the synthesis of anatase TiO_2 with exposed {001} facets and sheet-like morphologies. Our synthetic route facilitated rapid, low temperature crystallization of anatase TiO_2 with good crystallinity, higher surface area ($155 m^2 g^{-1}$) and excellent stability for sol prepared. Electron diffraction studies revealed the mechanism of formation of sheet-like crystals by oriented aggregation of the nanocrystals and were found to be {001} facets exposed structures. Hence, this environmentally friendly synthetic approach provides anatase formation with high energy facets, crystallinity and reduced e-/h+ pair recombination rates and thus resulted in enhanced photocatalytic activity with degradation of ~95% under indoor light within an hour. In addition, the as-synthesized TiO_2 also exhibited better antimicrobial activity against common microbes such as E. coli and C. albicans. The results point to a promising environmentally benign route for the low temperature synthesis of wide spectrum active titania sol-gel coatings with increased activity.

MINERALS

Investigations on the recovery of high value iron from copper slag waste

In continuation of the ongoing programme on minerals reported last year in annual report, efforts were made to recover iron as the high value metallic iron from metallised slag. During the period, about 1 kilogram of metallised copper slag with >85% metallisation was subjected to plasma melting at different plasma power input and melting durations. Metallic iron from the slag was separated by magnetic separation and subjected to a detailed characterisation in terms of purity, recovery and metallisation. The results of preliminary plasma melting showed that a metallic iron of more than 98% metallisation has been resulted from the metallised slag with metal recovery of about 98% at plasma melting conditions of 15KW power input for a duration of 5 minutes. Further optimisation of plasma melting conditions and the physical characterization of metallic iron in terms of trace impurities, metallographic features are in progress.

Pilot plant scale trials on upgradation of low grade ilmenite for VV Minerals

Based on the encouraging results of earlier laboratory scale and higher scale of studies on metallisation and rusting of 2 low grades of ilmenite, VV Mineral came forward to set up a pilot plant facility to process about 700 metric tonnes (350 tonnes each) of 2 grades of ilmenites (45% TiO_2 and 55% TiO_2). It was also planned to hire a commercial sponge iron rotary kiln of suitable capacity for the metallisation of ilmenite and set up a pilot plant at the premises of M/s. VV Titanium Limited, Tuticorin for further chemical processing such as rusting and leaching of metallised ilmenite. An agreement between CSIR-NIIST and VV Mineral was signed on July 07, 2016 to this effect.

During the period under report, services were rendered to VV Mineral in identifying commercial sponge iron rotary kiln facility for ilmenite metallisation. In view of the ease of logistics and also the capacity of rotary kiln, M/s Popuri Steels with two 50 tonnes per day capacity commercial rotary kiln was selected for the metallisation campaign. Discussions were also held prior to the actual campaign regarding selection of reduction parameters, modification of rotary kiln parameters suitable for ilmenite in view of its lower iron content and smaller particle size compared to iron ore feed.

CSIR-NIIST actively participated in the metallisation campaign held at M/s Popuri Steels Limited, Bellary, Karnataka which lasted 10 days. During the campaign, NIIST associated with the monitoring of the reduction parameters, rotary kiln temperature regime, product quality in terms of metallisation and the separation of kiln discharge. During the campaign, about 350 metric

tonnes of 45% TiO_2 containing TVP ilmenite and 330 metric tonnes of HT grade (55% TiO_2) ilmenite was processed. Both the rotary kilns of 50 Tonnes per day capacity were used simultaneously. About 450 metric tonnes of metallised ilmenite of both the grades with metallisation in the range 83-88% was produced.

View of 50 TPD capacity commercial DRI Rotary kiln used for metallisation of ilmenite

Rusting of metallised ilmenite and its subsequent leaching in the pilot plant

Aeration Rusting

A stirred tank reactor of 14 M^3 capacity to handle 5 tonnes of metallised ilmenite /batch with a pitched blade agitator was designed for the pilot plant and got fabricated and commissioned at M/s. VV Titanium Ltd., Tuticorin, Tamil Nadu. The material of construction of the tank was rubber lined MS. The reactor had also provision for steam purging for raising the temperature during rusting.

Initial rusting experiments were carried out at 2 metric tonnes per batch and the solid to liquid ratio was maintained at 1:2.5 (w/v). Freshly prepared ferrous chloride was used as the catalyst. After the solution containing the required quantity of catalyst is heated to about 60 °C, the metallised ilmenite was added with air being purged at the bottom and agitator running at 100 rpm. The initial pH of the solution was adjusted to around 4 by adding the required quantity of HCl. The reaction was allowed to continue for 10-12 hours after which the slurry from the reactor was pumped out into a holding tank for dilution and separation of beneficiated ilmenite from iron oxide slurry.

Photograph of rusting reactor

A stirred tank reactor with a capacity of2 tonnes/ batch was designed, fabricated and commissioned at the pilot plant for carrying out acid leaching of rusted ilmenite. The reactor was lined with FRP and was provided with steam injection facility for heating. The agitator is again 4-bladed pitched blade design.

The reactor was loaded with rusted product slurry from the holding tank. After assessing the solution level in the reactor, the quantity of HCl to be added is calculated in order to make the final acid concentration of 20% for leaching. The contents in the reactor was heated to about 90-95 ° C by purging steam and the reaction was allowed to continue for 8

hours. When the contents in the reactor is sufficiently cooled, it was diluted and pumped into a holding tank for washings and separation. During the period under report, about 250 metric tonnes of metallised product has been processed in the pilot plant. While the rusting of metallised ilmenite resulted in beneficiated ilmenite product containing 84- 86% TiO_2, subsequent leaching of the beneficiated ilmenite in HCl yielded synthetic rutile with more than 91-92% TiO_2.

Photograph of 2 tonnes/ batch leaching reactor

Production of Sm-Co alloy Powders

Sm-Co alloy powders were prepared by the reduction -diffusion process. reduction parameters such as soaking temperature, time and excess calcium in the charge were optimised for optimum yield of the alloy powder.A reduction temperature is 1100^0-1200^0C soaking period is 2-4 hrs and excess of calcium/calcium hydride 40% (stoichiometric over) was found satisfactory for the optimum yield of Sm-Co alloy powder. The reduced alloy powders were separated from the slag by leaching with ammonium chloride solution. Leaching parameters such as ammonium chloride concentration, duration of leaching was optimsed for better alloy yield and avoid dissolution of alloy powder. The alloy powders after washing with acetone and drying, were characterised by XRD. SEM and EDAX to evaluate the impurity levels, alloy composition etc.

Utilisation of Iron Oxide from Titanium Mineral industries

Preparation of high purity iron oxide from waste iron oxide by solvent extraction

During the period efforts were made to prepare high purity iron oxide from iron oxide waste byproduct received from KMML, Kollam, Kerala by solvent extraction. A stock solution of KMML waste iron oxide was prepared by dissolving 1000 mg of sample in 4 M HCl and the solution was made upto 1 litre. The solution contained 833.70 mg/L of iron (III), 68.88 mg/L of Ti (IV) and 107.42 mg/L of other metal ions.

The solution was then subjected to solvent extraction in 2 stages. In the first stage, only tributyl phosphate (TBP) was used as the solvent during which, only iron and titanium from the solution were loaded into the organic phase. The concentration of TBP in kerosene was varied from 0.5 to 3 M and the extraction efficiency of the organic phase with respect to iron and titanium were measured by the estimation of these metal irons both in aqueous and organic phase. It was observed that 99.79% of iron from the solution was extracted into the organic phase with 3M TBP solution. However, the extraction efficiency found decreased with the decrease of TBP concentration. Only 95.5% of iron was extracted from the solution when the concentration of TBP was reduced to 0.5M.

Subsequently, the loaded iron and titanium ions in the organic phase were stripped using hydrochloric

acid solution. Here again, the concentration of hydrochloric acid was optimised to enable maximum stripping of iron from the organic phase. It was observed that the percentage removal of iron from the organic phase found increasing initially from 97.8 to 99.8 when the concentration of the HCl was increased from 0.2 to 0.4 M. and decreased thereafter. Hence 0.4M HCl was found to be more effective in the selective stripping of iron from the organic phase. The strip solution was subsequently treated with 3M ammoniacal solution for the precipitation of iron at pH of 3.5-4.0.

Titanium metal ions extracted into the organic phase during hydrochloric acid stripping were subsequently removed using 6M HCl into the aqueous solution. High purity iron oxide with a purity of 99.155% was prepared by the above technique and the same was subjected to physical and chemical characterisation.

Development of Beneficiation flowsheet for the preparation of pharmaceutical and cosmetic grade clays from selected Indian clays

Major steps involved in the beneficiation of clays include, enrichment of the <2 micron fraction in the clay and removal of the Impurity mineral phases in the <2 micron fraction in the clay to enhance its critical parameters.

Enrichment of the desired size fraction (in this case <2 micron fraction) in the clay was achieved by the size reduction of raw clays namely, TPC (Thonnakal Pink Clay), TYC (Thonnakal yellow clay) and BHC ((Bhuj Clay) followed by blending , blunging and screening of the clay slurry in a 300 micron BSS test sieve. The <300 micron fraction slurry was then used for enrichment of finer fraction using a set of cyclones comprising of 2 inch stub cyclone, 2 inch Standard cyclone and 1 inch cyclone.

Removal of impurity mineral phases in -2 micron fraction of the clay was carried out using different beneficiation techniques selection of which was based on the nature and type of impurity mineral phases identified in the respective clay samples. Wet High Intensity Magnetic Separator (WHIMS) was employed for the removal of titanium and iron content and thereby increasing the brightness of the non magnetic fraction of clay samples. The separation involved conditioning of the feed slurry followed by its magnetic filtration using WHIMS.

Feed Clay, non magnetic and magnetic fractions after magnetic separation in WHIMS

The final cleaning up of the product sample was carried out at acidic pH (2.8 – 3.0), wherein the iron in the ferric form will be reduced using sodium dithionite to water soluble ferrous form and it will be subsequently complexed with tri-sodium phosphate to avoid back reaction. The slurry was then filtered and water washed to get rid of the complexed ferrous iron from the sample. Beneficiated clay samples prepared as above were analysed for major impurities, trace elements, heavy elements, particle size distribution and brightness. The results were compared with the values of USP grade pharmaceutical clays. It was

observed that, all the parameters of beneficiated clays are well within the range of pharma grade clays conforming to USP grade.

METALLIC MATERIALS

High Strength Aluminum Alloy Product Developments for Next Generation Automotive Applications

Reducing emission, improving fuel economy and earning carbon credits has been the compelling needs for the auto industries to seek innovative approaches in design and selection of materials of very high performance. In order to achieve weight savings in vehicles, the automobile original equipment manufacturers (OEM) and component suppliers are increasingly using ultra-high-strength steel, aluminium, magnesium, plastics and composites. In the present context, development of new alloys, efficient casting methods and heat treatment techniques, which improve the material properties and functional requirements, offer the potential for growth that could significantly expand the usage of aluminum alloys in the whole range of automotive vehicles from lighter to heavy vehicles.

NIIST endeavours to replace heavier components such as gear box casings, fly wheel housings, load bearing components such as suspension control arms and high temperature components such as piston by using Al-Si alloys, strengthened by alloying elements such as Cu, Mg, Ni etc.This high strength Al-Si-Cu/(Mg, Ni) alloy with improved properties. This can be achieved by minor addition of alloying elements and transition elements to the existing Al-Si-Cu alloys and processing it by gravity casing or squeeze casting techniques followed by heat treatments.

Manufacture of Prototype piston component

For the manufacture of Al-Si alloy piston for the strategic applications, dies have been designed, fabricated and assembled in the squeeze casting machine (indigenously developed) and tested for its operations in collaboration with GVJ Engineering, Coimbatore. The Al-Si alloy was melted and processed in the industrial scale by following the process steps of the melt treatments (such as alloy additions, degassing, modification and grain refinement etc.) developed for the lab scale process. Alloy billets (100x100x120 mm) and Piston components were cast and heat-treated for the T6-condition by following the same heat treatment schedule adopted for the billets developed in the lab scale process.

The mechanical properties and other properties such as fatigue, wear and corrosion characteristics were evaluated. The typical Mechanical Properties of the Piston component developed is

Alloy	Condition	UTS (MPa)	Elongation (%)	Hardness (BHN)
NIIST Alloy Squeeze cast (T6-condition)	Room temp	340-370	1-2	110-120

Development of Hub Component Sandhar Industries, New Delhi

For developing lightweight automotive hub component for automotives (in collaboration with Sandhar Industries Limited (STL), New Delhi), techniques to make thin sections upto 0.50 mm were developed by Squeeze casting process. The following property targets were achieved.

For the Gravity Cast Alloy: UTS 280-340MPa., 2-3% elongation, Hardness, 80-100 BHN. For the Squeeze Cast Alloy: UTS 450-460MPa., 3-5% elongation, Hardness, 100-115 BHN.

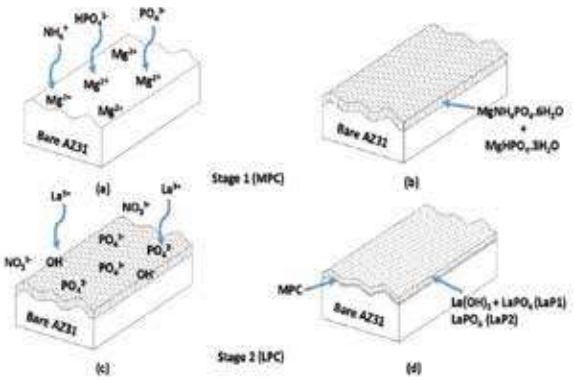
Using the drawing and geometry inputs provided by STL, the design for single cavity die for the manufacture of the component (with reduced weight and thickness) is made and analysed for its manufacturability in the industrial scale. The target for manufacturing the component by reducing its weight /thickness by more than 30%. The process optimisation is under progress.

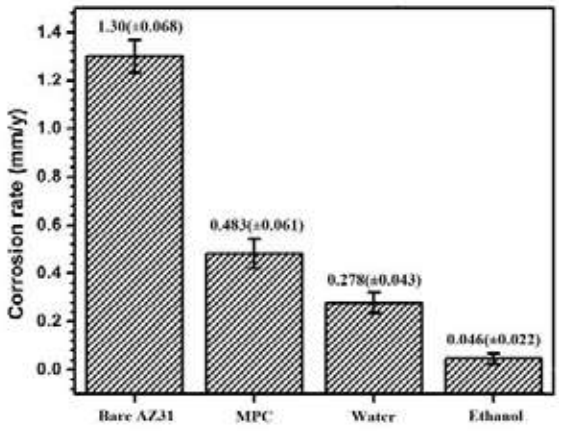
Recycling of Aluminium

With the aim of developing technology of Aluminium Recycling, a project on "Technology development of recycling of aluminium alloys (scraps) for industrial applications" has been initiated in collaboration with industries. Aluminium casting industries at Coimbatore have been tied up for using their industrial facilities for scrap recycling and product development. Initially, industrial scraps from known sources are used for recycling. After optimising the process, scraps of unknown compositions will be melted and processed. Similarly, compacts to be made using Al-powder will be used for making the melts of specific compositions of industrial importance and compared with the castings of ingot melting.

Lanthanum phosphate coating on magnesium alloys for corrosion resistance in aqueous NaCl solution

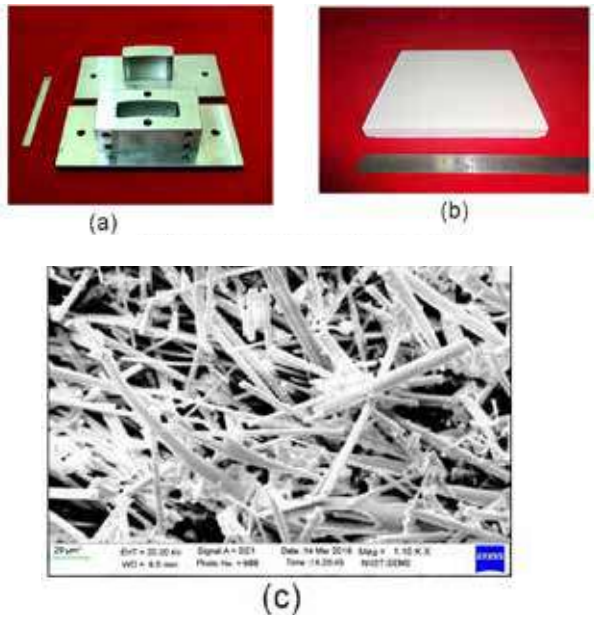
A novel lanthanum phosphate ($LaPO_4$) based coating on magnesium AZ31 alloy was developed through chemical conversion coating method for better corrosion resistance. A two stage coating method was proposed for effective deposition of $LaPO_4$ on Mg substrates: initially a magnesium based phosphate layer was formed in ammonium biphosphate bath, and a subsequent immersion of the sample in lanthanum nitrate solution converted the pre-coated layer of magnesium phosphate into $LaPO_4$. The effect of two different solvents for lanthanum nitrate bath, water and ethanol, on the formation of coating was studied. The results indicated that the conversion of MgPO4 layer into LaPO4 was effectively done in the bath prepared using ethanol whereas presence of OH- ions in the water based bath led to the formation of more $La(OH)_3$ rather than $LaPO_4$ in the coating. The corrosion performance of the coated samples evaluated using electrochemical and immersion tests in 3.5 wt.% NaCl solution showed a higher corrosion performance with the sample coated in the nitrate bath prepared using ethanol due to the formation of more $LaPO_4$. Presence of more $La(OH)_3$ rather than $LaPO_4$ on the coating prepared using water as solvent reduced the corrosion performance but still showed significantly better corrosion resistance than the bare as well as precoated $MgPO_4$ samples.



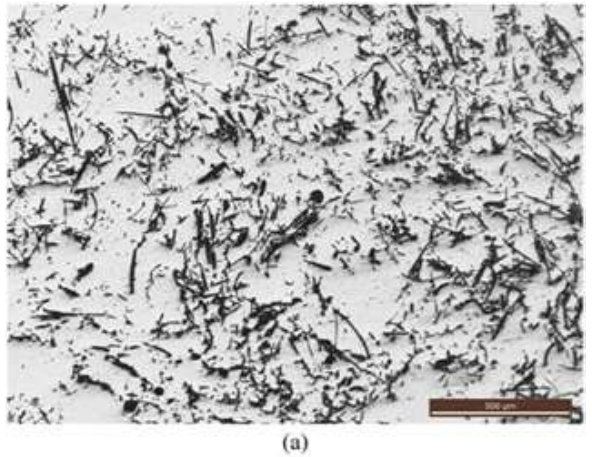


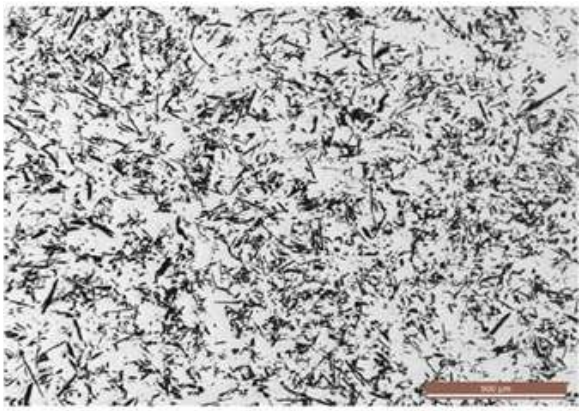
Structure and Properties of Squeeze Infiltrated Zirconia Grade-Aluminosilicate Short Fiber Reinforced Aluminum Composites:

Squeeze infiltration process is successfully adopted to develop Al6061 metal matrix composite reinforced with zirconia grade aluminosilicate fiber using 15 and 20 vol% preforms. Composites microstructure depicts uniform distribution of fiber throughout the matrix with the elimination of preform breakage, porosities, and shrinkage. TEM observation shows the formation of Al_2O_3 at the interface, which controls the chemical interaction between the matrix and the fiber. Infiltrated composite shows enhanced wear resistance behavior compared to that of base alloy, and it improves with the increase in volume fraction of the reinforcement. However, sliding speed overcomes the volume fraction concept in improving the wear resistance of the composite by the quick formation of mechanically mixed layer (MML) at increased sliding speed. The tensile and impact strength of the base alloy is slightly higher than that of the composite due to its ductile nature. Incorporation of fiber in the matrix improves the CTE, hardness, compression and corrosion properties of the composite.



(a) Die used for squeeze infiltration process (b) Macrograph of the zirconia grade aluminosilicate fiber preform (c) SEM image of zirconia grade aluminosilicate fiber used in the perform





The optical microstructure of Al6061-aluminosilicate composite reinforced with

(a) 15 vol% of fiber (b) 20 vol% of fiber by squeeze infiltration process.

Design and Fabrication of Functionally Graded Bimetallic Aluminum Alloy by Sequential Casting Technique

Functionally Graded Materials (FGM) provides variation in properties and better functional performance within a component induced by micro-structural and compositional changes. Sequential casting is a facile and fairly new technique to produce functionally graded materials and components by controlled mould filling process. In the present investigation functionally graded bimetallics of aluminum alloys are prepared by sequential gravity casting using A390-A319 alloy and A390-A6061 alloy combinations. The effect of temperature of the two melts and the time gap between pouring of the melts on microstructure and properties of the bimetals are investigated. The microstructures show good interface bonding between the two different alloys. The hardness test shows higher hardness at A390 hypereutectic alloy region. The tensile and compression test shows higher strength compared to standard values of base alloys and good interface bonding between the sequential cast alloys. The process described in this study is a facile, potential and effective approach to create good bonding between two different aluminum alloys to develop advanced functional and structural materials which can be used in various automobile components to reduce the overall weight of the vehicle, by which better fuel efficiency and performance can be achieved.

A maximum hardness of 160 BHN is obtained in both sequential gravity cast alloys at A390 region and a minimum hardness of 105 BHN and 91 BHN are obtained in A390-A319 and A390-A6061 systems respectively in the heat treated samples. The microstructure and OES results are in very good agreement with the magnitude of hardness. A390-A319 system has a tensile strength of 337 MPa and compressive strength of 490 MPa and for A390-A6061 shows 364 and 401 MPa respectively. The tensile and compression test proved that the interface have very good bonding between the metals. The region of A390 aluminum in A390-A319 and A390-A6061 sequential gravity cast system shows better wear resistance properties than A319 and A6061 regions. Both abrasive and adhesive type of mechanisms were observed in both the sequential cast systems.

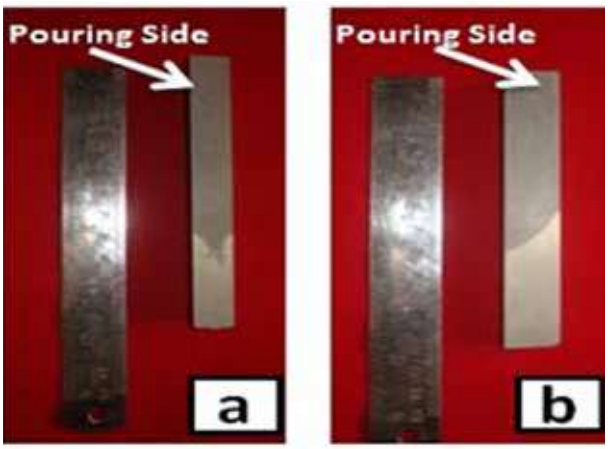
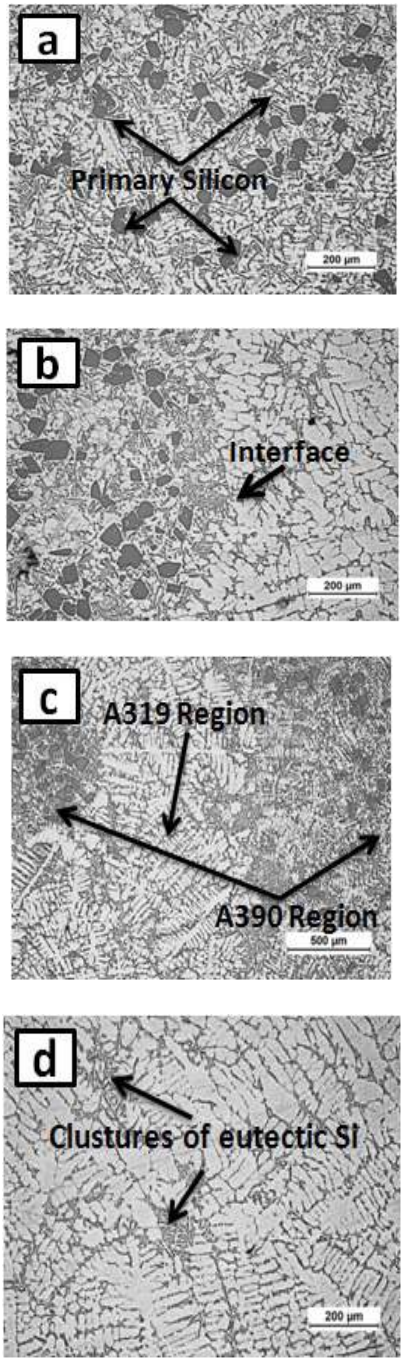


Photo macrograph showing interface of Sequential gravity cast A390-A319 aluminium alloy (a) Conical interface at the centre of casting and (b) straight Interface towards the mould wall



Optical micrographs of Sequential Gravity Cast A390-A319 aluminium alloy, taken from A390 portion to A319 portion at different locations (a,b,d at 10x and c at 5x magnification)

Utilisation of Electron Microscopy and Micro Chemical Analysis Facility

With the help of scanning electron microscopy (SEM), material characterization and morphological study were done for different divisions of NIIST-Thiruvananthapuram and other institutions. More than 2920 samples were investigated. Major users of SEM in NIIST are Chemical Science Division, Materials Science and Technology Division, Biotechnology and Process Engineering. An amount of Rs. 7,26,872/- (Internal and External) has been earned. Different types of materials such as aluminum alloys, various types of ceramics, superconductive materials, Polyanilinenanomaterials, clays and biological samples were handled. Samples from outside parties like academic Institution and University were also done, detailed list as follows.

a) V. S. S. C. Thiruvananthapuram
b) RGCB Thiruvananthapuram
c) IIST, Thiruvananthapuram
d) JNTBGRI Thiruvananthapuram
e) S. N. College Kollam
f) S. N. College Kannur
g) MarThoma College, Ayur
h) St. Mary's College

Liquid Nitrogen Plant

A 10 l/h capacity liquid nitrogen plant is being well maintained. LN2 requirements for the up keep of the sophisticated instruments like NMR, TEM, SEM, EDS were met in addition to superconductivity research as well as other R&D requirements of NIIST. Last year 10,640 liters of LN2 was produced and supplied to the various sections. The plant is maintained for the smooth functioning continuously.

Powder X-Ray Diffractometer

PANalyticalX'pert Pro X-Ray diffractometer is maintained in this division. Necessary expertise in the analysis and interpretation of the powder diffraction pattern was built up in the department and the facility is also extended to all the R&D activities of the institute. A large number of samples (2439 numbers) have been studied for their structural characterization and an amount of Rs. 2,87,890/- has been earned.

पर्यावरण प्रौद्योगिकी प्रभाग

पर्यावरण प्रदूषण नियंत्रण के लिए अभिनव प्रक्रियाओं के डिजाइन और क्षेत्र के प्राकृतिक संसाधनों की मूल्यवृद्धि के माध्यम से पर्यावरण प्रौद्योगिकी प्रभाग (ई.टी.डी.) स्वदेशी प्रौद्योगिकियों के विकास का एक केंद्र बन गया है। ई.टी.डी. की पर्यावरण प्रबंधन सेवाओं का सांविधिक पर्यावरण प्रभाव मूल्यांकन अध्ययन और खनन, बुनियादी ढांचे और प्रक्रिया उद्योगों में नई परियोजनाओं की मंजूरी के लिए स्थानीय उद्योगों और सरकार द्वारा उपयोग किया जाता है। एन.आई.आई.एस.टी. केरल का एन.ए.बी.ई.टी-श्रेणी-ए मान्यता प्राप्त सलाहकार संगठन है जिसे खनन और बंदरगाहों तथा हार्बर क्षेत्रों में मान्यता है। इस प्रभाग के अंतर्गत एन.आई.आई.एस.टी. का कम्प्यूटेशनल मॉडलिंग समूह भी शामिल है।

हम विज्ञान से इंजीनियरिंग और प्रौद्योगिकी के लिए संपूर्ण मूल्य श्रृंखला में योगदान करते हैं। जबकि पेटेंट और एस.सी.आई. प्रकाशन आर.एंड.डी. प्रयासों का परिणाम हैं, प्रभाग ने एक ऐसी रणनीति अपनायी है, जहां सफल परिणामों में से अधिकांश को प्रौद्योगिकी पाइपलाइन में अवशोषण करता है।

प्रभाग की प्रौद्योगिकी उपलब्धियों में काली या हरी मिर्च से सफेद मिर्च के उत्पादन के लिए प्रक्रिया, पर्यावरण अनुकूल कॉयर रेटिंग, बहि: स्राव उपचार, ठोस अपशिष्ट प्रबंधन, गंध नियंत्रण के लिए जैव-फिल्टर, बायोगैस संयंत्र, खाद्य अवशिष्ट डाइजेस्टर्स, रसोई कचरे कम्बोस्टर, फाइबर कंपोजिट से लकड़ी का विकल्प जैसे टेक-उत्पादों और कम्प्यूटेशनल मॉडलिंग टीम से, एम.एस.एम.ई. धातु कास्टिंग फाउंड्री उद्योग के लिए एक सस्ती सिमुलेशन सॉफ्टवेयर आदि शामिल हैं। पर्यावरण प्रौद्योगिकी प्रभाग **"स्वच्छ भारत मिशन"** की पृष्ठभूमि में बेहतर भविष्य के लिए एक स्थायी वातावरण बनाने के लिए और भारत सरकार की **"मेक इन इंडिया"** पहल को क्रियान्वित करने के लिए प्रयासरत है।

मुख्य विशेषताएं

- केरल मछुआरा फेडरेशन सहकारी लिमिटेड (मत्स्यफेड) के लिए मछली स्टालों/फिशमील संयंत्रों में जैव फिल्टर गंध नियंत्रण प्रणाली और बहि: स्राव उपचार संयंत्र
- मेसर्स नीट्टा जिलेटिन इंडिया लिमिटेड में कुचल अस्थि चार्जिंग स्टेशन उत्सर्जन के लिए एक गैस बायोफिल्टर को प्रवर्तन में लाया
- एन.आई.आई.एस.टी. लाइसेंसधारक (गैलेक्सी एंवायर प्राइवेट लिमिटेड) द्वारा दो चावल मिलों और एक आइस क्रीम कारखाने में बी.एफ.बी.आर. अवायवीय उपचार प्रौद्योगिकी पर आधारित बहि: स्राव उपचार संयंत्रों को स्थापित किया गया है।
- निम्नलिखित तकनीकी सलाहकार सेवाएं प्रदान की गईं: शबरिमला सन्निधानम 5 एम.एल.डी. सीवेज ट्रीटमेंट संयंत्र (एस.टी.पी.) निरीक्षण और समस्या निवारण
- बी.बी.एम.पी. (बेंगलूरू नगर निगम) में बोयोफिल्टर और निकास वेंटिलेशन वाला बायोफिल्टर गंध नियंत्रण प्रणाली संपूर्ण की गयी, के.सी.डी.सी., कुड्लू में 500 टी.पी.डी. एकीकृत ठोस अपशिष्ट प्रबंधन संयंत्र।
- बायो ड्राइंग द्वारा नगरपालिका ठोस अपशिष्ट उपचार
- पेरक्लोरट उपचार के लिए एक जैवप्रक्रिया का प्रारंभिक स्केल इकाई:
- खाद्य उपशिष्ट डाइजेस्टर सह-बायो गैस संयंत्र की फील्ड इंस्टॉलेशन
- लक्षद्वीप के द्वीप पारिस्थितिकी तंत्र में जलवायु परिवर्तन प्रभावों का जोखिम मूल्यांकन
- कोल्लम में समुद्र तट रेत खानिजों के खनन के लिए खनन पट्टा के नवीकरण के लिए पर्यावरणीय प्रभाव आकलन
- डाइऑक्सीन अनुसंधान

कम्प्यूटेशनल मॉडलिंग

- स्मार्ट फाउंड्री 2020 – धातु कास्टिंग उद्योग के लिए स्मार्ट विनिर्माण
- प्रक्रिया उद्योग में कम्प्यूटेशनल द्रव गतिशीलता अनुप्रयोगों
- ऑटोकस्ट एक्स 1 फ्लो + सॉफ्टवेयर का तकनीकी उन्नयन और 3 डी फाउंडरी टेक प्राइवेट लिमिटेड, मुंबई से तकनीकी सहायता और रॉयल्टी के लिए नया समझौता ज्ञापन।
- जैव-तेल के उत्पादन के लिए माइक्रोएल्गे का जल द्रव्यमान द्रवीकरण
- वेक्टर से पैदा होने वाली बीमारी (डेंगू) के प्रसार को अनुकरण करने के लिए जी.आई.एस. से जुड़े स्थानिक मॉडल
- सिस्टम्स बायोलॉजी में डेटा विश्लेषिकी के लिए मॉडलिंग आर्किटेक्चर का विकास

ENVIRONMENTAL TECHNOLOGY DIVISION

The Environmental Technology Division (ETD) is a hub of indigenous technology development, achieved through the design of innovative processes for environmental pollution control and value addition to the region's natural resources. ETD environmental management services are used by local industries and government for statutory environmental impact assessment studies and clearances of new projects in mining, and ports Harbour. NIIST is a NABET-Accredited Category A consultant organization in Kerala having accreditation in the Mining and Ports & Harbour Sectors. This Division is also home to the Computational Modeling group of NIIST.

We contribute across the entire value chain-from science to engineering to technology. While patents and SCI publications come from the R & D efforts, the division has adopted a strategy where most of the successful outcomes are absorbed into the technology pipeline.

The division's technology basket has processes for production of white pepper from black or green pepper, environment-friendly coir retting, effluent treatment, solid waste management and tech-products like bio-filters for odour control, biogas plants, food-waste digesters, kitchen waste composter, wood substitutes from fibre composites, and from the computational modeling team, a simulation software, affordable to the MSME metal casting foundry industry.

The Environmental Technology Division endeavors to create a sustainable environment for a better future against the backdrop of the **"Swachh Bharat"** mission and the **"Make in India"** initiative of the Government of India.

Highlights

- Biofilter odour control systems and effluent treatment plant in fish stalls/ fishmeal plants for Kerala Federation of Fishermen Co-operatives Ltd. (Matsyafed)
- Commissioned a gas biofilter for crushed bone charging station emissions at M/s Nitta Gelatin India Limited.
- Effluent treatment plants based on BFBR anaerobic treatment technology have been installed by NIIST licensee (Galaxy Environ. Pvt. Ltd.) at two rice mills and an icecream factory.
- Technical advisory services were provided for Sabarimala Sannidhanam 5 MLD sewage treatment plant (STP) – inspection and troubleshooting.
- Biofilter odour control system comprising biofilters and exhaust ventilation completed at BBMP (Bengaluru Municipal Corporation) 500 tpd integrated solid waste management plant at KCDC, Kudlu.
- Municipal Solid Waste treatment by Biodrying
- Pilot scale unit of a bioprocess for treating perchlorate.
- Field installations of food waste digester cum biogas plant
- Vulnerability assessment of Climate Change impacts in Island ecosystem of Lakshadweep
- Environmental Impact Assessment for renewal of mining lease for mining of beach sand minerals for Indian Rare Earths & KMML, Ltd. Chavara, Kollam
- Dioxin research

Computational Modeling

- SMART Foundry 2020 - Smart manufacturing for metal casting industry
- Computational fluid dynamics applications in process industry
- Technical up gradation of ***AutoCAST X1-FLOW***$^{+}$ software and new MoU for technical support and royalty from 3D Foundry Tech Pvt. Ltd., Mumbai.
- Hydrothermal liquefaction of microalgae for production of bio-oil
- GIS-linked spatial models to simulate the spread of vector-borne disease (dengue)
- Development of a modeling architecture for data analytics in Systems Biology

ENVIRONMENTAL TECHNOLOGY

DSIR-NIIST-CRTDH: Common Research and Technology Development Hub for Environmental Intervention in MSMEs

The **Common Research and Technology Development Hub for Environmental Interventions in MSMEs (CRTDH)** has been set up at NIIST, which provides technology and services to MSMEs and R&D for problems of common interest to MSMEs. The following sectors have been identified for technology interventions:

- Cashew processing: roasting and emissions
- Desiccated coconut: wastewater
- Fish meal factories
- Rice mill

Municipal Solid Waste treatment by Bio-drying

Bio-drying is a method of using self-generated heat to dry municipal solid waste. After drying, the solid waste is mechanically processed to separate metals and inert materials such as glass and stones, to produce a combustible, high-calorie fraction comprising plastics, paper, dry organic materials, textile fabrics, rubber, leather etc. This fraction is shredded to required size and baled to produce RDF. It can be used as a fuel in thermal power generation.

The Solid Waste Management Rules 2016 (SWM-2016) notified by Government of India in April 2016 makes it mandatory for all industrial units using fuel and located within 100 km from a solid waste based RDF plant to make arrangement to replace at least 5% of their fuel requirement by RDF.SWM-2016 give preference to technologies that supply combustible fraction of waste as refuse derived fuel (RDF) to power plants or cement kilns

A project, costed at Rs. 1 crore was sanctioned by the Department of Environment and Climate Change, Government of Kerala, in Jan 2016 with the objective of biodrying process development and design. Biodrying can be used on MSW without source segregation. Although SWM-2016 requires waste generators to segregate waste, ensuring efficiency and quality of separation of wet and dry wastes is difficult. Biodrying technology can be used on the combined wastes, while source segregated large quantity organic waste from commercial establishments can be treated by anaerobic digestion.

Biodrying process development experiments have been conducted in NIIST with the objectives of enhancing rate of drying. Total of 15 experiments have been completed.

a. changing air flow rate
b. changing air direction
c. remixing to reduce short circuiting and in homogenous drying
d. changing bed heights to study compaction (volume reduction), pressure drop
e. using humid air to increase bed temperature and consequent increased rate of heat production because of higher metabolic rate at enhanced temperature
f. addition of compost as a initial inoculum to reduce start-up time
g. pressing to enhance gas-solid contact
h. Estimate odour generation from exhaust air
i. Finding conditions that reduce fly nuisance

NIIST Bioprocess for Treating Perchlorate (Rocket Fuel)

Perchlorate (Rocket fuel) is a persistent, endocrine disrupting pollutant known to cause thyroid dysfunction. In the recent past high level ground water contamination of perchlorate and associated high incidence of hypothyroidism was reported in Kerala. Therefore, it is very important to control the

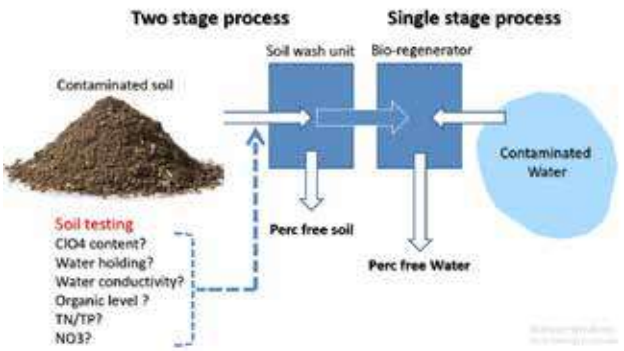
environment release of perchlorate especially from places where it is handled in bulk. CSIR-NIIST is the pioneer in environmental monitoring and remediation of perchlorate in India. The Bioprocess developed by NIIST will detoxify perchlorate contaminated water as well as soil to ensure public health and to protect environment.

The NIIST Bioprocess is eco-friendly and economic, where it uses a specific microbial system capable of converting perchlorate into non-toxic chloride and oxygen. The process was tested successfully in a pilot scale unit for treating both water as well as soil. The removal efficiency was almost 100% without any secondary treatment. Being anaerobic, it requires less energy input and no secondary treatment.

The bioprocess was demonstrated in a pilot scale unit (150 lit capacity) capable of treating 720 lit contaminated water in a day. Similarly, demonstration of contaminated soil treatment was done at 750 kg level per batch. In soil treatment, perchlorate in contaminated soil will be completely extracted in water and the water will be treated in the bioreactor (regenerated) for cleaning subsequent soil lots. This approach cleans up soil much faster, compared with more time consuming composting or in-situ remediation approaches practiced in other countries.

Treatment of the heavily contaminated ground water is very important because that will avoid spreading the contaminant to more wide areas in course of time. Therefore, in the affected areas, in place of providing alternate drinking water supply, treating the contaminated ground water and supplying the same to local community is a more sustainable approach. This will help in gradually reducing the ground water perchlorate in the area. An integrated Reverse osmosis (RO) or Ion exchange with biological treatment is generally practised in USA and other countries for perchlorate contaminated drinking water treatment. This approach will be economical and environment friendly. The NIIST bioprocess can be upgraded for drinking water treatment purpose by linking with a standard RO or Ion exchange process unit.

The major beneficiaries of NIIST bioprocess will be agencies (like VSSC) or industries (cracker) that either produce or consume perchlorate in bulk. Perchlorate in contaminated soil or wash water (except high strength brine) can be directly treated with this process in short a period of time.



Schematic of the water/soil treatment approach

Demonstration scale soil treatment system

Environmental Impact Assessment

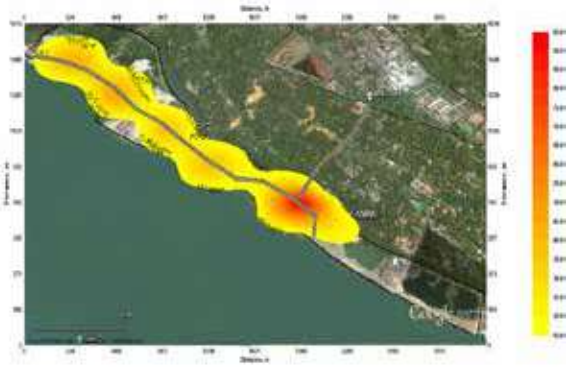
1. Environmental Impact Assessment for renewal of Mining lease for Mining of Beach sand minerals including mechanized dredge mining in Block No: III covering an area of 88.119 Hectares, Kollam District, Client: Kerala Minerals & Metals Ltd, Chavara, Kollam

KMML has appointed CSIR - NIIST to evaluate the environmental aspects and their possible associated impacts that would arise due to the proposed heavy mineral sand mining and mineral separation and to work out environmental management plan to prevent, control, minimise or eliminate the adverse environmental impacts envisaged from the proposed mining and mineral separation.

The proposed project is for renewal of mining lease and enhancement of mineral sand production from 2,50,000 TPA to 7,50,000 TPA in Block III and physical separation of minerals at Mineral Separation plant (MSP). Based on the EIA studies CSIR-NIIST has recommended total production not to exceed 4,50,000 TPA .

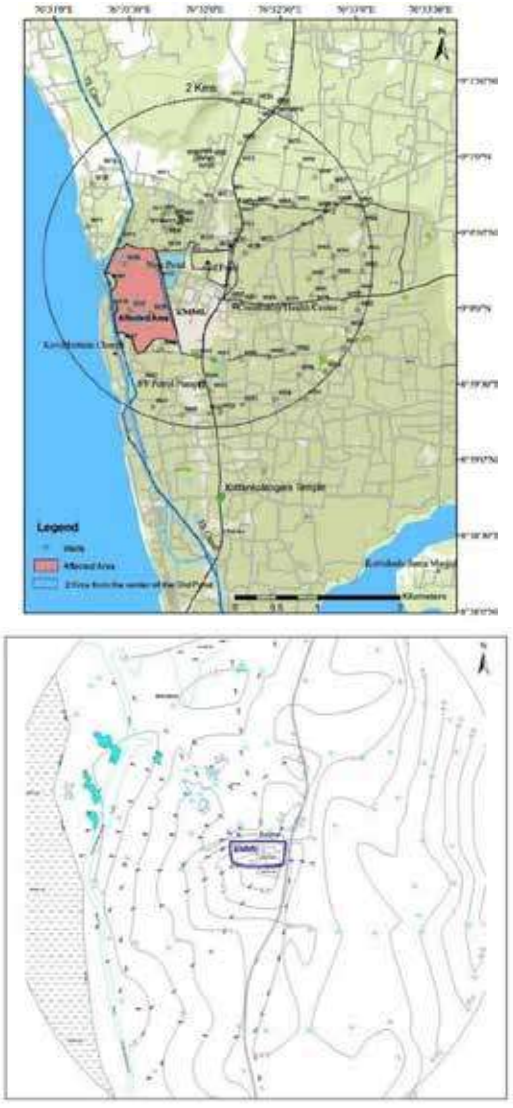
Primary and secondary data on meteorology, air, noise, water, soil traffic, land use, ecology and socio economics were collected and analysed by NIIST.

Impact of the proposed activity has been predicted based on the field studies as well as desk research quantification of the impacts was carried out applying mathematical models Envitrans FDM pro for PM10 and hemispherical model for noise modelling and ground truthing.



Isopleth plot for the emission after the implementation of the mitigation measures

The surface and ground water characteristics have been established through field monitoring data at 17 locations generated during the study (pre-monsoon/ post monsoon) with respect to physicochemical characteristics and pollutant levels and the same has been compared with quality criteria for drinking water. A Hydrology survey was carried out to find the flow of ground water in the ML area and the buffer zone. The Ground water contour map indicated that the flow/movement of water direction is predominantly towards Northwest, South West and to the western side rom KMML TiO2 plant. High iron content was observed in these directions and the impact extended to 70 Ha downstream of KMML TIO2 plant. This iron content is due to the percolation or leakage of iron oxide to ground water from the old KMML sludge ponds for which mitigation plans are suggested in the report.



NIIST has suggested the construction of 13 groynes to allow beach sand accretion in the KMML mine lease area to enable the beach formation and sand accumulation. The management plan also suggests rip rap bank protection, green belt development , conversion of mined area to sand dunes, creation of wet land ideal for mangrove afforestation which can serve as barrier in preventing sea water intrusion to the inland as well as for recreation purposes. The deepening of the TS canal also enables smooth navigation of waterways. The NWAI undertakes dredging of the TS canal, this may enable the KMML to use the dredged out material to refill the mined out area for making the area to the original topography. A positive outcome of the proposed activity is that the mining out of rare earths sand and separation of HM concentrates eventually contributes to a reduction in the overall level of radiation.

Social Impact Assessment survey was conducted by SISSR, an NGO and empanelled agency approved by NABET. The R & R scheme has been formulated after tripartite discussion between district administration, affected people and project authorities. The report also gives a detailed explanation of setting up of a post project monitoring cell and Environmental monitoring committee, which ensure that the mitigation measures planned by way of environmental protection, function effectively during the entire period of mining and reclamation.

Draft final report was submitted to KMML & KPCB for conduct of public hearing. The report was well accepted by the public. District Administration / Kerala State Pollution Control Board has forwarded the proposal to MOEF recommending the project for Environmental Clearance.

Environmental Impact Assessment (EIA & EMP) study for mining area IREL NK block II &NK block- II EE.

Beach sand of this region consists of several important minerals of industrial importance. The major minerals present are Ilmenite, Rutile, Zircon, Sillimanite and Monazite. Mining of Monazite makes the area radiation free. Mining of these valuable minerals are required to meet the demands of several user industries in the state as well in the country.

Application for prior environmental clearance in Form-1 is being submitted to Ministry of Environment & Forests (MoEF), Government of India, New-Delhi and NIIST has accorded TOR for conduct of study.

The objective of the study is to identify the environmental impacts on the lease area due to the proposed dredge mining activity. The study will identify the existing environmental conditions, predict impacts and suggest environmental safeguards and develop post project monitoring programme to ensure environment friendly mining and transportation of the concentrate. The duration of the project is two years ending in December 2018.

EIA study for the Block-IV and Block IV EE (Total ML area : 220.566 ha.) of Indian Rare Earths Ltd. Chavara, Kollam

The proposed project includes two mine leases, Block-IV and Block IV EE. In Block –IV, IRE propose to enhance the capacity from 2,37,500 tpa to 7,50,000 tpa. The capacity expansion using two dredgers is mainly due to the pressure from the locals to mine the area at a faster rate and give back the land within three years. The project has been accorded prior environmental clearance based on the submission and presentation to MOEF&CC

The objective of the study is to identify the environmental impacts on the lease areas due to the proposed mining activity. The EIA will be based on the mining plan and the method of mining proposed to be adopted for the area and the production rate proposed for ML area. The study will identify the existing environmental conditions, predict impacts and suggest environmental safeguards and develop post project monitoring programme to ensure environment friendly mining and transportation of the concentrate.

Vulnerability Assessment for Climate Change impacts in Coasts and Island eco-systems of India

The aim was to study the impact of sea water intrusion into fresh water aquifers due to climate change in islet ecosystems. Agatti island of Lakshadweep was taken as the study area. Water samples from wells across the Agatti Islandwere collected,ensuring that the sampling pointsare uniformly distributed in the study area. Two consecutive sampling points maintain an average distance of 750 m along the length of the island.The samples were chemically analyzed to estimate the concentartions of various anions and cations as per Indian standard IS 3025.

The extent of saline water intrusion was estimated by calculating Simpson's ratio given by Cl^-/ ($HCO3^-$ + $CO3^-$) which classifies the level of contamination in a five point scale where a ratio < 0.5 represents good quality and > 6.6 represents the highest contamination.

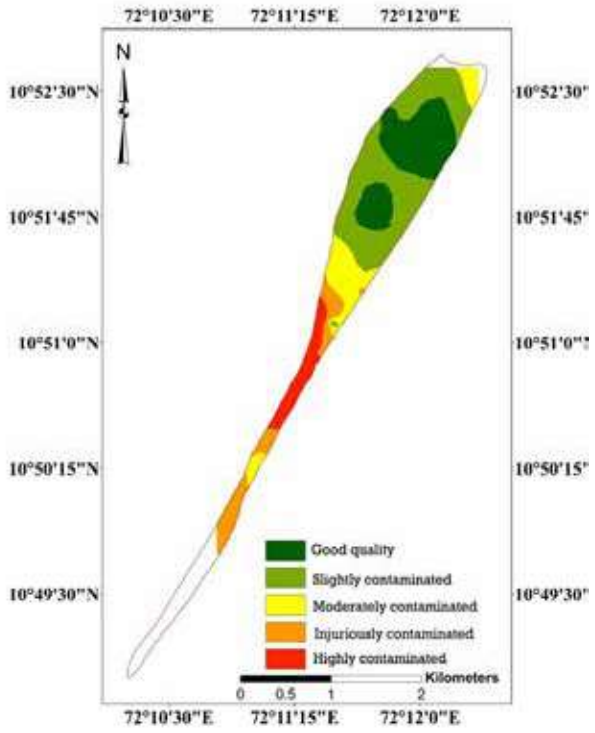
Classification of contamination based on Simpson's ratio

Sl. No	Level of quality	Simpson's Ratio = Cl-/ (HCO3- + CO3-)
1	Good quality	< 0.5
2	Slightly contaminated	0.50 – 1.30
3	Moderately contaminated	1.30 – 2.80
4	Injuriously contaminated	2.80 – 6.60
5	Highly contaminated	> 6.60

Base Exchange index (BEX) was also be used to identify whether an aquifer is undergoing salinization or freshening; the BEX (for a dolomite free aquifer system) is given by,

$BEX = Na^+ + K^+ + Mg^{2+} - 1.0716Cl^-$ *(meq/L)*.A positive BEX represents freshening, while a negative BEX represents salinization and a BEX with a value of zero represents no base exchange.

In order to understand the nature of distribution of the saline water intrusion, the ArcMap module of ArcGIS software was used for generating continuous profiles from discrete data of parameters. The 'Kriging' interpolation technique converted point data to continuous surface data. The distribution profile of Simpson's ratio indicates thatits values are highest in the narrow land strip in the middle of the island and nearer to the coasts. The BEX values are highly negative in the same strip, in tune with the findings on Simpson's ratios.These observations reveal significant saline water intrusion in the coastal area of the island.



Profile of Simpson's ratio across the study area.

Dioxin Research

Dioxins are a class of Persistent Organic Pollutants (POPs), which are considered the most dangerous chemicals created by humans. Dioxins can cause a number of health problems like cancer, hormone disruption, birth defects, infertility etc.

India's first dioxin analysis laboratory was established in CSIR-NIIST in 2003 to empower India's POPs monitoring capabilities and develop an inventory of emission sources. CSIR-NIIST had also participated in the United Nations Industrial Development Organisation (UNIDO) funded National Implementation Plan (NIP) programme and played a pivotal role in developing POP inventories. Of late, the modernization of the facility was carried out under the CRTDH programme of CSIR-NIIST and sophisticated instruments such as Dioxin analyzer (GC-MS/MS), Automated cleanup system, Accelerated solvent extraction system, Stack and ambient air sampling equipment are available. Further reduction in time is expected upon addition of Dionex accelerated solvent extraction system.

Accelerated_solvent_extraction_unit

Automated_clean_up_system

We are equipped with dioxin stack gas sampling system (Method 23) and ambient high volume PUF sampler (TO- 09) for the periodic air sampling at industrial stacks, biomedical/ waste incinerators, open burning sites etc. Presently the facility is equipped to carry out the analysis of dioxins in environmental and food samples.

Dioxin from Open Burning

There is no municipal waste collection and treatment system in many of the cities in India. It has resulted in the accumulation of garbage in the streets and is periodically set to fire. Burning of these heterogeneous solid wastes under crude conditions causes the emission of dioxins and other pollutants. There is no data available on the emission of dioxins in India under these conditions. A Kerala State Pollution Control Board sanctioned project is ongoing to determine the emission factors of dioxins from open burning of municipal solid wastes in Kerala. Preliminary analysis of soil samples collected from waste dump site near Attakulangara, Thiruvananthapuram has shown a total TEQ level of 11.2 pg/g WHOPCDD/F . It is higher than the Canadian soil quality guideline of 4 pg WHO2005 PCDD/F- TEQ/g (ppt). Further studies are ongoing to carry out the sampling and analysis from selected open burning sites.

A burn hut, equipped with air handling systems, temperature monitoring probes and online data collection systems, has been constructed for simulation studies. The emission factors of dioxins will be generated by carrying out open burning experiments under various combustion and waste composition conditions.

Burn Hut

Testing and Analytical Services

Facility for testing and analysis of water, soil and sediment samples for various physiochemical and water quality parameters is used by various government departments, research institutions, students from universities and colleges, public & private sector agencies and private individuals. The samples are routed through the testing and analytical cell.

COMPUTATIONAL MODELING AND SIMULATION

The Computational Modeling and Simulation Group makes use of computational models for understanding and designing of processes like metal casting, mineral processing reactors and biological systems. Further, this group is also involved in development of commercial technical software and providing computational support to other groups within the Institute. The main highlight of this year is the initiation of a multi-institutional DST-funded project on smart manufacturing of small metal castings. As part of 12th FYP network project under chemical cluster, "**Indus Magic** - Innovate, Develop& Up Scale Modular, Agile, Intensified & Continuous Processing & Plants" with CSIR-NCL as nodal lab, we have been involved in developing multi-scale models including reaction kinetics, heat and mass transfer for multi-phase micro-structured reactors (MSR's). In the biological cluster, NIIST is participating in "**Genesis**-Genomics and Informatics Solutions for Integrating Biology" with CSIR-IMTech as nodal lab. In the work package Bioinformatics@CSIR for societal benefits, GIS-linked spatial models have been developed to simulate the spread of vector-borne disease (dengue). In the work package on network modeling, agent-

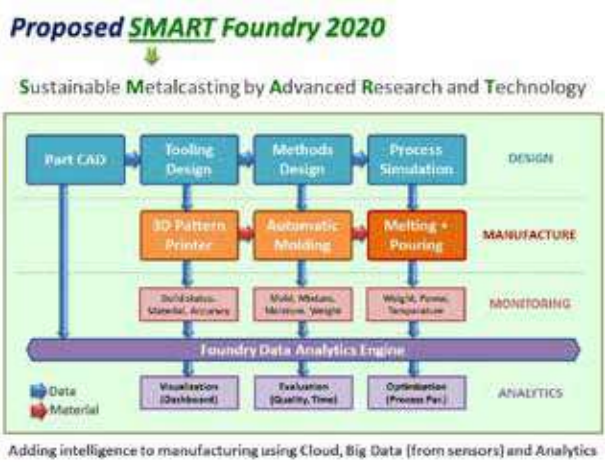
based models were developed for biological signal transduction networks. The 12th Plan CSIR-Network projects under Chemical Cluster and Biology Cluster came to an end and these projects were reviewed by the respective Sectoral Monitoring Committees. On the technology front, new features in the mold filling algorithm of ***AutoCAST X1-FLOW***$^{+}$ software were beta tested and benchmarked.

SMART Foundry 2020

SMART Foundry 2020 (Sustainable Metal Casting by Advanced Research and Technology), an Indian initiative in smart manufacturing has been sanctioned by DST under Technology Systems Development Program.

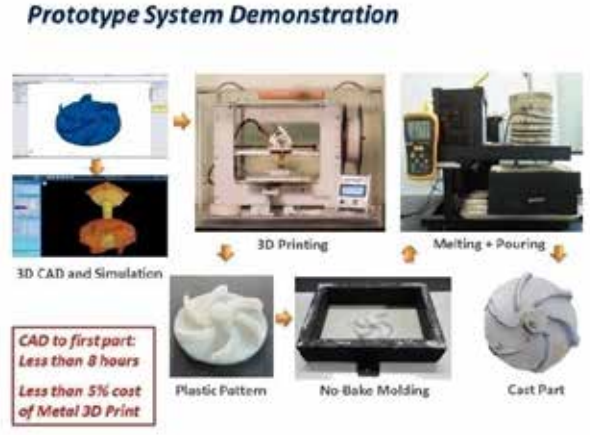
This project is aimed at "reinventing" the metal casting process for education and entrepreneurship, by leveraging five key technology drivers: Virtual engineering, cloud computing, smart sensors, the Internet of Things (IoT) and big data analytics. This challenge of mapping India onto the smart manufacturing scenario which is considered as the fourth industrial revolution is being taken up by ten technical institutes (public as well as private) and 5 industrial partners . The project cost is Rs. 8.25 crores from DST and a total contribution of Rs. 1.25 crores from five private industrial partners. **CSIR-NIIST is the overall project coordinator for this project and the amount sanctioned for CSIR-NIIST is Rs. 3.32 crores for a period of three years.**

SMART Foundry Version 1.0 will be demonstrated at VNIT, Nagpur during March 2018. It is planned to create a fully integrated and semi automatic facility with unique and novel features to make small intricate shaped Al castings up to 1 kg weight.



The building blocks of the SMART Foundry System

A proof-of-concept system has been developed by the team to demonstrate the feasibility of manufacturing small metal parts starting from its 3-D CAD model—the first part within a day, and subsequent parts within an hour each. The manufacturing process of an aluminium impellor was demonstrated at the Indian Foundry Congress, 2016.



The entire facility can be set up in a small room (25 m^2), which is ideal for training students, who, in turn, can set up micro manufacturing units with very little investment. They can also use it for making metal busts of people, household appliances and other innovative applications. The new process aims to change the perception of the metal casting foundry from "**dirty, difficult, and dangerous**" to "**sustainable, smart, and safe**."

Prototype demonstration during IFC 2016 at Coimbatore

AutoCAST X1- FLOW^{+} Software Technology: The Story continues...

Virtual Casting is a software package for the simulation of the solidification process of industrial castings and was developed by CSIR-NIIST. In 2011, the **Virtual Casting Solver Technology** was transferred to 3D Foundry Tech Pvt. Ltd. (3DFT), a company incubated in the Indian Institute of Technology Bombay and in 2012-13, it was integrated into ***AutoCAST*** an easy–to-use software package for casting method design, solid modeling, and simulation. under the name ***AutoCAST X1-FLOW***$^{+}$. From 2013-17, ***AutoCAST X1-FLOW***$^{+}$ has been showcased at five Indian Foundry Exhibitions. During 2016-17, 24 new customers were added, taking the total number of licenses transferred to individual foundries, foundry clusters and educational institutions to more than 150.

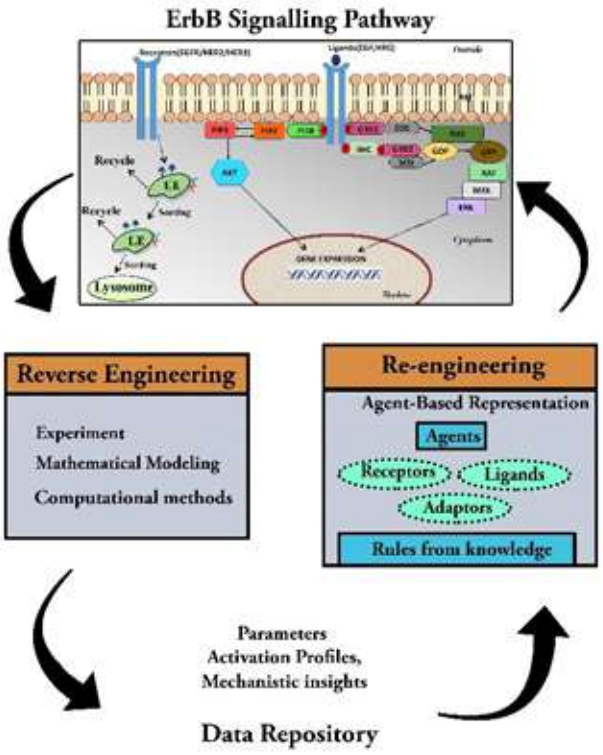
A new MOU has been signed during January 2017, for rendering technical support to the private industry 3D Foundry Tech Pvt. Ltd., Mumbai for a period of five years starting from April 2017 at a cost of Rs. 1.5 lakhs per year and extending the term of royalty for a period of five years with effect from April 2017. This collaboration between a CSIR Laboratory, IIT and industry has led to one of the most commercially successful **'Made in India'** engineering software products.

AutoCAST X1-FLOW^{+} is available from 3D Foundry Tech Pvt. Ltd. 507-C, Ecstasy Business Park City of Joy, JSD Road, Mulund (W) Mumbai – 400 080, India.

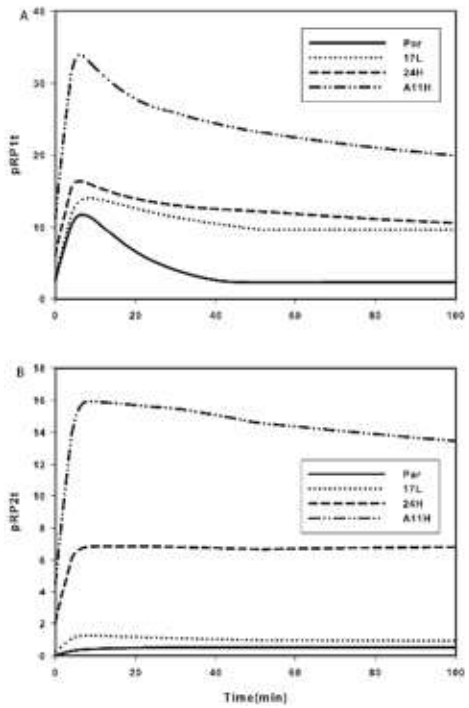
A Modeling Architecture for Data Analytics in Systems Biology

Advances in high-throughput biotechnologies have led to increasing volumes of biochemical data. Data mining techniques and design-driven systems modeling approaches have led to the concept of reverse engineering biological systems. Biological systems can be reverse engineered by experimentation and computational modeling. The data outcomes of reverse engineering give fine insights but make limited contribution to system-level understanding.

A data analytics pipeline architecture has been conceptualized that learns from the data given by reverse engineering, and uses it for re-engineering the system by carry out experiments *insilico*. A whole world of unexplored hypotheses can be tested on the computer. As a proof-of-concept, we simulated bio-molecular signal transduction in the ErbB signaling pathway. A mathematical model that quantitatively predicts co-expression of ErbB (or HER) receptors in activation and trafficking, has been taken for this study. The data pipeline is initiated by cues from the model that give the rates of biochemical reactions, to formulate knowledge-based rules foran agent-based re-engineering model. Simulation studies using these rules, support the known facts on EGFR-HER2-HER3 dynamics.



The Data Analytics Pipeline



Total receptor phosphorylation levels for EGFR and HER2 in Par, 17L, 24H and A11H cell lines expressing different levels of receptors.

Re-engineering models, built using the results of reverse engineering, opens up the possibility of harnessing the power pack of data which now lies scattered in literature. Virtual experiments could then become more realistic when empowered with the findings of empirical cell biology and modeling studies (**Bioinformatics,** 33(5), 726-732 (2017)).

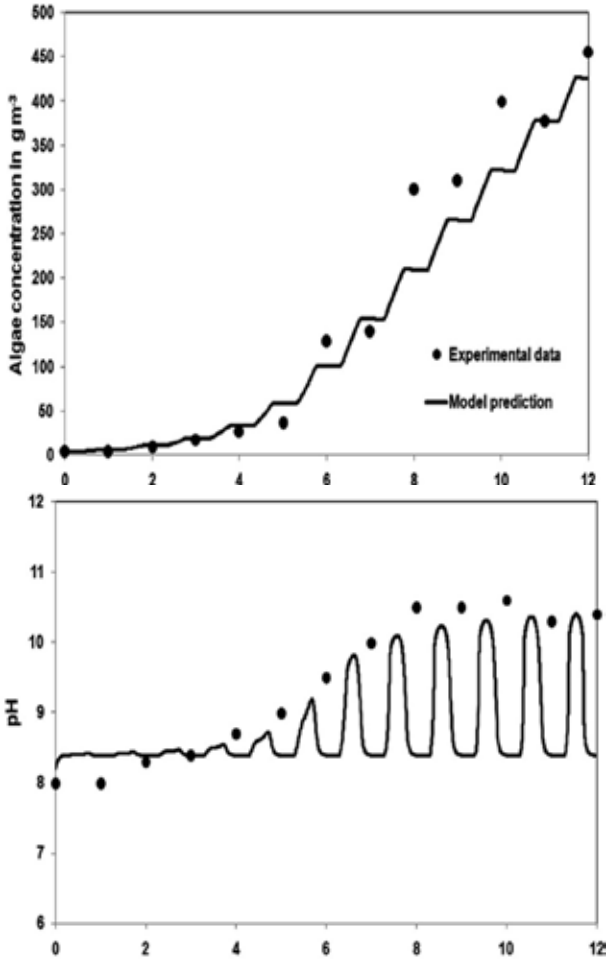
Hydrothermal liquefaction of microalgae for production of bio-oil - experiments & modeling

This is a project, which focuses on the production of bio-oil by thermo chemical conversion of algae biomass. The thermochemical route involves the hydrothermal liquefaction (HTL) at elevated temperature (200-400°C) and pressure (5-20 MPa). A low lipid and highprotein microalgae *Arthrospiraplatensis* is considered for the present investigation. The work flow of the conversion of microalgae to bio-oil is shown in Figure below.

Work flow used in the study for conversion of microalgae to bio-oil

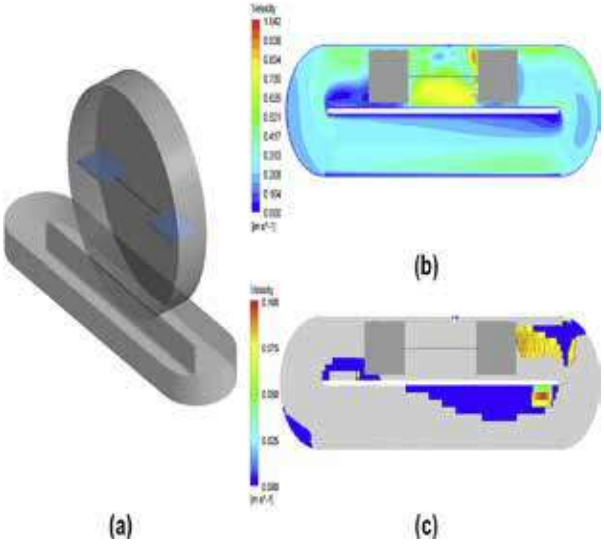
This year, the focus has been on the development of a dynamic model for biomass growth and CFD modelling of hydrodynamics in open raceway pond. The dynamic behaviour of the algal system was developed by solving mass balance equations of various components, considering light intensity and gas-liquid mass transfer. A CFD modelling of the hydrodynamics of open raceway pond was developed by solving mass and momentum balance equations of the liquid medium. The prediction of algae concentration from the dynamic model was compared with the experimental data. The hydrodynamic behaviour of the open raceway pond was compared with the literature data for model validation (Bioresource Technology 2017).

The graph shows the results of the algae biomass concentration and pH variation during the time period of 12 days obtained from the dynamic modeling along with the experimental observations. It can be seen from the figure that the model predicted profiles of the algae concentration and pH have a similar trend with the experimental results.



A comparison plot of (a) algae concentration (b) pH profiles between the model and experimental work.

A CFD model was developed to simulate the hydrodynamics and mixing behaviour of our open raceway pond with the working volume of 150L. The dimensions of the open raceway pond used in the present study are: length 2 m, width 0.5 m and depth 0.15 m. A two-bladed paddle wheel was used to generate mixing in the open raceway pond. The contour plot of the mean velocity magnitude at a position of 0.05 m depth is shown. It can be observed that the maximum velocity of 1.0 m/s is obtained near the paddle wheel regime, while the uniform flow regime is observed elsewhere, with a velocity of 0.2 m/s. It is generally accepted that an average liquid velocity of 0.2 m/s is suitable for the growth of microalgae cultures in raceway reactors. The dead-zones in the open raceway pond as predicted by the CFD simulation are shown.



(a) A sketch of CFD model geometry (b) contour plot of mean velocity in the raceway pond (c) the dead zones in the raceway pond predicted by CFD model.

WASTE MANAGEMENT SOLUTIONS FOR SOCIETY

Design improvement & performance evaluation of NIIST food waste digester cum biogas plant for field installation

The **compact kitchen waste digester cum biogas plant** was one of the major developments under CSIR-800 activity in NIIST Thiruvananthapuram. Design improvement and performance evaluation of the scale-up version of the digester for treating large quantity of organic wastewas one of the activities during 2016-17 period. A demonstration scale

modified unit was established in NIIST and it was continuously operated for nearly 8 months. Compared with the previous model, the revised design was more mechanical with automatic control system for more efficient biogas production and its utilization. The 40 Kg food waste/day unit was generating around 7 M^3 biogas daily (average biogas was 160-180 L/Kg food waste, methane content >60%). The total solid loading into the digester was around 4.6 Kg/M^3.day.

Demonstration scale (40 kg/day) food waste digester cum biogas unit operating in NIIST campus

In a continuing effort to improve the digester performance, making it more compact and efficient in terms of waste degradation and methane production, more in-depth microbial ecology of the system was studied. Molecular (QPCR) Genomic tools (NGS) were applied to understand the community profile during adverse VFA build up leading to digester failure. A mixed microbial system with hydrolytic bacteria (cellulolytic, proteolytic and lipolytic) was developed and batch experiments confirmed enhanced hydrolytic activity of food wastes augmented with this consortium. All these scientific inputs will help to redesign the digester with a better performance, which is in progress now.

Field installation of Food waste digester

Installation of Food waste digester in government schools

To contribute to the Swachha Bharat mission and to attain the Millenium Development Goal sustainable development (MDG 7), field installation of the newly developed food waste digester cum biogas plants was done during 2016-17 period.

The safe disposal of food waste in schools within the city area is a challenge. Government schools providing breakfast and lunch will have large quantity of putrifiable waste food. Some of the schools approached NIIST for technical support for waste treatment in an environment friendly way. Accordingly, the compact food waste digester developed under the societal research programme (CSIR 800) in NIIST is installed in two government schools to provide a sustainable solution for the problem. The first installation was done in Dec 2016 at Govt. LP school in Poojapura, whereas the second installation was done in February 2017 at Govt. UP school Thycaud. Unlike the conventional biogas plants the NIIST food waste digester can take any food waste including egg shell, lemon, onion peel etc. Moreover, it does not need the addition of water along with the waste. The unit is movable with a low foot print. The unit provided to both the schools were capable of handling 3-8 kg food waste daily, producing around 150-170 L biogas/kg food waste. The organic manure (slurry) from the digester was used by schools for organic farming and gardening. The installation of the units were followed by training the staff for operating the unit and troubleshooting to ensure sustained operation of the treatment plants.

The major beneficiaries of the digester installation in these school are the students who are mainly from poor economic background. Installation of the food waste treatment units helped the school authorities to maintain a cleaner and odour free environment for the students.

The school models are designed as an education tool with simple pictorial representation of the bioprocess involved. This will help the students to understand the science of bio-methanation and the importance of waste treatment and environment protection. This will have major impact in the society.

The food waste digester unit installed in Govt. UP school, Poojapura, TVM.

Installation of food waste digester in Lakshadweep islands

As part of the 12 FYP project VACCIN (Nodal lab NISAIR), the respective taskforce committee put forth recommendations to implement technological solutions developed under the CSIR 800 project in NIIST for environment protection of the island ecosystem. The recommendations include installation of the compact food waste digester, clean coir retting process and the household wastewater treatment system.

As a first step a compact kitchen waste digester unit was installed in Kavaratti island during the task force meeting in October 2016. The performance of the unit is under evaluation now. If found successful, meeting the special environmental conditions of the island, more units will be installed during the coming years as part of the RSP 4003 project.

Similarly, the clean coir retting process will provide new job openings for the islanders. The wastewater treatment system will reduce fresh water consumption and will ensure more water environment. Installation of coir retting unit and water treatment units are planned for 2017-18 period.

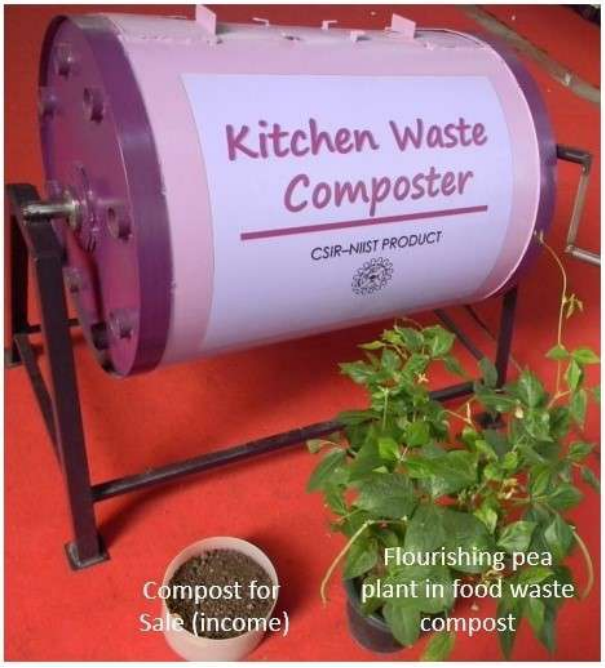
The demonstration scale NIIST digester installed in Kavaratti island

Demonstration of NIIST food waste digester cum biogas unit

We have arranged few demonstrations to popularize the R&D activities under CSIR 800 in NIIST. This includes participation in major exhibitions and demonstration for students from various educational institutions. The major exhibitions where the R&D development under CSIR 800 were showcased included India International Trade Fair, New Delhi, Kerala Science Congress and few other regional exhibitions.

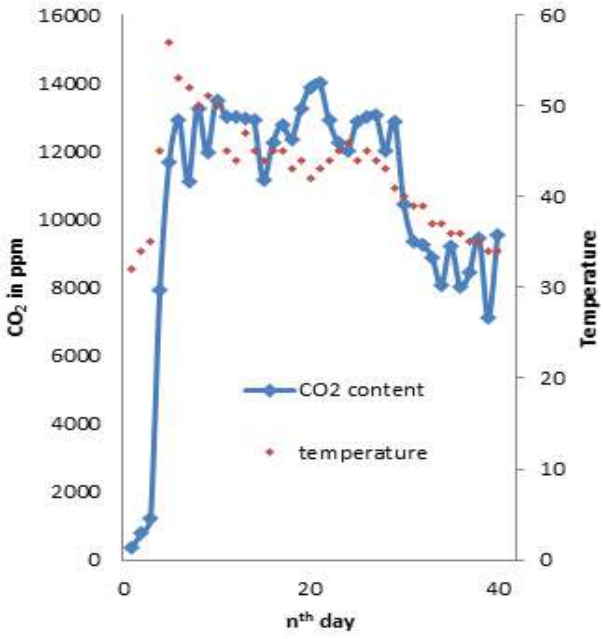
Exhibition of compact food waste digester in CSIR 800 pavilion in 2016 IITF, New Delhi.

CSIR-NIIST Kitchen waste composting unit



The NIIST composting units along with the compost produced and vegetable growing in the compost

The development of a compact kitchen waste composting unit was another activity during 2016-17 period. This is a based on a new concept, "Waste to Wealth and Food", ideal for urban as well as rural areas with limited space constrains for disposing putrifiable household wastes. The aerobic waste sludge based inoculum initially added to the system speeds up the aerobic composting process. The specially designed aerobic composting unit converted food waste into good quality compost. During the composting the temperature gone up to ~60 °C and the maturation period required was only two weeks. Two batch operations were already completed and the results are highly promising. Compared with existing composting units, advantages of this unit are there is no need of repeated addition of EM solution (bacterial inoculum), no fly or smell issues. The 220 L capacity composting unit was able to treat ~45 kg food waste in 30 days period.



Temperature and CO_2 profile during one batch of composting operation.

This can be an ideal system for income generation for women groups like the Kudumbasree. The operators can income from both waste collection points (houses) as well as by selling the compost. Moreover, organic vegetables can be cultivated

using the compost prepared from the food waste. Vegetables grown in the food waste composting unit show better growth and yield. ICAR-CPCRI (Central Plantation Crop Research Institute, Kayamkulam Kerala) has expressed interest to test this unit in field for preparing compost from agro residues as well as food wastes. This will be a part of village adoption programme of ICAR in Alapuzha district in Kerala.

GLIMPSES OF COMPLETED PROJECTS FROM THE DIVISION

Effluent treatment plant with BFBR anaerobic reactor at Keerthi Rice Mill, Kalady installed by NIIST licensee: Galaxy Environ Pvt. Ltd.

Odour control system at 500 tpd MSW mechanical biological treatment plant at KCDC, Bengaluru.

Gas biofilters under construction at 500 tpd municipal solid waste treatment facility. Installation of exhaust ducting.

एस. & टी. सेवा प्रभाग

S & T SERVICE

RESEARCH PLANNING & BUSINESS DEVELOPMENT

CONTRACT RESEARCH PROJECTS 2016-17

SL NO	CLIENT	PROJECT TITLE	PROJECT LEADER
		AGRO PROCESSING & TECHNOLOGY DIVISION	
1	DST	A study on optimizing the material utilisation in auyurvedic industry by replacing herbal roots by benign herbal parts and by developing new bio active applications for herbal spent material	Dr A Sundaresan
2	Dept of Agriculture, Govt of Kerala	Setting up of technology business incubation centre	Mr V V Venugopal
3	Dept of Agriculture, Govt of Kerala	Setting up a ginger processing plant at Wayanad	Mr V V Venugopal
4	DST	Study on the mechanism of anoikis in human mammary cancer cells, induces by a purified lectin from Morus Alba L	Dr S Priya
5	DBT	Fluorescent probes for bio sensing applications	Dr P Jayamurthy
6	Spices Board	Development of functional food products from spices and botanicals for better health management	Dr P Nisha
7	KSCSTE	Endophytic bacterial flora of the rice plants from the acidic soil of Kuttanad and their exploitation in improved paddy cultivation	Dr B S Dileep Kumar
8	KSCSTE	Can enrichment of Palm Neera Syrup cause immunomodulation	Mrs M V Reshma
9	DBT	Bio prospecting of two coded anti-diabetic medicinal plants based on ethnomedical leads- A molecular pharmacological approach	Dr P Jayamurthy
10	KSCSTE	Bis Indolyl mathane conjugates of Biaryls: Role in apoptosis, cell cycle regulation and PI3K/AKT/mTOR signaling pathway in Human breast and cervical cancer cells	Dr S Priya
11	DST	Role of mitophagy in cardiac hypertrophy: an in vitro cell line approach	Dr Vandana Sankar
12	DST	Mining and characterization of novel antimicrobial molecules produced by streptomyces species	Dr S Nishant Kumar
13	DBT	Dissect the function of fundamental cilia-genes associated with ciliopathies in patients	Dr Shobi Veleri
14	Food Safety & Standards Authority of India	Occurrence of acrylamide, a heat induced food toxicant, in processed food products of India: mitigation strategies and health risks	Dr P Nisha
15	M/s Aarsha Veda	Solvency efficacy validation of Thailamurchanam	Mr V V Venugopal

16	M/s Bipha Drug Laboratories Pvt Ltd	Chemical characterization and anti diabetic and anti cancer activities of selected raw materials and formulations	Dr P Nisha
17	HAFED	Process development for blanching and drying of fresh turmeric	Mr V V Venugopal
18	M/s Arbee Bio Marine Pvt Ltd, Mysore	Hydrogenation of fish oil and isolation of squalline from rice bran oil deo distillate	Mr M M Sreekumar
MICROBIAL PROCESSES AND TECHNOLOGY DIVISION			
19	DST	Biochemical and molecular investigation on stress mediated lipid accumulation and biomass productivity in microalgae	Dr Muthu Arumugham
20	DBT	Stereoselective synthesis of chiral alcohols of Pharmaceutical importance via microbial oxido reductases: Process development and scale-up	Dr P Binod
21	DBT	Waste to wealth: Development of green process for the production of second generation biofuel from crop wastes	Dr R Sindhu
22	DST	Integrated technologies for economically sustainable bio-based energy	Dr Rajeev K Sukumaran
23	DST	Improved cultivation, taxonomy and functional characterization of rare and novel rhizobacterial genomes of plants grown in abiotic stress soils	Dr N Ramesh Kumar
24	Ministry of Earth Sciences	Bio prospecting and taxonomic studies of marine micro organisms in search of novel anti-infectives	Dr N Ramesh Kumar
25	TIFAC	Centre for bio fuels Phase II	Dr Rajeev K Sukumaran
26	DST	Hydrotropic assisted pre-treatment of ligno cellulosic biomass and adsorptive removal of fermentation inhibitors formed during pre-treatment	Dr Leena Perumal Devendra
27	DBT	Characterization, recombinant expression, process scale up validation of selected hydrolases from native action bacteria for commercial exploitation	Dr Rajeev K Sukumaran
28	KSCSTE	Molecular approach to enhance folate production in probiotic lactic acid bacteria	Dr K Madhavan Nampoothiri
29	SERB, DST	Bio prospecting of micro algal resources for nutritionally important high value lipid production	Dr Muthu Arumugham
30	DBT	Investigation on the synergistic effect of phytohormones on omega -3- fatty acid production from nanochloropsis sp.	Dr Muthu Arumugham
31	M/s T Stanes & Company Ltd	The development of stabilized formulations of biopesticides and biofertilizers	Dr Rajeev K Sukumaran

CHEMICAL SCIENCES & TECHNOLOGY DIVISION

32	MNRE	Dye Sensitized Solar Cell (DSSC) quantum dot dye sensitized solar cell	Dr Joshy Joseph
33	DST	Design and synthesis of multifunctional organic – DNA conjugates for biomolecular applications	Dr Joshy Joseph
34	DST	Cucurbit[n] uril homologues and their derivatives as receptors for a few ionic and neutral analytes	Dr Rakesh Mishra
35	DST	Design a smart drug delivery system using activatable cell penetrating peptides scaffold- based non- peptide carriers for targeting human cancer	Dr K K Maiti
36	DBT	Detection of zinc in epileptic condition using ratiometric fluorescent molecular probes	Dr A Ajayaghosh
37	DST	Development of novel organic materials for photovoltaic applications	Dr C Vijayakumar
38	DST	Development of semi conducting push pull polymers for photo voltaic applications	Dr B Bijitha
39	SERB	Utilization and activation of CO2 via transition metal-mediated insertion reaction: A computational study	Dr V Prabha
40	KSCSTE	Silver starch hydrogel hybrid nanocomposite for anti microbial wound healing applications	Dr J D Sudha
41	KSCSTE	Synthesis utility of dien aminodioate for synthesis of 1,2-Dihydropyridines and its resulting derivatives for evaluational of their anti microbial, anti tuberculosis & anti malarial potential	Dr L Ravishankar
42	KSCSTE	Design, synthesis and structural properties of fluorescent protein chromophore based on organic material. Metal organic framework membranes over porous substrate for Carbon Capture and Sequestration (CCS) applications	Dr K Manoj
43	DST	Solar Hydrogen: An alternative avenue	Dr Suraj Soman
44	DST	Stimuli induced phase transition : A facile route to module optical properties in molecular crystals	Dr Sunil Varughese
45	DST	Novel protocols for the construction of carbon-carbon and carbon- Hetero atom bonds mediated by nucleophilic hetero cyclic carbenes and phosphines	Dr K V Radhakrishnan
46	DST	Transition metal/ Lewis acid mediated reactions of strained diazanorbornes and carbonyl compounds: Efficient access to biologically relevent scaffolds	Dr K V Radhakrishnan
47	DST	Sulfonimidamides: Its synthesis and applications in organic synthesis; Development of new methodologics for the synthesis of hetrocyclic systems	Dr Ganesh Chandra Nandi
48	DST	Fluorescent molecules and assemblies for sensing and imaging(J C Bose Fellowship)	Dr A Ajayaghosh

49	DST (FAST TRACK)	Design, synthesis and studies of self-assembling luminescent metallo- peptides	Dr V K Praveen
50	DST (FAST TRACK)	Development of a Knoevenagel condensation/dipolar cycloaddition strategy towards highly functionalized heterocycles and its applications in medicinal/ material chemistry & chemical biology	Dr Jubi John
51	DST	Charge carrier transport in polymeric and organic semiconducting thin films for application in light emitting diodes, field-effect transistors and photovoltaic devices	Dr K N Narayanan Unni
52	DST	Investigation of ultra fast dynamics of chromophores involved in singlet exciton fission processes towards solar cell applications	Dr Karunakaran Venugopal
53	SERB, DST	Synthesis a library of Aza-C KRN 7000 and Aza galacto lipid analogues for immunomodulatory screening	Dr L Ravishankar
54	KSCSTE	Development of synthetic strategies for diverse compound collection of privileged structural motifs for medicinal chemistry	Dr L Ravishankar
55	DST	New materials for improved, cost-effective perovskites solar cells	Dr Joshy Joseph
56	SERB	Nano structured electrodes for energy storage devices	Dr Raghi Raghavan
57	DBT	Gold nanorod based targeted nanoprobe for cancer theranostics: Diagnosis by Surface Enhanced Raman Scattering (SERS) and fluorescence imaging and therapy by PDT and PTT	Dr K K Maiti
58	SERB	Modulating the morphology and molecular packing of self-assembled organic nanomaterials for efficient photo-induced electron transfer	Dr K Yoosaf
59	ISRO	Development of flexible solar cells through innovative photoanode/ Active later systems	Dr J D Sudha
60	DST	Low cost photonic device for diagnostic applications	Dr Animesh Samantha
61	SERB	Quantum chemical modeling of CC and CN metathesis reactions and functional molecules containing unusual carbon-metal bonds	Dr C H Suresh
62	DST	Dynamic molecular, suprsmolecular and surface chemistry for spatiotemporal modulation of smart advanced functional materials	Dr Sreejith Shankar Pooppannal
63	DBT	Development of novel NIR absorbing sensitizers and their nano-conjugates for the multi model cancer imaging and therapy	Dr Joshy Joseph
64	GAIL(India) Ltd	Organic based hybrid thermoelectric materials for low cost refrigeration usage	Dr Biswapriya Deb
65	M/s Aasha Biochem	Developing methodology for converting oxyresveratrole to its synthetic derivatives	Dr K V Radhakrishnan
66	DST	Development of iron based superconductors	Dr U Syamaprasad

MATERIALS SCIENCE & TECHNOLOGY DIVISION

67	DST	Development of Mg Sb based alloy for high temp. Applications	Dr U T S Pillai
68	NORITAKE	Adsorbents for gas and vapour molecules. Rational design of materials , porous nano structures and surface chemistry	Dr S Ananthakumar
69	BRNS	Development of photo catalytic reactor based on the wide spectrum nanotitania- organic hybrids for decomposition of dyes and recovery of precious additive / solvent on spent laser dye solution	Dr Saju Pillai
70	BRNS	Tailoring of magneto structural phase transitions near the room temperatures in inter metallic heusler alloys for the magnetic refrigeration applications	Dr M Vasundhara
71	DST	Development and pilot scale production of microwave ceramic substrates and LTCC green tapes suitable for microwave circuits	Dr K P Surendran
72	BRNS	Multicaloric effects in certain systems with magneto- structural transitions	Dr Manoj Raama Varma
73	DST	Exchange biased magnetic heterostructures	Dr Senoy Thomas
74	SERB, DST	Dielectric inks for printed electronic: Materials to Devices	Dr K P Surendran
75	DST	Aluminium –Silicon piston alloy development by squeeze casting process for strategic application	Dr M Ravi
76	KSCSTE	Metal organic framework membranes over porous subtrates for carbon capture and sequestration (CCS) Applications	Dr Seethalekshmy Sunil
77	CVRDE	Development of aluminium piston by squeeze casting technology	Dr M Ravi
78	DST	Delaminated surfactant free layered double hydroxides as multifunctional fillers for semicrystalline polymers	Dr E Bhoje Gowd
79	ICDD	Structural data of new ceramic complex oxides	Dr P Prabhakar Rao
80	DST	Development and pilot scale production of microwave ceramic substrates and LTCC green tapes suitable for microwave circuits	Dr Jose James/ Dr K P Surendran
81	DST (TSDP)	Development of ceramic membranes and setting up of a pre-pilot plant manufacturing facility	Dr U S Hareesh
82	SERB	Developments of environmentally benign inorganic pigments for energy saving cool roof and anti-corrosive applications	Dr K G Nishanth
83	DST	Technology development of recycling of aluminium (SARAPS) alloys for industrial applications	Dr M Ravi
84	DST	Synthesis and characterization of broad spectrum ultraviolet filter with visible light emission and antioxidant activity: A potential multifunctional active ingredient with multitude of applications	Dr Adersh Ashok

ENVIRONMENTAL TECHNOLOGY DIVISION

85	Coir Board, Kochi	Process development for enhancing the longevity of coir geotextiles(Coir Bhoovastra)	Dr V S Prasad
86	SERB	Development of magnetically modulated therapeutically active layered double hydroxide(LDH) as a nanomedicine with hyperthermia potential for cancer theranostics	Dr Manoj Raama Varma
87	Coir Board, Kochi	Bio plastic from poly(Lactic acid)/ Coir composites	Mr M Brahmakumar
88	Coir Board, Allepey	Process development for surface modification of coir fibers for enhanced spinnability	Dr E Bhoje Gowd
89	SERB	Designing green, self-healing coatings for metal protection	Dr K G Nishanth
90	M/s Schneider Electric DRC, France	Nano ceramic smart fillers for improving the thermal dissipation property of eproxy polymer dielectrics	Dr S Ananthakumar
91	DST	Novel hybrid nanostructured surface modified electrodes for sensors and biosensors	Dr K P Prathish
92	DSIR	Common research and technology development- Hub for environmental intervention in the MSME Sector	Dr Ajit Haridas
93	DST	Algal biomass as a potential renewable resource of energy: Production of fuels & chemicals by heterogeneous catalysis	Dr Churchil Angel Antony Raj
94	DST	Development of hydrothermal liquefaction of microalgae for production of bio-oil	Dr Paneerselvam
95	Kerala State Pollution Control Board	Determination of emission factors of dioxins from open burning of municipal wastes in Kerala	Dr K P Prathish
96	DST	Development of chloride free saleable iron oxide from by-products of Titanium pigment production via chloride route	Dr K P Prathish
97	Department of Environment and Climate Change	Biodrying: A comprehensive model waste management scheme for Kerala	Dr Ajit Haridas
98	DST	SMART FOUNDRY (SMART= Sustainable Metal casting using Advanced Research and Technology	Dr S Savithri

CONSULTANCY PROGRAMMES 2016-17

SL No	CLIENT	PROJECT TITLE	PROJECT LEADER
1	Dept of Agriculture, Govt of Kerala	Setting up of a ginger processing facility in Wayanad	Mr V V Venugopal
2	M/s Santhigram , TVM	Perfection of ideas on molt type processing of quality jackfruit seeds into value added products & exploration of the feasibility of commercialization of the product	Dr P Nisha
3	M/s Brahmins Food India Pvt Ltd	Technical consultancy for technology upgradation of breakfast powder unit	Mr V V Venugopal/ Mr M M Sreekumar
4	M/s Sreedhareeyam Ayurvedic Medicines Pvt Ltd	Development of food formulations/ drinks and modernization of ayurvedic manufacturing facility	Mr V V Venugopal/ Mr M M Sreekumar
5	M/s Arbee Bio Marine Pvt Ltd , Mysore	Hydrogenation of fish oil sample	Mr M M Sreekumar
6	M/s HLL Lifecare Ltd, Trivandrum	Polymer Nanocomposites	Dr E Bhoje Gowd
7	M/s SRF Ltd	Microstructure analysis of Nylon-6 and polyster industrial yarns	Dr E Bhoje Gowd
8	JNTBGRI, TVM	Taxonomy studies of western Ghats plants studies through morphological characterization	Dr P Prabhakar Rao
9	SRF Ltd, Chennai	Microstructure analysis of Nylon-6 and PET industrial yarns	Dr E Bhoje Gowd
10	M/s V V Minerals	Pilot plant scale demonstration of metallisation of ilmenite and its subsequent rusting in the beneficiation of ilmenite	Dr H K Bhat
11	M/s HLL Lifecare Ltd, Trivandrum	Characterization of latex/Polymer nanocomposites	Dr E Bhoje Gowd
12	KMML	EIA for KMML project	Mr J Ansari
13	KMML	EIA study for KMML pond	Mr J Ansari
14	Mr Cyriac Thomas	Coir composite horticulture box	Dr V B Manilal
15	T D B	Odour control of 5 MLD STP Sannidhanam	Dr Ajit Haridas

16	3D Foundry Tech Pvt Ltd	Additional module for Flow+ for prediction of fill related and soldification related defects in investment casting process	Dr S Savithri
17	IRE	EIA study for IRE block IV& IV EE, Kollam	Mr J Ansari
18	KUIDFC Ltd	Odour control for 500 TPD MSW composting at Kudlu and Lingadheernahalli	Dr Ajit Haridas
19	Akash Fishmeal and Fishoil Private Limited	Fish meal factory effluent treatment & odour control	Dr Ajit Haridas
20	Matsyafed, KSCFFDL, TVM	Fish stall odour control	Dr Ajit Haridas
21	IRE Ltd	EIA and EMP study for IREL NK Block-II & NK Block-II EE	Mr J Ansari
22	Matsyafed, KSCFFDL, Alappuzha	Fish meal factory effluent treatment & odour control	Dr Ajit Haridas
23	Kerala State Remote Sensing & Environment Centre	Analysis of heavy metals in water samples	Dr K P Prathish

MoUs / AGREEMENTS SIGNED

Sl No	Title	Date of signing	Nature of the MoU	Name of the firm/firms with whom the MoU/Agreement is entered into	Project leader
1	Determination of emission factors of dioxins from open burning of municipal wastes in Kerala	18.04.2016	Agreement	Kerala State Pollution Control Board, Pattom, Thiruvananthapuram	Dr K P Prathish
2	EIA & EMP study for mining area IREL NK Block-II & NK Block-IIE	26.04.2016	Agreement	IRE	Mr J Ansari
3	Development of ceramic adsorbents for gas and vapour molecules	18.05.2016	Agreement Extension	M/s Noritake Co.Limited 1-36 Noritake-shinmachi 3 chome, Nishi-ku Nagoya 451-8501, Japan	Dr U S Hareesh
4	Scientific analysis of different medicinal plants & Conservation of endangered plants	30.05.2016	MoU	Calicut University	Dr K V Radhakrishnan
5	Agreement for collaborative Research between CSIR-NIIST and Mailhem IKOS Environment Pvt Ltd - Anaerobic digester cum biogas plant for household organic waste	01.06.2016	Technology Transfer	M/s Mailhem IKOS Environment Pvt Ltd, 14, Vishrambaug Bhawan, Apte Road Pune-411 016	Dr B Krishnakumar
6	Agreement for collaborative Research between CSIR-NIIST and DBT	16.06.2016	Agreement	JNTBGRI, Palode	Dr Rajeev K Sukumaran
7	Agreement for collaborative Research between CSIR-NIIST and DBT	21.06.2016	Agreement	JNTBGRI, Palode	Dr P Jayamurthy
8	Agreement between Arshveda and CSIR-NIIST	27.06.2016	Agreement	M/s Arshveda Solvency efficacy of medicated oils (Thaila Murchanam)	Mr V V Venugopal

9	Blue Pigment	28.06.2016	Non Disclosure Agreement	M/s Shepherd Colour Company, USA	Dr S Ananthakumar
10	Agreement for joint Research between CSIR-NIIST and RGCB, Thiruvananthapuram	29.06.2016	Agreement	Rajiv Gandhi Centre for Biotechnology Thiruvananthapuram 695 014	Dr L Ravishankar
11	Procurement of license for biofilter technology	07.07.2016	Technology Transfer	M/s Elixir Enviro Systems Pvt Ltd, Alappuzha	Dr Ajit Haridas
12	Plant Scale metallisation and chemical beneficiation studies on low grades of ilmenites for the production of upgraded ilmenites	07.07.2016	Agreement	V V Mineral, 17/C, Thirunelveli	Dr Harikrishna Bhat
13	Process development for enhancing the longevity of coir geo textiles (COIR BHOOVASTRA)	03.08.2016	MoU	Coir Board, Registered at Coir House, M G Road, Kochi- 682 016	Dr V B Manilal
	Bio- Plastics from poly(Lactic Acid)/ Coir Composites	03.08.2016	MoU	Coir Board, Registered at Coir House, M G Road, Kochi- 682 016	Dr V B Manilal
	Process development for surface modification of coir fibers for enhanced spin ability	03.08.2016	MoU	Coir Board, Registered at Coir House, M G Road, Kochi- 682 016	Dr V B Manilal
14	Exploring lanthanum phosphate based crucibles for use in metallurgical applications	05.08.2016	NDA	M/s Ants Ceramics Pvt Ltd, Unit No:1, Jivdhani Industrial Estate No 1, Off Western Express Highway, Dhumal Nagar, vasai East, Palghar- 401 208, Maharastra	Dr U S Hareesh
15	Development in various multi disciplinary and cutting edge areas including traditional knowledge and plant based natural products	11.08.2016	MOU	M/s Jawaharlal Nehru Tropical Botanic Garden and Research Institute, Palode, Trivandrum	Dr. K V Radhakrishnan

16	Development of sunlight active self cleaning coatings based on photo catalytic titania and hydro phobic coatings based on lanthanum phosphate	02.09.2016	Confidentiality Agreement/ Material transfer Agreement	M/s H R Johnson India Pvt Ltd, Maharashtra	Dr U S Hareesh
17	Alumina based HTCC and LTCC substrates for hybrid microelectronic circuits in strategic sector applications	19.09.2016	MoU	M/s Ants Ceramics Pvt Ltd, Unit No:1, Jivdhani Industrial Estate No 1, Off Western Express Highway, Dhumal Nagar, vasai East, Palghar-401 208, Maharashtra	Dr K P Surendran
18	Consultancy for modernization of Sreedhareeyam ayurvedic medicines Pvt Ltd, Koothattukulam	28.09.2016	Agreement	M/s Sreedhareeyam ayurvedic medicines Pvt Ltd, Koothattukulam	Mr M M Sreekumar
19	Development of latex nano composites	30.09.2016	Agreement	M/s HLL Lifecare Ltd, HLL Bhavan, Poojapura	Dr E Bhoje Gowd
20	Development in various multidisciplinary and cutting edge areas including traditional knowledge and plant based natural products	06.10.2016	Agreement	Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram 695 014	Dr K V Radhakrishnan
21	Development of stabilised liquid & powder	24.10.2016	Agreement	T Stanes Co Ltd, 8/23-24, Race Course Road, Coimbatore - 641 018 Tamil Nadu	Dr Madhavan Nampoothiri
22	Occurrence of acrylamide, a heat induced food toxicant, in processed food products of India: Mitigation strategies and health risk	02.11.2016	MoU	Food Safety & Standards Authority of India, Ministry of Health & Family Welfare(FSSAI)	Dr P Nisha
23	Fish meal factory effluent treatment & odour control	22.11.2016	MoU	Matsyafed Fish Meal & Oil Control	Dr Ajit Haridas

24	SMART FOUNDRY - 2020	28.11.2016	MoU	IIT, MEFGI, CHARUSAT	Dr S Savithri
25	Research leading to product development and clinical applications	02.01.2017	MoU	M/s Regional Cancer Centre, Medical College P O, Trivandrum - 695 011	Dr K K Maiti
26	Rare earth phosphate powders and rare earth blue pigment powders (Trial Materials)	06.01.2017	NDA and Trial Materials Transfer Agreement	M/s Krishna Conchem Products Pvt. Ltd., #2, Bldg.#.6, Sector 3, Millennium Business Park, Mahape, Navi Mumbai - 4000710	Dr U S Hareesh
27	Develop colloidal gold particle 9CGP) conjugated antibody system for the detection of Malaria	06.01.2017	Agreement for Collaboration	M/s HLL Lifecare Ltd., HLL Bhavan, Poojappura, Trivandrum - 695012, Kerala	Dr K K Maiti
28	Industrial evaluation of IR reflective inorganic Blue pigment	30.01.2017	NDA & Material Transfer Agreement	M/s Ferro Corporation Company, 6060 Parkland Blvd, Suite 250 Mayfield Heights, OH44124, USA	Dr S Ananthakumar
29	Hydrogenation of fish oil and isolation of squalline from Rice bran oil distillate	13.02.2017	Agreement for Sponsored Project	M/s Arbee Biomarine Extracts Pvt.Ltd., 13/ P2, Thandya Industrial Area, Thandavapura, Nanjangud, Mysore - 571301601	Mr M M Sreekumar
30	Production of bioactive components of fish oil	07.03.2017	Agreement for Consultancy Project	M/s Aasha Biochem, 10/363 Chorode, Vatakara, Kozhikode, Kerala 673106	Dr K V Radhakrishnan
31	Research leading to product development and clinical applications	09.03.2017	MoU	M/s Regional Cancer Centre, Medical College P O, Trivandrum - 695 011	Dr K K Maiti

PATENTS
FILED IN INDIA

NFNO	TITLE	INVENTORS	COMP. FILING DATE	APPLICATION NO.
0171NF2016/IN	Low Cost Bio-Based Ionic Liquid Crystal Membrane Usefu, Ml For Energy Storage Systems & Preparation Thereof.	Ayyappanpillai Ajayaghosh, Janardhanan Devaki Sudha, Sasi Renjith, Nallathamby Kalaiselvi, Bongu Chandrasekhar	16-Aug-16	201611027797
0122NF2016/IN	A Novel Diketopyrole Supramolecular Black Dye And Elastomer As A Near Infrared Filter	Ayyappanpillai Ajayaghosh, Samrat Ghosh	20-Jan-17	201711002216

FILED ABROAD

NFNO	TITLE	INVENTORS	COMP. FILING DATE	APPLICATION NO.
147NF2009/DE	Novel Porphyrin Derivatives For Photodynamic Therapy (Pdt): A Process For The Preparation Thereof And Their Use As Pdt Agents And Fluorescence Probes For Biological Applications	Danoboyina Ramaiah, Suneesh C Karunakaran, Vadakkancheril S Jisha, Tavarekere K Chandrashekhar, Alagar Srinivasan, Madhavan Radhakrishna Pillai, Sivakumari Asha Nair, Saneesh Babu P Saras, Chintalagiri Mohan Rao, Kunchala Sridhar Rao	04-May-16	11711133.6
0147NF2009/FR	Novel Porphyrin Derivatives For Photodynamic Therapy (Pdt): A Process For The Preparation Thereof And Their Use As Pdt Agents And Fluorescence Probes For Biological Applications	Danoboyina Ramaiah, Suneesh C Karunakaran, Vadakkancheril S Jisha, Tavarekere K Chandrashekhar, Alagar Srinivasan, Madhavan Radhakrishna Pillai, Sivakumari Asha Nair, Saneesh Babu P Saras, Chintalagiri Mohan Rao, Kunchala Sridhar Rao	04-May-16	11711133.6

0147NF2009/ GB	Novel Porphyrin Derivatives For Photodynamic Therapy (Pdt): A Process For The Preparation Thereof And Their Use As Pdt Agents And Fluorescence Probes For Biological Applications	Danoboyina Ramaiah, Suneesh C Karunakaran, Vadakkancheril S Jisha, Tavarekere K Chandrashekhar, Alagar Srinivasan, Madhavan Radhakrishna Pillai, Sivakumari Asha Nair, Saneesh Babu P Saras, Chintalagiri Mohan Rao, Kunchala Sridhar Rao	04-May-16	11711133.6
0082NF2013/ US	Self Healing Silica Based Low K Dielectric Ink For Printed Electronic Applications	Kuzhichalil Peethambharan Surendran, Mailadil Thomas Sebastian, Jobin Varghese	10-Jun-16	15/103,719
0082NF2013/ EP	Self Healing Silica Based Low K Dielectric Ink For Printed Electronic Applications	Kuzhichalil Peethambharan Surendran, Mailadil Thomas Sebastian, Jobin Varghese	10-Jun-16	14833475.8
0082NF2013/ JP	Self Healing Silica Based Low K Dielectric Ink For Printed Electronic Applications	Kuzhichalil Peethambharan Surendran, Mailadil Thomas Sebastian, Jobin Varghese	13-Jun-16	2016-539173
0082NF2013/ CN	Self Healing Silica Based Low K Dielectric Ink For Printed Electronic Applications	Kuzhichalil Peethambharan Surendran, Mailadil Thomas Sebastian, Jobin Varghese	22-Jul-16	201480073944X
0170NF2010/ US	Molecular Probes With High Fluorescence For Solid-State Lighting, Selective Discrimination Of Counterions Of Zinc, Two Photon Imaging	Ayyappanpillai Ajayaghosh, Kizhumuri P. Divya, Sampath Srinivasan	04-Oct-16	15/285363

0112NF2014/ US	New Inorganic Blue Pigments From Cobalt Doped Magnesium Having Transition Element Oxides And A Process For The Preparing The Same	Padala Prabhakar Rao, Saraswathy Divya	15-Nov-16	15/311423
0112NF2014/ CN	New Inorganic Blue Pigments From Cobalt Doped Magnesium Having Transition Element Oxides And A Process For The Preparing The Same	Padala Prabhakar Rao, Saraswathy Divya	17-Nov-16	2015800266277
0277NF2013/ WO	A Bioprocess For Reducing Perchlorate And/Or Nitrate	Krishnakumar Bhaskaran, Anupama Vijaya Nadaraja	30-Dec-16	PCT/ IN2016/050464
0164NF2014/ WO	A Thermo - Laminated Multilayered Zircon Based High Temperature Co-Fired Ceramic (Htcc) Tape And The Process Thereof	Kuzhichalil Peethambharan Surendran, Mailadil Thomas Sebastian, Jobin Varghese	10-Jan-17	PCT/ IN2017/050014

GRANTED IN INDIA

TITLE	INVENTORS	GRANT DATE	PATENT NO.
A Reusable Thiophene End-Capped Bipyridine Fluorescent Assay For Selective Detection Of Cyanide Anions In Aqueous And Biorelevant Samples And Process Thereof	Ayyapanpillai Ajayaghosh, Sivaramapanicker Sreejith, Kizhumuri P. Divya, Puroshothaman Jayamurthy	13-Aug-16	274930
Multifunctuinal Alcohols Obtained From Cardanol, Multifunctional Acrylic Crosslinker And Pendant Phosphorous Flame Retardant Derivatives Thereof	Vadakkethonippurathu Sivankutty Nair Prasad, Chennakkattu Krishna Sadasivan Pillai	29-Sep-16	276033
Magnetic Dye-Adsorbent Catalyst	Shukla Satyajit Vishnu, Warrier Krishna Gopakumar, Manoj Raama Varma, Madadhin Thazhe Lajina, Narayani Harsha, Chalappurath Pattelath	21-Oct-16	276454
An Improved Method And A Device For Separation Of Fats And Suspended Solids From Wastewater	Vattackatt Balakrishnan Manilal, Ajit Haridas	23-Jan-17	279467
Preparation Of Green Colorant From Mixed Rare Earth And Molybdenum Compounds And Process Thereof As Surface Coatings	Mundlapudi Lakshmipathi Reddy	24-Feb-17	280655

GRANTED ABROAD

TITLE	INVENTORS	GRANT DATE	PATENT NO.
Novel Porphyrin Derivatives For Photodynamic Therapy (Pdt): A Process For The Preparation Thereof And Their Use As Pdt Agents And Fluorescence Probes For Biological Applications	Danoboyina Ramaiah, Suneesh C Karunakaran, Vadakkancheril S Jisha, Tavarekere K Chandrashekhar, Alagar Srinivasan, Madhavan Radhakrishna Pillai, Sivakumari Asha Nair, Saneesh Babu P Saras, Chintalagiri Mohan Rao, Kunchala Sridhar Rao	04-May-16	2526103
Semiconductor Oxide Nanotubes-Flyash And Semiconductor Oxide Nanotubes-Metal Oxide Composite Particles, Their Processing Via Ion-Exchange Mechanism, And Methods For Their Recycling In The Dye-Removal Application Thereof	Shukla Satyajit Vishnu, Padinhattayil Hareesh, Narayani Harsha, Jose Manu, Karunakaran Remya	21-Jul-16	I 542564
A Novel Economicical And Efficient Process For Commercial Production Of High Purity Lignans Frm Sesame Oil	Chami Arumugham, Chandrasekharan Pillai Balachandran, Mullan Velandy Reshma, Andikannu Sundaresan, Shiny Thomas, Divya Sukumar, Syamala Kumari Sathyanandan Saritha	28-Jul-16	11 2008 000 860
Metal Oxide Modified And Unmodified Molecularly Imprinted Conducting Polymer Film Based Aqueous Aminoacid Sensors	Varghese Saumya, Krishna Pillai Padmaja Kumari Prathish, Talasila Prasada Rao	14-Oct-16	6022480
Molecular Probes With High Fluorescence For Solid-State Lighting, Selective Discrimination Of Counterions Of Zinc, Two Photon Imaging	Ayyappanpillai Ajayaghosh, Kizhumuri P. Divya, Sampath Srinivasan	15-Nov-16	9493488
A Process For Decomposition Of Organic Synthetic Dyes Using Semiconductor-Oxides Nanotubes Via Dark Catalysis.	Shukla Satyajit Vishnu, Warrier Krishna Gopakumar, Babu Babitha Kunnathuparambil	28-Mar-17	9604859

ज्ञान संसाधन केन्द्र

सूचना सेवा

सूचना बूम के युग में शोधकर्ताओं को एस. एंड टी. सूचना सेवा प्रदान करने के उद्देश्य से ज्ञान संसाधन केंद्र की स्थापना की गई है। केंद्र द्वारा अंतर्विषयी अनुसंधान में सक्रिय रूप से लगे हुए वैज्ञानिकों, तकनीकी व्यक्तियों और शोध विद्वानों की ज़रूरतों को पूरा किया जाता है। केंद्र स्वचालित है और ई-शासन के मानदंडों की पुष्टि करता है। वर्ष 2016-17 की अवधि के दौरान, के.आर.सी. ने पुस्तकों, वैज्ञानिक सामग्रियों, डेटाबेस और पी.एच.डी. थीसिस के सूचना संसाधनों के संग्रह का एन्हांस किया और संस्थान के सभी स्टाफ सदस्यों को और आसपास के अन्य अनुसंधान एवं विकास तथा शैक्षणिक संस्थानों से आये विद्वानों के लिए सूचना सेवाएं प्रदान करना जारी रखा। इसके वर्तमान संग्रह में 13536 पुस्तकें, 10947 मानक और 11387 पत्रिकाओं के बाउंड वॉल्यूम शामिल हैं। वर्ष 2016-17 के दौरान 23 हिंदी पुस्तक सहित 123 नई पुस्तकों को संग्रह में जोड़ा गया और 25 विदेशी और 29 भारतीय पत्रिकाओं के लिए सदस्यता ली गई। इसके अतिरिक्त 3 पत्रिकाऐं और 28 पुस्तकें मुफ्त में प्राप्त हुई। केंद्र द्वारा एस. सी.आई.फाईंडर, विज्ञान की वेब, डेरवेंट अभिनव सूचकांक, क्यूपेट ए.एस.टी.एम. जैसे विभिन्न ई-पत्रिकाओं, खुले संसाधनों और डेटाबेसों के लिए पहुंच प्रदान करता है। एन.आई.आई. एस.टी शोधकर्ताओं की अतिरिक्त सूचना की आवश्यकताओं को अन्य सी.एस.आई.आर, डी.एस.टी. संस्थानों से संसाधन के साझा करने के माध्यम से पूरा किया जाता है। पारंपरिक सेवाओं के अलावा, वैज्ञानिकों और छात्रों के अनुरोध पर साहित्य खोज, पेटेंट खोज और प्रशस्ति पत्र विश्लेषण किया गया। के.आर. सी. ने उच्च गुणवत्ता वाली पत्रिकाओं में शोध पत्र प्रकाशित करने के लिए और साहित्यिक चोरी की जांच और पूर्व कला खोज में शोधकर्ताओं की मदद की है। के.आर.सी. संस्थान की वेबसाइट, सोशल मीडिया पृष्ठों और संस्थागत रिपोजिटरी का प्रबंधन, रखरखाव और उद्यतन भी करता है। वर्तमान में, आई.आर में 2122 जर्नल लेख, 264 पी.एच.डी. थीसीस और 186 समाचार आइटम होते हैं। केंद्र ने एक द्विवार्षिक न्यूज़लेटर एन.आई.आई.एस.टी. समाचार प्रकाशित किया हैं। के.आर.सी. संदर्भ प्रबंधन सॉफ्टवेयर, साहित्य खोज, पूर्व कला खोज, खुली पहुंच, अनुसंधान मूल्यांकन, सोशल मीडिया, साहित्यिक चोरी की रोक, प्रभावी संचार आदि पर शोधकर्ताओं को नियमित रूप से प्रशिक्षण प्रदान करते हैं।

सूचना प्रौद्योगिकी सेवाएं

प्रयोगशाला की सभी इंटरनेट आवश्यकताओं को पूरा करने के लिए आईटी प्रयोगशाला समय समय पर इसके मौजूदा इंट रनेट बैंडविड्थ को बढ़ाती है। वर्तमान में, प्रयोगशाला एन के एन से 100 एमबीपीएस पट्टे लाइन और बीएसएनएल से 24 एमबीपीएस पट्टे लाइन के साथ जुड़ा हुआ है। केंद्र की तरफ से वैन-आधारित अनुसंधान सहयोग को सक्षम करने के लिए परस्पर जुड़े (एन.के.एन. बी. डब्लू) सभी शोध संस्थानों में राष्ट्रीय ज्ञान नेटवर्क बैंडविड्थ (एन.के.एन.बी.डब्लू) का प्रबंधन करता है। परिसर में सभी इमारतों को गीगाबाइट फाइबर ऑप्टिक बैकबोन और निजी कंप्यूटरों को वी.एल.ए.एन.एस. के माध्यम से जोड़ा जाता है। वर्ष 2016-17 के दौरान स्कोलर्स हॉस्टल, निदेशक का बंगला, मुख्य भवन, फाउंड्री, पी.ई.ई.टी. और ई.एन.वी.टी बिल्डिंग में 160 इंटरनेट पोर्टों को जोड़ा गया जिससे वायर्ड और वायरलेस नेटवर्क के माध्यम से कुल इंटरनेट कनेक्शन की संख्या 1000+ हो गयी। घर से कार्यालय कंप्यूटर को कनेक्ट करने के लिए वैज्ञानिकों को सुरक्षित वी.पी.एन. कनेक्टिविटी प्रदान की गई।

सभी उपयोगकर्ताओं को हाई स्पीड कनेक्टिविटी प्रदान करने के लिए एन.आई.आई.एस.टी डेटा सेंटर उच्च अंत सर्वर, भंडारण उपकरणों, यू.टी.एम. डिवाइस और कोर स्विच का रखरखाव करता है। सुरक्षित और प्रभावी नेटवर्क प्रबंधन के लिए एस.ओ. पी.एच.ओ.एस. से एक उच्च अंत यू.टी.एम. डिवाइस शामिल किया गया। 100% थ्रूपुट और >99% नेटवर्क अपटाइम के साथ 24x7 सेवाएं महत्वपूर्ण अनुप्रयोगों के बैंडविड्थ और इंटरनेट ब्राउज़िंग, डेटा अपलोड/डाउनलोड, ईमेल, वीडियो कॉन्फ्रेंसिंग आदि को पूरा करता है। डेटा सेंटर में इस वर्ष प्रेसिजन ए सी स्थापित किया गया था और सभी यू.पी.एस. को अलग कमरे में स्थानांतरित कर दिए गए। केंद्र ने बुनियादी ढांचे, संसाधनों और सेवा, दोनों प्रदान करने में महत्वपूर्ण प्रगति की है। केन्द्र की तरफ से आधार सक्षम बॉयोमीट्रिक उपस्थिति प्रणाली

के सुचारू संचालन को सुनिश्चित करता है; स्टाफ, शोध छात्रों और पेंशनभोगियों को संस्थागत पहचान पात्र जारी करता है। सी.एस.आई.आर के दिशानिर्देशों के आधार पर संस्थागत ई-मेल सेवा को ज़िम्ब्रा से एन.आई.सी. डोमेन में माइग्रेट किया गया। कर्मचारियों और शोध छात्रों के सभी ई-मेल आई.डी. भी माइग्रेट किए गए। वैज्ञानिकों की भर्ती के लिए ऑनलाइन आवेदन प्राप्त करने के लिए सॉफ्टवेयर अनुप्रयोग ऑनलाइन भर्ती प्रोसेसिंग सिस्टम लागू किया गया और सफलतापूर्वक कार्यन्वित किया गया। कर्मचारी, उनके परिवार के सदस्यों और पेंशनभोगियों के लिए संचालित प्रयोगशाला परीक्षणों के रिकॉर्ड को बनाए रखने के लिए एक एप्लिकेशन कार्यान्वित किया गया और प्रयोगशाला रिपोर्टों को देखने के लिए प्रावधान भी किया जाता है। एन-ा.आई.आई.एस.टी. की चालू परियोजनाएं, कार्यालय ज्ञापनों, नोटिसें, परिपत्रों, प्रपत्रों, पत्रिकाओं का उपयोग और चालू गतिविधियों को शामिल करने के लिए एक नया इंट्रानेट पोर्टल नियोजित किया गया। इसके अलावा, एच.आर.टी.ई.एम. और अन्य उच्च अंत उपकरणों की बुकिंग के लिए ऑनलाइन इंस्ट्रुमेंट बुकिंग सिस्टम के लिए एप्लिकेशन नियोजित किया गया। केंद्र ने ई.आर.पी. कार्यान्वयन के एकीकरण और आसान कामकाज के लिए विभिन्न समूहों को समन्वित किया और सुविधा प्रदान की। संस्थागत वेबसाइट के द्वीभाषी रूप में नियमित रखरखाव और नवीनीकरण के अलावा दो अंतर्राष्ट्रीय सम्मेलनों के लिए वेबसाइटों के विकास में भी यह केंद्र शामिल है, अर्थात् सी. एस.एम.ए.टी 2017 और ई.ए.एस. 8। सॉफ्टवेयर संस्थापना, पुनर्स्थापना, मरम्मत, सॉफ़्टवेयर उद्यतन, नेटवर्क और आई. टी. से संबन्धित मुद्दों को हल करने के लिए के.आर.सी. एक सहायता डेस्क को बनाए रखता है।

प्रयोगशाला द्वारा भंडार व क्रय सॉफ्टवेयर, डी-स्पेस और कोहा, लिबस्यूट, केमड्रा, सिग्माप्लॉट, ओरजिन और एज़प्रोक्सी जैसे विभिन्न अनुप्रयोगों का भी प्रबंधन करता है। अनुप्रयोगों, मेल और वेबसाइट की सामग्री का आवधिक बैकअप उत्पन्न करके और सर्वर ग्रेड एंटीवयरस सॉफ़्टवेयर को नियोजित करके एक वायरस मुक्त नेटवर्क पर्यावरण हासिल किया है। हेवी-ड्यूटी रंग मल्टी फंक्शन लेज़र प्रिंटर और ए 3/ए 4 स्कैनर्स की एक विस्तृत विविधता के माध्यम से केंद्र छपाई और स्कैनिंग सुविधा प्रदान करता है। आई.टी. उत्पादों के अधिग्रहण में गुणवत्ता सुनिश्चित करने में केंद्र सहायता प्रदान करता है।

KNOWLEDGE RESOURCE CENTRE

Information Services

The Knowledge Resource Centre has been established with the objective to provide S&T information services to the researchers in the era of information boom. The centre caters to the need of scientists, technical personals and research scholars actively engaged in the interdisciplinary research. The centre is automated and confirms to the norms of e-governance. During the period 2016-17, KRC enhanced the collection of information resources of Books, Scientific Periodicals, Databases and PhD Thesis and continued to provide information services to all institute members and to walked-in research scholars from other nearby R & D and Academic institutions. Its present collection contains 13536 Books, 10947 Standards and 11387 Bound Volumes of Periodicals. During the year 123 new books including 23 Hindi books were added to the collection and 25 Foreign and 29 Indian Periodicals were subscribed. Additionally 3 periodicals and 28 books were received as gratis. The Centre provide access to various e-journals, open resources and databases viz SciFinder, Web of Science, Derwent Innovation Index, Qpat and ASTM. The additional information requirement of NIIST researchers are fulfilled through resource sharing from other CSIR, DST institutes. Apart from traditional services, Literature search, Patent search, Citation analysis were carried out on requests from scientists and students. KRC also assisted researchers to publish in high-quality journals and helped in plagiarism check and prior art search.

KRC also manages, maintain and update the institute website, Social media pages and institutional repository (IR). The IR presently consists of 2122 journal articles, 264 PhD Theses and 186 News items. The centre published a biannual newsletter 'NIIST Samachar'. KRC is regularly providing training on reference management software, literature search, prior art search, open access, research evaluation, social media for researchers, preventing plagiarism, and effective communication etc.

Information Technology Services

The internet bandwidth enhanced from time to time to fulfill the requirement of the laboratory. At present, the laboratory is linked with 100mbps leased line from NKN and 24 mbps leased line from BSNL. The centre manages National Knowledge Network Bandwidth (NKN BW) to enable WAN-based research collaboration across all the research institutes interconnected over NKN BW. All buildings in the campus are interconnected through gigabit fiber optic backbone and VLANs connecting personal computers. During 2016-17, 160 internet ports were added to Scholars hostel, Director's Bungalow, Main Building, Foundry, PEET and ENVT Building making the total internet connection to 1000+ PCs through wired and wifi network. Secured VPN connectivity is provided to scientists to connect PCs to their office computers from outside the office.

The NIIST data center maintains high-end servers, storage devices, UTM devices and core switches to provide high speed connectivity to all users. A high-end UTM device from SOPHOS was included for secured and effective network management. The 24X7 services with 100% throughput and >99% network uptime cater to the bandwidth of critical applications and internet browsing, data upload/download, emails, video conferencing etc. This year Precision ACs were installed in the data centre and all UPS were shifted in a separate room. The centre made significant progress both in strengthening the infrastructure, resources and in rendering services.

The centre ensures the smooth functioning of AADHAR enabled Biometric Attendance System; issuing of Institutional identity cards for the staff, research scholars and pensioners. The institutional E-mail service from Zimbra is migrated to NIC Domain based on the guidelines from CSIR. All the e-mail ids of staff and research scholars have also been migrated. The software application "Online Recruitment Processing System" for receiving applications

online was deployed and implemented successfully for the recruitment of scientists. Application to maintain, print and view the records of medical tests conducted in NIIST laboratory. A new intranet portal was deployed to incorporate on-going projects, OMs, notices, circulars, forms, journal access and on-going activities of NIIST. Also, an application for Online Instrument Booking System was deployed for the booking of HRTEM and other high-end equipments. The centre co-ordinated and facilitated various groups for integration of the ERP implementation and smooth functioning.

The centre is involved in the development of websites for two International Conferences namely, CSMAT 2017 and EAS8 in addition to the regular maintenance, updation of institutional website in bi-lingual form. The centre is maintaining a help desk to solve the issues related to software installations, reinstallations, repairs, software updates, network and IT related issues.

The lab manages various applications like Stores and Purchase Software, D-Space and Koha, Libsuite, Chemdraw, Sigmaplot, Origin and Ezproxy. Periodic backup of the applications, mails and website contents are generated and a virus-free network environment is achieved by deploying server grade antivirus software. The centre provides printing and scanning facility through a wide variety of heavy-duty Color Multi-Function Laser Printers and A3/ A4 Scanners. The centre assist in ensuring quality in acquisition of IT products.

List of Publications 2016

1. TOM (A P), HARIDAS (A), PAWELS (R)
Biodrying Process Efficiency: -Significance of ReactorMatrixHeight,1ST GLOBALCOLLOQUIUM ON RECENT ADVANCEMENTS AND EFFECTUAL RESEARCHES IN ENGINEERING, SCIENCE AND TECHNOLOGY
Raerest; 25:130; 2016

2. GHOSH (T), GOPAL (A), NAGASAWA (S), MOHAN (N), SAEKI (A), NAIR (VC)
Following the TRMC Trail: Optimization of Photovoltaic Efficiency and Structure - Property Correlation of Thiophene Oligomers
ACS Applied Materials & Interfaces; 8(38): 25396; 2016

3. RAKHI (R B), AHMED (B), ANJUM (D); ALSHAREEF (H N)
Direct Chemical Synthesis of MnO2 Nano whiskers on Transition Metal Carbide Surfaces for Supercapacitor Applications
ACS Applied Materials & Interfaces; 8(29): 18806; 2016

4. RAMYA (AN), JOSEPH (M M), NAIR (J B), KARUNAKARAN (V), NARAYANAN (N), MAITI (K K)
New Insight of Tetraphenylethylene - based Raman Signatures for Targeted SERS Nanoprobe Construction Toward Prostate Cancer Cell Detection
ACS Applied Materials & Interfaces; 8(16):10220; 2016

5. DUTTA (D), ALEX (S M), BOBBA (K N), MAITI (K K), BHUNIYA (S)
New Insight into a Cancer Theranostic Probe: Efficient Cell-Specific Delivery of SN-38 Guided by Biotinylated Poly (vinyl alcohol)
ACS Applied Materials & Interfaces; 8(49): 33430; 2016

6. NABEELA (K), THOMAS (R T), NAIR (J B), MAITI (K K),WARRIER (K G K), PILLAI (S)
TEMPO-Oxidized Nanocellulose Fiber-Directed Stable Aqueous Suspension of Plasmonic Flower-like Silver Nanoconstructs for Ultra-Trace Detection of Analytes
ACS Applied Materials & Interfaces; 8(43): 29242; 2016

7. THOMAS (M), ILLATHVALAPPI (R), KURUNGOT (S), NAIR (B N), MOHAMED (A A P), ANILKUMAR (G M), YAMAGUCHI (T), HAREESH (U S)
Graphene Oxide Sheathed ZIF-8 Microcrystals: Engineered Precursors of Nitrogen - Doped Porous Carbon for Efficient Oxygen Reduction Reaction (ORR) Electrocatalysis
ACS Applied Materials & Interfaces; 8(43): 29373; 2016

8. JAYARAM (D T),RAMOS-ROMERO (S), SHANKAR (B H), GARRIDO (C), RUBIO (N), SANCHEZ-CID (L), GOMEZ (S B), BLANCO (J), RAMAIAH (D)
In Vitro and in Vivo Demonstration of Photodynamic Activity and Cytoplasm Imaging through TPE Nanoparticles
ACS Chemical Biology; 11(1):104; 2016

9. LINSHA (V), SHUHAILATH (K A), MAHESH (K V), MOHAMED (A A P), ANANTHAKUMAR (S)
Biocatalytic Conversion Efficiency of Steapsin Lipase Immobilized on Hierarchically Porous Biomorphic Aerogel Supports
ACS Sustainable Chemistry & Engineering; 4(9):4692; 2016

10. SASI (R), SAROJAM (S), DEVAKI (S J)
High Performing Biobased Ionic Liquid Crystal Electrolytes for Supercapacitors
ACS Sustainable Chemistry & Engineering; 4(6):3535; 2016

11. ATHUL (K R), PILLAI (U T S), SRINIVASAN (A), PAI (B C)
A Review of Different Creep Mechanisms in Mg Alloys Based on Stress Exponent and Activation Energy
Advanced Engineering Materials; 18(5):770; 2016

12. MUTHU (C), AGARWAL (S), VIJAYAN (A), HAZRA (P), JINESH (K B), NAIR (V C)
Hybrid Perovskite Nanoparticles for High-Performance Resistive Random Access Memory Devices: Control of Operational Parameters through Chloride Doping
Advanced Materials Interfaces; 3(18); 2016

13. THANVEER (T), RAMANUJAN (R V), THOMAS (S)
Magnetocaloric effect in amorphous and partially crystallized Fe40Ni38Mo4B18 alloys
AIP Advances; 6(5); 2016

14. DIWAN (U), KUMAR (V), MISHRA (R K), RANA (N K), KOCH (B), SINGH (M K), UPADHYAY (K K)
A pyrene - benzthiazolium conjugate portraying aggregation induced emission, a ratiometric detection and live cell visualization of HSO3
Analytica Chimica Acta; 929:39; 2016

15. VEDHANARAYANAN (B), NAIR (V S), NAIR (V C), AJAYAGHOSH (A)
Formation of Coaxial Nanocables with Amplified Supramolecular Chirality through an Interaction between Carbon Nanotubes and a Chiral pi-Gelator
Angewandte Chemie-International Edition; 55(35):10345; 2016

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The Chemistry and Applications of pi-Gels
Annual Review Of Materials Research; 46:235; 2016

17. RAJU (A), LAKSHMI (V), PRATAAP (R K V), RESMI (V G); RAJAN (T P D), PAVITHRAN (C), PRASAD (V S), MOHAN (S)
Adduct modified nano-clay mineral dispersed polystyrene nanocomposites as advanced corrosion resistance coatings for aluminum alloys
Applied Clay Science; 126:81; 2016

18. SANOOP (P K), ANAS (S), ANANTHAKUMAR (S), GUNASEKAR (V), SARAVANAN (R), PONNUSAMI (V)
Synthesis of yttrium doped nanocrystalline ZnO and its photocatalytic activity in methylene blue degradation
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Sequential N-Heterocyclic Carbene-Catalyzed Reactions of Enals and Cyclic Aryldiene-1, 3-Diones: Synthesis of Tricyclic Chromenones and Related Compounds
Asian Journal of Organic Chemistry; 5(12): 1447; 2016

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Synthesis of Cyclopentachromans by N-Heterocyclic Carbene-Mediated Homoenolate Annulation of Chroman-3-ene-4-ones
Asian Journal of Organic Chemistry; 5(6):778; 2016

21. MENON (R S), BIJU (A T), NAIR (V)
Recent advances in N-heterocyclic carbene (NHC)-catalysed benzoin reactions
Beilstein Journal of Organic Chemistry; 12:444; 2016

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Recent advances in N-heterocyclic carbene (NHC)-catalysed benzoin reactions
Beilstein Journal Of Organic Chemistry; 12:2124; 2016

23. RANI (D N), ABRAHAM (T E)
A potential tissue culture approach for the phytoremediation of dyes in aquaculture industry
Biochemical Engineering Journal; 115:23; 2016

24. IDRIS (A S O), PANDEY (A), SUKUMARAN(R K)
Production of endoglucanase from Trichoderma reesei RUT C30 and its application in deinking of printed office waste paper
Biologia; 71(3):265; 2016

25. SHALIN, T; SINDHU, R; PANDEY, A; FARACO, V; BINOD, P;
Production of poly-3-hydroxybutyrate from mixed culture
Biologia; 71(7):736; 2016

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Synthesis of multifunctional gamma-PGA-based superparamagnetic iron oxide nanoparticles for magnetic resonance imaging and controlled drug release
BIOLOGIA; 71(9):967; 2016

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Biomass & Bioenergy; 85:48; 2016

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Biomedicine & Pharmacotherapy; 83:1387; 2016

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Bioorganic & Medicinal Chemistry Letters; 26(7):1767; 2016

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Pretreatment of biomass Preface
Bioresource Technology; 199:1; 2016

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An evaluation of dilute acid and ammonia fiber explosion pretreatment for cellulosic ethanol production
Bioresource Technology; 199:13; 2016

32. RAGHAVI (S), SINDHU (R), BINOD (P), GNANSOUNOU (E), PANDEY (A)
Development of a novel sequential pretreatm ent strategy for the production of bioethanol from sugarcane trash
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33. SINDHU (R), BINOD (P), PANDEY (A)
Biological pretreatment of lignocellulosic biomass - An overview
Bioresource Technology; 199:76; 2016

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Production and characterization of poly(3-hydroxy butyrate-co-3 hydroxyvalerate) (PHBV) by a novel halotolerant mangrove isolate
Bioresource Technology; 201:253; 2016

35. ANUSREE (M), WENDISCH (V F), NAMPOOTHIRI (K M)
Co-expression of endoglucanase and beta-glucosidase in Corynebacterium glutamicum DM1729 towards direct lysine fermentation from cellulose
Bioresource Technology; 213:239; 2016

36. CHRISTOPHER (M), ANUSREE (M), MATHEW (A K), NAMPOOTHIRI (K M), SUKUMARAN (R K), PANDEY (A)
Detoxification of acidic biorefinery waste liquor for production of high value amino acid
Bioresource Technology; 213:270; 2016

37. DEVENDRA (L P), KUMAR (M K), PANDEY (A)
Evaluation of hydrotropic pretreatment on lignocellulosic biomass
Bioresource Technology; 213:350; 2016

38. MOHAN (A J), SEKHAR (V C), BHASKAR (T), NAMPOOTHIRI (K M)
Microbial assisted High Impact Polystyrene (HIPS) degradation
Bioresource Technology; 213:204; 2016

39. NAIR (N R), NAMPOOTHIRI (K M)BANARJEE (R), REDDY (G)
Simultaneous saccharification and fermentation (SSF) of jackfruit seed powder (JFSP) to L-lactic acid and to polylactide polymer
Bioresource Technology; 213:283; 2016

40. RANGANATHAN (P), GU (S)
Computational fluid dynamics modelling of biomass fast pyrolysis in fluidised bed reactors, focusing different kinetic schemes
Bioresource Technology; 213:333; 2016

41. SINDHU (R), BINOD (P), PANDEY (A)
A novel sono-assisted acid pretreatment of chili post harvest residue for bioethanol production
Bioresource Technology; 213:58; 2016

42. SULOCHANA (S B), ARUMUGAM (M)
Influence of abscisic acid on growth, biomass and lipid yield of Scenedesmus quadricauda under nitrogen starved condition
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250. PANNERI (S), GANGULY (P), MOHAN (M), NAIR (B N), MOHAMED (A A P), WARRIER(K G), HAREESH (U S)
Photoregenerable, Bifunctional Granules of Carbon-Doped g-C3N4 as Adsorptive Photocatalyst for the Efficient Removal of Tetracycline Antibiotic
Acs Sustainable Chemistry & Engineering; 5 (2):1610; 2017

251. PRATHAPAN(A), VARGHESE(M V), ABHILASH(S), RAJ (PS), MATHEW (A K), NAIR (A), NAIR(R H), RAGHU (K G)
Polyphenol rich ethanolic extract from Boerhavia diffusa L. mitigates angiotensin II induced cardiac hypertrophy and fibrosis in rats
Biomedicine & Pharmacotherapy;.87:427; 2017

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Recent Advances in the Chemistry of Pentafulvenes
Chemical Reviews;117 (5):3930; 2017

253. PRIYANKA (A), SINDHU (G), SHYNI(G L), RANI (MRP), NISHA (V M), RAGHU (K G)
Bilobalide abates inflammation, insulin resistance and secretion of angiogenic factors induced by hypoxia in 3T3-L1 adipocytes by controlling NF-kappa B and JNK activation
International Immunopharmacology; 42:209 ; 2017

254. RAJESHKUMAR(R), JAYARAJ(J), SRINIVASAN (A), PILLAI (U T S)
Investigation on the microstructure, mechanical properties and corrosion behavior of Mg-Sb and Mg-Sb-Si alloys
Journal Of Alloys And Compounds; 691:81; 2017

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Reduced graphene oxide based ternary nanocomposite cathodes for high-performance aqueous asymmetric supercapacitors
Electrochimica Act; 231:539; 2017

256. REMYA (R), DEB (B)
Ultrathin organic spin-on layers on indium tin oxide as a prospective tool for enhanced light throughput
Materials Letters; 186:220; 2017

257. RENJU (U A), RAO (P P), THAMPI (D S V)
Influence of phase transition from order to disorder and Philip's ionicity on the thermal expansion coefficient of pyrochlore type compositions with a multivalent environment
New Journal Of Chemistry; 41(1):245; 2017

258. RESHMITHA (T R), THOMAS (S), GEETHANJALI (S), ARUN (K B), NISHA (P)
DNA and mitochondrial protective effect of lycopene rich tomato (Solanum lycopersicum L.) peel extract prepared by enzyme assisted extraction against H2O2 induced oxidative damage in L6 myoblats
Journal Of Functional Foods; 28:147; 2017

259. ROSHNI (S B), SEBASTIAN (M T), SURENDRAN (K P)
Can zinc aluminate-titania composite be an alternative for alumina as microelectronic substrate
Scientific Reports; 7; 2017

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Gold nanoparticle patterned on PANI nanowire modified transducer for the simultaneous determination of neurotransmitters in presence of ascorbic acid and uric acid
Journal Of Applied Polymer Science; 134(1); 2017

261. SAHOO (M), JAYANNAVAR (A M)
Stokes efficiency and its stochastic properties
Physica A-Statistical Mechanics And Its Applications; 465:40; 2017

262. SANTHINI (P V), NIMISHA (G), JOHN (J), SURESH (E), VARMA (R L), RADHAKRISHNAN (K V)
Pd-Catalyzed oxidative annulation of enamides with diazabicyclic olefins: rapid access to cyclopentene fused 2-pyrrolines
Chemical Communications; 53 (11):1848; 2017

263. SARANYA (J), SHILPA (G), RAGHU (K G), PRIYA (S)
Morus alba Leaf Lectin (MLL) Sensitizes MCF-7 Cells to Anoikis by Inhibiting Fibronectin Mediated Integrin-FAK Signaling through Ras and Activation of P-38 MAPK
Frontiers In Pharmacology; 8; 2017

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Anisotropic Phase Formation Induced Enhancement of Resistive Switching in Bio-based Imidazolium Ionic Liquid Crystals
Chemistryselect; 2(1):315; 2017

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Fine tuning of compact ZnO blocking layers for enhanced photovoltaic performance in ZnO based DSSCs: a detailed insight using beta recombination, EIS, OCVD and IMVS techniques
New Journal Of Chemistry; 41(3):1007;2017

266. SHAMLA(L), NISHA (P)
Acrylamide formation in plantain (Musa paradisiaca) chips influenced by different ripening stages: A correlation study with respect to reducing sugars, amino acids and phenolic content
Food Chemistry; 222:53; 2017

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Self-Assembling and Luminescent Properties of Chiral Bisoxadiazole Derivatives in Solution and Liquid-Crystalline Phases
Journal Of Physical Chemistry B; 121(8):1922; 2017

268. SOMAN (S), CHACKO (A S), PRASAD (V S)
Semi-interpenetrating network composites of poly(lactic acid) with cis-9-octadecenylamine modified cellulose-nanofibers from Areca catechu husk
Composites Science And Technology; 141:65; 2017

269. SREELEKSHMI (R V), SUDHA (J D), MENON (A R R)
Novel organomodified kaolin/silica hybrid fillers in natural rubber and its blend with polybutadiene rubber
Polymer Bulletin; 74(3):783; 2017

270. SUDAKSHINA (B), CHANDRASEKHAR (K D), YANG (H D), VASUNDHARA (M)
Observation of complex magnetic behaviour in calcium doped neodymium manganites
Journal Of Physics D-Applied Physics; 50(6); 2017

271. SUYANA (P), GANGULY (P), NAIR (B N), MOHAMED (A P), WARRIER (K G K), HAREESH (U S)
Co3O4-C3N4 p-n nano-heterojunctions for the simultaneous degradation of a mixture of pollutants under solar irradiation
Environmental Science-Nano; 4(1):212; 2017

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Interaction between Octenidine-based Solution and Sodium Hypochlorite: A Mass Spectroscopy, Proton Nuclear Magnetic Resonance, and Scanning Electron Microscopy-based Observational Study
Journal Of Endodontics; 43(1):135; 2017

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Triazatruxene radical cation: a trigonal class III mixed valence system
RSC Advances; 7(2):821; 2017

परिक्षण एवं विश्लेषणात्मक सेवा सेल

परिक्षण और विश्लेषणात्मक सेवा सेल (टी.ए.एस.सी) द्वारा केरल और उसके आसपास के अनुसंधान विद्वानों, शिक्षाविदों और उद्योगों के परिक्षण एवं विश्लेषण की आवश्यकताओं का समन्वय होता है। अत्याधुनिक सुविधाओं वाले अत्यंत परिष्कृत विश्लेषणात्मक उपकरण उपलब्ध होने से सी.एस.आई.आर- एन.आई.आई.एस.टी. छात्रों, लघु उद्योगों और उद्यमियों की ज़रूरतों को पूरा करता है और इस तरह इन अत्याधुनिक उपकरणों का अधिकतम उपयोग होता है। यद्यपि ये उपकरण संस्थान में हो रही अनुसंधान एवं विकास गतिविधियों की आवश्यकताओं के लिए हैं, तो भी, एक नीति के रूप में एन.आई.आई.एस.टी. द्वारा इन सुविधाओं के उपयोग को भुगतान के आधार पर, सामान्य रुप से आम जनता के लिए और विशेष रूप से छात्रों के लिए विस्तार किया जाता है। इस अवधि के दौरान परिक्षण और नमूनों के विश्लेषण से बाहरी एजेंसियों और छात्रों से 18.46 लाख रुपए का राजस्व प्राप्त हुआ। उच्च रिज़ॉल्यूशन संचरण इलेक्ट्रॉन माइक्रोस्कोपी (एच.आर.टी.ई.एम) के उपयोग से 6.73 लाख रुपए प्राप्त हुए, एक्स.आर.डी. और एन.एम.आर/एस.एस. सुविधाओं से क्रमशः रु. 2.76 लाख और रु. 4.76 लाख एकत्रित किए गए। लाभार्थियों में 170 छात्र, 17 लघु उद्योग और 5 उद्योग और 47 अनुसंधान एवं विकास संस्थान शामिल हैं।

TESTING AND ANALYTICAL SERVICES CELL

Testing and Analytical Services Cell (TASC) coordinates the testing and analysis requirement of research scholars, academicians and industries in and around Kerala. Having very sophisticated analytical equipments of state of art facilities, CSIR-NIIST caters to the needs of the students, small scale industries and entrepreneurs and thereby maximize the utilization of these sophisticated equipments. Though these equipments are meant for the requirements of the ongoing R&D activities of the Institute, as a policy NIIST extends utilization of these facilities for the public in general and students in particular on payment basis. During the period, a revenue of Rs.18.46 lakhs was generated from the testing and analysis of the samples from the external agencies and students. By extending the services of major instruments like High Resolution Transmission Electron Microscopy (HRTEM) SEM/XRD and NMR/MS revenue of Rs. 6.77, 2.76 and 4.76 lakhs was generated respectively. The beneficiary include 170 students, 17 SSIs , 5 industries and 47 R&D institutions.

पुरस्कार एवं सम्मान

डॉ. ए. अजयघोष	इंडियन सोसाइटी ऑफ केमिस्ट्स एंड बायोलॉजिस्ट्स द्वारा आई.एस.सी.बी. पुरस्कार
डॉ. माधवन नम्पूतिरि	बायोटेक रिसर्च सोसाइटी, भारत का 'फेलो पुरस्कार'
डॉ. राजीव के. सुकुमारन	बायोटेक रिसर्च सोसाइटी, भारत का 'प्रो एस.बी. चिंचोलकर मेमोरियल अवार्ड'
डॉ. सी. विजयकुमार	रसायन विज्ञान के लिए "केरल राज्य युवा वैज्ञानिक पुरस्कार 2016"
श्री. नागाश्रिनिवासु	6 वां राष्ट्रीय फोटोग्राफी पुरस्कार

AWARDS & HONOURS

Dr A Ajayaghosh	ISCB Award given by Indian Society of Chemists and Biologists
Dr Madhavan Nampoothiri	'Fellow Award' of the Biotech Research Society, India
Dr Rajeev K Sukumaran	'Prof S B Chincholkar Memorial Award' of the Biotech Research Society, India
Dr C Vijayakumar	Kerala State Young Scientist Award 2016 for Chemical Sciences
Mr Nagasrinivasu	6th National Photography Award

एन.आई.आई.एस.टी के वैज्ञानिकों द्वारा विदेशी दौरे

नाम	दौरा किया देश	अवधि	दौरे का उद्देश्य
डॉ. ए. अजयघोष	जापान (ओसाका)	13.10.2016 – 21.10.2016	डी.एस.टी-जे.एस.पी.एस, जापान के द्विपक्षीय एक्सचेंज कार्यक्रम के तहत
डॉ. ई भौजे गौड	चीन	20.10.2016 – 24.10.2016	आई.यू.एम.आर.एस.-आई.सी.ए, 2016 में व्याख्यान देने के लिए
	फ्रांस	22.05.2016 – 25.05.2016	कार्यात्मक पॉलिमार और स्व-समुच्चित सिस्टम पर आयोजित 2016 इंडो फ्रेंच सम्मेलन में व्याख्यान देने के लिए
डॉ. पी. बिनोद	स्विट्जरलैंड	01.09.2016 – 30.09.2016	मैरी क्यूरी इंटरनेशनल अनुसंधान स्टाफ एक्सचेंज योजना (जैव एर्सोट) / के लिए यूरोपीय संघ के सातवें फ्रेमवर्क प्रोग्राम पर सहयोगात्मक परियोजना
डॉ. जोशी जोसफ	फ्रांस	22.05.2016 – 25.05.2016	कार्यात्मक पॉलिमर और स्व-समुच्चित सिस्टम पर आयोजित 2016 इंडो फ्रेंच सम्मेलन में व्याख्यान देने के लिए
डॉ. के माधवन नंपूतिरि	मेक्सिको	27.01.2017 – 10.02.2017	इंडो-मैक्सिकन द्विपक्षीय अनुसंधान सहयोग के तहत डी.एस.टी भारत और कोनासिट द्वारा प्रायोजित यात्रा
डॉ. मनोज राम वर्मा	जर्मनी	23.08.2016 – 26.08.2016	व्याख्यान देने केलिए और भविष्य सहयोग पर चर्चा करने के लिए
	स्लोवेनिया	27.08.2016 – 03.09.2016	
	फिनलैंड	04.09.2016 – 11.09.2016	
डॉ. के.एन. नारायणन उन्नी	मास्को, रूस	05.09.2016 – 10.09.2016	सहयोगात्मक अनुसंधान के लिए ए.एन फ्रंकलिन भौतिक रसायन विज्ञान एवं विद्युत रसायन विज्ञान इंस्टीट्यूट के दौरे केलिए
डॉ. के.पी. प्रतीश	जर्मनी	10.10.2016 – 14.10.2016	हाइऑक्सिन विश्लेषण के लिए ट्रीपल क्वाड्रपल एम.एस. तकनीक में फैक्टरी प्रशिक्षिण
डॉ. के.जी. रघु	दक्षिण कोरिया	01.09.2016 – 04.09.2016	के.एस.एस.ओ की 45 वीं वार्षिक वैज्ञानिक बैठक के सिलसिले में ओबेसिटी और मेटाबोलिक सिंड्रोम पर आयोजित अंतर्राष्ट्रीय कांग्रेस में व्याख्यान देने के लिए

डॉ. राजीव के. सुकुमारन	दक्षिण कोरिया	05.10.2016 – 08.10.2016	11 वीं एशियाई जैव हाइड्रोजन और जैवगैस संगोष्ठी में व्याख्यान देने केलिए
	ऑस्ट्रेलिया	02.05.2016 – 04.05.2016	कर्टिन विश्वविद्यालय, पर्थ, ऑस्ट्रेलिया में आर्थिक रूप से स्थायी जैव आधारित ऊर्जा केलिए एकीकृत प्रौद्योगिकी पर इंडो-ऑस्ट्रेलियन ग्रैंड चैलेंज परियोजना की तीसरी संयुक्त बैठक में भाग लेने केलिए और तकनीकी दौरे केलिए
डॉ. एन. रमेश कुमार	जर्मनी	01.08.2016 – 30.09.2016	मैक्स प्लें रासायनिक पारिस्थितिकी इंस्टीट चूट, जेना, जर्मनी में कृषि माइक्रोबायोलॉजी पर अनुसंधान केलिए
डॉ. सजू पिल्लै	डेनमार्क	14.10.2016 – 12.01.2017	नैनो, डेनमार्क (अंतर्विषयी नैनौसाइंस केंद्र) में सहयोगात्मक अनुसंधान केलिए
डॉ. के.पी. सुरेन्द्रन	पुर्तगाल	05.11.2016 – 11.11.2016	भारत – पुर्तगाल सहयोगी परियोजना के भाग के रूप में
डॉ. सी. विजयकुमार	जापान	10.07.2016 – 05.08.2016	इलेक्ट्रॉनिक विज्ञान अनुसंधान संस्थान, होक्काइडो विश्वविद्यालय, साप्पोरो, जापान में सहयोगी अनुसंधान केलिए
	फ्रांस	22.05.2016 – 25.05.2016	कार्यात्मक पॉलिमर और स्व-समुच्चित सिस्टम पर आयोजित 2016 इंडो फ्रेंच सम्मेलन में व्याख्यान देने केलिए

विदेशी वैज्ञानिकों/प्रतिष्ठित व्यक्तियों द्वारा एन.आई.आई.एस.टी में दौरा

नाम	दौरा किया देश	अवधि	यात्रा का उद्देश्य
प्रो. अलेक्सी तामीव	मास्को	19.04.2016	कार्बनिक पतली फिल्मों में चार्ज वाहक गतिशीलता पर व्याख्यान
प्रो. शिगेयूकि यागी	जापान	11.07.2016	ओ.एल.ई.डी. अनुप्रयोग की दिशा में वाहक-परिवहन मोएटिज़ के साथ फास्फोरोसेंट ऑर्गेनो धातु कॉप्लेक्ससों के विकास पर व्याख्यान
प्रो. सी. पुल्ला राव	आई.आई.टी. मुंबई	18.07.2016	अभिज्ञान: रासायनिक चयनात्मकता और इससे निहितार्थ विषयक व्याख्यान
प्रो. बिजू वासुदेवन पिल्लै	जापान	16.08.2016	एकल सेमीकंडक्टर क्वांटम डॉट्स में चार्ज वाहक गतिशीलता: चुनौतिओं और संभावनाओं पर व्याख्यान
डॉ. जे जेरार्डो सौसिडो कैस्टैनेडा	फ्रांस	22.09.2016	इंडो मैक्सिकन द्विपक्षीय विनिमय परियोजना

डॉ. अजय अग्रवाल	सी.एस.आई.आर-सी.ई.ई.आर.आई, पिलानी	30.09.2016	बायोकेमिकल सेंसिंग केलिए प्लेटफ़ॉर्म डिवाइस पर व्याख्यान
प्रो. पीटर कोम्बा	जर्मनी	19.10.2016	बिस्पिडाईन-धातु-ऑक्सो कॉप्लेक्सेस – नई अभिक्रियाओं और नए अभिक्रिया चैनलों पर व्याख्यान
प्रो. सुरेश भार्गवा	ऑस्ट्रेलिया	06.12.2016	अपनी खोजों का नवाचार में स्थानांतरण: सीमाओं से परे सोचना विषयक व्याख्यान
डॉ. देवेंद्र के अग्रवाल	अमेरिका	07.12.2016	माइक्रोस्वाइंस में एस.ओ.सी.एस. 3 जीन थेरेपी ने ओ- इंटिमल हाइपरप्लासिया को रोकने के द्वारा एंजियोप्लास्टी प्रेरित कोरोनरी विश्रांति एनोसिस को कम कर देता है पर प्रस्तुति
प्रो. एन. संजीव मूर्ति	अमेरिका	16.12.2016	सामग्री विज्ञान के क्षेत्र में समस्याओं को हल करने केलिए एक्स - रे विवर्तन अनुप्रयोगों पर व्याख्यान
श्री. हेनारिक पेटरसन	स्वीडन	12.01.2017	डी.एस.एस.सी गतिविधि
प्रो. धनञ्जय पाण्डेय	आई-आई-टी बी. एच.यू.	19.01.2017	मल्टीफेरोइक पेरोव्स्काइट्स पर व्याख्यान

FOREIGN VISITS BY NIIST SCIENTISTS

Name	Country Visited	Duration	Purpose of visit
Dr A Ajayaghosh	Japan (Osaka)	13.10.2016 - 21.10.2016	Under DST-JSPS, Japan bilateral exchange programme.
Dr E Bhoje Gowd	China	20.10.2016 - 24.10.2016	To deliver a lecture at IUMRS-ICA-2016
	France	22.05.2016 – 25.05.2016	To deliver a lecture at the 2016 Indo French Conference on Functional Polymers and self assembled systems
Dr P Binod	Switzerland	01.09.2016 - 30.09.2016	Collaborative project on European Union Seventh Framework Prog. for Marie Curie Int. Research staff exchange scheme (Bio Assort)
Dr Joshy Joseph	France	22.05.2016 – 25.05.2016	To deliver a lecture at the 2016 Indo French Conference on Functional Polymers and self assembled systems
Dr K Madhavan Nampoothiri	Mexico	27.1.2017 - 10.2.2017	The visit is under Indo Mexican bilateral research collaboration sponsored by DST India and CONACYT
Dr Manoj Raama Varma	Germany	23.08.2016 -26.08.2016	To give lectures and discuss future collaborations.
	Slovenia	27.08.2016 - 03.09.2016	
	Finland	04.09.2016 - 11.09.2016	
Dr K N Narayanan Unni	Moscow, Russia	05.09.2016 - 10.09.2016	To visit A. N. Frunklin Instt. Of Physical Chemistry & Electrochemistry for Collaborative research
Dr K P Prathish	Germany	10.10.2016 - 14.10.2016	Factory training in GC-triple quadruple MS techniques for dioxin analysis
Dr K G Raghu	South Korea	01.09.2016 - 04.09.2016	To deliver a talk at the International Congress on Obesity & Metabolic Syndrome in connection with the 45th Annual Scientific Meeting of KSSO

Dr Rajeev K Sukumaran	South Korea	05.10.2016 - 08.10.2016	To deliver a lecture at 11th Asian Bio hydrogen and Biogas Symposium
	Australia	02.05.2016 – 04.05.2016	To attend the 3rd joint meeting of the Indo- Australian grand challenge project on " Integrated technologies for economically sustainable bio-based energy'' at Curtin University, Perth, Australia and the technical tour
Dr N Ramesh Kumar	Germany	01.08.2016 - 30.09.2016	To undertake research on "Agricultural Microbiology" at Max Planck Instt. For Chem Ecology, Jena, Germany
Dr Saju Pillai	Denmark	14.10.2016 -12.01.2017	Collaborative research at i NANO, Denmark (Interdisciplinary Nanoscience Center)
Dr K P Surendran	Portugal	05.11.2016 - 11.11.2016	As part of Indo Portuguese collaborative Project
Dr C Vijayakumar	Japan	10.07.2016 - 05.08.2016	Collaborative research at Research Instt. For Electronic Science at Hokkaido University, Sapporo, Japan
	France	22.05.2016 – 25.05.2016	To deliver a lecture at the 2016 Indo French Conference on Functional Polymers and self assembled systems

VISITS OF FOREIGN SCIENTISTS /EMINENT PERSONALITIES TO NIIST

Name	Country from	Duration	Purpose of visit
Prof Aleksei Tameev	Moscow	19.04.2016	Delivered a talk on "Charge Carrier Mobility in Organic Thin Films"
Prof Shigeyuki Yagi	Japan	11.07.2016	Delivered a talk on "Development of Phosphorescent Organometallic Complexes with Carrier-transporting Moieties Towards OLED Application"
Prof C Pulla Rao	IIT- Mumbai	18.07.2016	Delivered a talk on "Recognition: An issue of chemical selectivity and its implications"
Prof Biju Vasudevan Pillai	Japan	16.08.2016	Delivered a talk on "Charge Carrier Dynamics in Single Semiconductor Quantum Dots: Challenges and Prospects"

Dr J Gerardo Saucedo Castaneda	France	22.09.2016	Indo Mexican bilateral exchange Project
Dr. Ajay Agarwal	CSIR-CEERI, Pilani	30.09.2016	Delivered a talk on "Platform Devices for Biochemical Sensing"
Prof Peter Comba	Germany	19.10.2016	Lecture delivered on "Bispidine-metal-oxo complexes – new reactions and new reaction channels."
Prof. Suresh Bhargava	Australia	06.12.2016	Delivered a talk on "Translating your discoveries into Innovation: Looking beyond the boundaries"
Dr Devendra K Agrawal	USA	07.12.2016	Presentation on "SOCS3 gene therapy reduces angioplasty induced coronary rest enosis by preventing neo-intimal hyperplasia in microswines"
Prof N Sanjeeva Murthy	USA	16.12.2016	Delivered a talk on "Applications of X-ray diffraction to solve problems in materials science".
Mr Henrik Pettersson	Sweden	12.01.2017	DSSC activity
Prof. Dhananjay Pandey	IIT-BHU	19.01.2017	Delivered a talk on "Multiferroic Perovskites"

पी.एच.डी से सम्मानित (अप्रैल 2016 - मार्च 2017)

क्र.सं	नाम	थीसिस शीर्षक	पर्यवेक्षक	विश्वविद्यालय	सम्मानित किया
1	समीरा एस	सिंथेसिस एंड कैरेक्टराइजेशन ऑफ़ एको-फ्रेंडली इनऑर्गानिक येलो पिग्मेंट्स फॉर कलरिंग अप्लिकेशन्स	डॉ. पी. प्रभाकर राव	कुसट	अप्रैल 2016
2	शरत चंद	लेविस एसिड/पैलेडियम कैटलैज़्ड सिंथेटिक ट्रांस्फ़ॉर्मेशन्स ऑफ़ पेंटाफुलवेन्स एंड इट्स डेरिवोटिव्स: फासैल सिंथेसिस ऑफ़ इण्डोल ऍपेन्डेड कार्बोसाइक्लस एंड हेटेरोसाइकल्स	डॉ. के.वी. राधाकृष्णन	एसीएसआईआर	अप्रैल 2016
3	चल्ला रवि किरन	थर्मल डिग्रडेशन स्टडीड ऑन एडिबल ऑयल्स ड्यूरिंग डीप फैट फ्राइंग प्रोसेस	डॉ. ए. सुन्दरेशन	कुसट	मई 2016
4	आशा कृष्णन	नोवल ऑप्टिकल प्रॉपर्टीज इन साइज ट्यून्ड सोडियम आक्साईड क्रिस्टल्स फॉर फंक्शनल एप्लिकेशन्स	डॉ. एस. के. घोष	कुसट	मई 2016
5	अनूजा जे बाबू	सिंथेसिस, कैरक्टरैसेशन एंड सुपरकडक्टिंग प्रॉपर्टीज ऑफ़ SmFeAs01-xFx बैस्ड आयरन निक्टिडेस	डॉ. श्यामप्रसाद	कुसट	मई 2016
6	सजिन फ्रान्सिस	आइसोलेशन एंड कैरेक्टराइजेशन ऑफ़ बायोलॉजिकली एक्टिव मॉलीक्यूल्स फ्रम स्पाइसेस एंड मेडिसिनल प्लांट ऑफ केरल	डॉ. मंगलम एस. नायर	केरल	जून 2016
7	अनीस पी.	स्कुराइन बेस्ड फ्लोरोसेंट प्रोब्स फॉर सेंसिंग & इमेजिंग ऑफ़ वेरियस बायोअनलैट्स	डॉ. ए. अजयघोष	एसीएसआईआर	जून 2016
8	डेरी होलाडे	एक्सप्लोरिंग दि रिसेप्टर, सेल्फ - असेंबली एंड फोटोफिसिकल प्रॉपर्टीज ऑफ़ मोनोफोरमैल 3,5 डाइअल्काइलडाइप्यररोलमीथेन बेस्ड साइक्लिक एंड एसाइक्लिक डेरिवेटिव्स	डॉ. एम. एल. पी. रेड्डी तथा डॉ. ए. श्रीनिवासन	केरल	जून 2016
9	अनुश्री एस. एस	पूनिक एसिड - ए पार्शियल पीपीएआर गामा अगोनिस्ट, एंहांसेस इनुलिन सेंसिटिविटी इन 3 टी 3 एलआई अडिपोसाइ बाइ सेफ़गार्डिंग माइटोकांड्रिया एंड अमेलिओरेटिंग इन्फ़्लमेशन	डॉ. के.जी. रघु	केरल	जुलाई 2016
10	वाणि शंकर	स्ट्राटेजीज फॉर इम्प्रूव्ड एन्जाइमाटिक हाइड्रोलिसिस ऑफ़ लिग्नोसेल्लुलोस	डॉ. राजीव के सुकुमारन/ डॉ. एस. सावित्री	कुसट	अगस्त 2016
11	सबीला बीवी एल	माइक्रो अल्गल बायोमास एंड आयल प्रोडक्शन इन नॉन – पोटबल वाटर्स फॉर पोटेंशियल अप्लिकेशन इन बायो फ्यूल्स एंड न्यूट्रास्यूटिकिल्स	डॉ. राजीव के सुकुमारन	कुसट	अगस्त 2016
12	हरिकृष्ण भट्ट के	इन्वेस्टीगेशन ऑण दि री-ऑक्सिडेशन एंड एसिड लीचिंग ऑफ़ बेनिफिसिएटेड इल्मेनाइटइन दि प्रोडक्शन ऑफ़ हाई ग्रेड सिंथेटिक रूटाइल फ्रॉम इल्मेनाइट ऑफ़ कोस्टल केरल, इंडिया	डॉ. एम. आर. पाटिल	विजयनगर श्रीकृष्णदेवराय यूनिवर्सिटी, बल्लारी	सितंबर 2016

Ph.D Awarded (April 2016 – March 2017)

13	सजिना के.वी.	प्रोडक्शन कैरेक्टराइजेशन एंड अप्लिकेशन्स ऑफ़ बायो - सरफेक्टेंट्स & एक्सओ – पाली सैकराइड फ्रम सूडोज़ीमा स्पीशीज	डॉ. अशोक पाण्डेय	केरल	सितंबर 2016
14	दिव्या जे. बी.	फोलिएट प्रोडक्शन बाइ प्रोबायोटिक लैक्टिक एसिड बैक्टीरिया	डॉ. के. माधवन नंपूतिरि	केरल	सितंबर 2016
15	दीपा सी.के	आइसोलेशन एंड कैरेक्टराइजेशन ऑफ़ प्लांट ग्रोथ प्रमोटिंग बैक्टीरिया (पी.जी.पी.आर)टु इम्प्रूव प्लांट ग्रोथ	डॉ. अशोक पाण्डेय	केरल	सितंबर 2016
16	धन्या आर.	मैकेनिस्टिक रोल ऑफ़ सिट्रस फ्लवोनोइड्स एंड देयर ग्लाइको कोंजूगेट्स इन दि मैनेजमेंट ऑफ़ टाइप 2 डाबिटीज	डॉ. पी. जयमूर्ति	कुसट	सितंबर 2016
17	अनीश पी. एस	सिंथेसिस एंड सेल्फ-आर्गेनाईजेशन प्रॉपर्टीज ऑफ़ एगुलर पी.आई कोंजूगेटेड मॉलिक्यूल पोसेसिंग कोलुमनार आर्डर	डॉ. सुरेश दास / डॉ. के.आर. गोपिदास	केरल	अक्तूबर 2016
18	धन्या एस. आर	आइसेलेशन कैरेक्टराइजेशन एंड डेवलपमेंट ऑफ़ नोवल बायोएक्टिव कॉपाउ डस फ्रम सिलेक्टड मेडिसिनल प्लांट्स यूस्ड इन आयुर्वेद	डॉ. मंगलम एस नायर	एसी. एस.आई.आर	अक्तूबर 2016
19	शांतिल एम.	कोर - शैल मेटल नैनो स्ट्रक्चर्स फॉर सरफेस एनहास्ड स्पेक्ट्रोस्कोपी	डॉ. के जोर्ज थॉमस	केरल	अक्तूबर 2016
20	टोनी जोर्ज थॉमस	स्टडी ऑफ़ सिलेक्टेड एरोमेटिक अमीन रेडिकल केटयॉन्स: जनरेशन, मेकानिस्टिक एंड स्पेक्ट्रोस्कोपिक इंवेस्टीगेशन्स	डॉ. के. आर. गोपिदास	केरल	अक्तूबर 2016
21	वैशाखन तंपी डी.एस.	सिंथेसिस एंड कैरेक्टराइजेशन ऑफ़ सिरेमिक ऑक्साइड आयनिक कंडक्टर्स फॉर सॉलिड ऑक्साइड फ्यूल सेल अप्लिकेशन्स	डॉ. पी. प्रभाकर राव	केरल	अक्तूबर 2016
22	अरुण बोबी	इन्फ्लुएंस ऑफ़ वाइ ओन दि माइक्रोस्ट्रक्चर, मैकेनिकल, वियार एंड कोरोशन प्रॉपर्टीज ऑफ़ मॉडिफाइड AZ91 मैग्नीशियम अलॉय	डॉ. यू. टी. एस. पिल्लै	कुसट	नवंबर 2016
23	रामकृष्णन आर.	नैनो स्ट्रक्चर्ड कंडूसिग पॉलीमर-इनऑर्गेनिक कंपोजिट्स फॉर ऑप्टो - इलेक्ट्रॉनिक अप्लिकेशन्स	डॉ. जे. डी. सुधा / डॉ. मनोज रामवर्मा	कुसट	नवंबर 2016
24	अल्बिश के. पॉल	सिंथेसिस, फोट्फिसिकल, फोटोबायोलॉजिकल एंड आयन बैंडिंग प्रॉपर्टीज ऑफ़ पोर्फयरिन्स एंड दयर कंजुगेट्स	डॉ. रामय्या	केरल	नवंबर 2016
25	सुमी एस.	इन्वेस्टीगेशन ओन स्ट्रक्चरल, मैक्रोस्ट्रक्चरल, इलेक्ट्रिकल ट्रांसपोर्ट प्रापर्टीज ऑफ सैरियम एंड ट्राजीशन मेटल बेस्ड कॉम्प्लेक्सस सेमीकंडक्टिंग ऑक्ससाइड्स फॉर हाई टेम्परेचर एनटीसी थर्मिस्टर अप्लिकेशन्स	डॉ. पी. प्रभाकर राव	केरल	दिसंबर 2016

26	अनुश्री एम.	यूटिलाइसेसन ऑफ़ एग्रो रेसिडुवल बायोमास फॉर एल - लाइसीन प्रोडक्शन बाइ कोरिने बैक्टीरियम ग्लूटामिकम	डॉ. के. माधवन नंपूतिरि	कुसट	दिसंबर 2016
27	रोहिणी आर. एन.	नोबिल मैटेरियल्स एन्ट्राप्पड हाइड्रोजेल नैनोकम्पोजिट	डॉ. जे.डी. सुधा	कुसट	जनवरी 2017
28	कार्तिक नारायणन	प्रोडक्शन, प्यूरिफिकेशन एंड कैरेक्टराइजेशन ऑफ कैटिनॉलिटिक एन्ज़ाइम्स फ्रॉम माइक्रोबियल कल्चर्स आइसोलेटेड फ्रॉम कोस्टल एनवायरनमेंट सैम्पल्स	डॉ. अशोक पाण्डेय	ए.सी. एस.आई.आर	जनवरी 2017
29	बैजु टी. वी.	स्टडी औन दि रिएक्टिविटी ऑफ़ बिस - π - एलिल एंड रिलेटड पैलेडियम इंटरमीडेयेट्स विथ फंक्शनलाइज़्ड 1,3 डाइन्स एंड कार्बोनिल कॉम्पौंड्स एंड लेविस एसिड केटलाइज़्ड पोवरोव रिएक्शन यूसिंग पेंटाफुल्वेन्स आस डाइनोफिल्स	डॉ. के.वी. राधाकृष्णन	ए.सी. एस.आई.आर	जनवरी 2017
30	हर्षा एन.	मैगनेटिक नैनोकंपोजिट्स फॉर आर्गेनिक डाई रिमूवल फ्रॉम अक्वस सोलूशन्स	डॉ. सत्यजित शुक्ला	ए.सी. एस.आई.आर	फरवरी 2017
31	अरविंद माधवन	डेवलपमेंट ऑफ़ आन एक्सप्रेशन सिस्टम फॉर हेट रोलोगोस प्रोटीन प्रोडक्शन इन फंगस	डॉ. राजीव के. सुकुमारन	कुसट	मार्च 2017
32	नमिता एल. के.	सिरेमिक रीइंफोर्स्ड सिलिकॉन इलास्टोमेर कंपोजिट्स फॉर फ्लेक्सिबल माइक्रोवेव अप्लिकेशन	डॉ. एम.टी. सेबास्टियन/ डॉ. एस. अनंतकुमार	केरल	फरवरी 2017
33	जोर्ज टी. एम.	सिंथेसिस, कैरेक्टराइजेशन एंड फोटोलुमिनेसेन्स प्रॉपर्टीस ऑफ़ लंथानाइड β-डाइकीटोनेट कॉप्लेक्सस	डॉ. एम.एल.पी. रेड्डी	ए.सी. एस.आई.आर	मार्च 2017
34	बिजोय मोहनदास के.एस.	डिज़ायन एंड डेवलपमेंट ऑफ नोवल फोस्फोरेसेंट इरीडियम (III) कॉम्प्लेक्स फॉर लाइटिंग एंड सेंसिंग अप्लिकेशन्स	डॉ. एम एल पी रेड्डी	ए.सी. एस.आई.आर	मार्च 2017
35	अरुण के.बी.	डेवलपमेंट ऑफ़ एविडेंस बेस्ड नोवल सिंबायोटिक कंपोनेन्ट्स फॉर दि प्रिवेंशन एंड मैनेजमेंट ऑफ़ लाइफस्टाइल एसोसिएटेड डिसीसेस	डॉ. पी निशा	कुसट	मार्च 2017
36	उषा गंगन टी.वी.	विज़िबल लाइट एक्साइटब्ल Eu 3+ -β-डिकीटोनेट कॉप्लेक्सस: सिंथेसिस, कैरेक्टराइजेशन, एंड फोटोफिसिकल प्रॉपर्टीज	डॉ. एम एल पी रेड्डी	ए.सी. एस.आई.आर	मार्च 2017
37	गोरंटला जग्गय्या नायडू	टोटल सिंथेसिस ऑफ़ ग्लय्कोलिपिड्स ऑफ़ बायोलॉजिकल सिग्निफिकेन्स कन्टाइनिंग अज़ा - शुगर्स स्ट्रक्चर एलूसिडेशन ऑफ़ उत्तरोसाइड बी	डॉ. एल. रविशंकर	ए.सी. एस.आई.आर	मार्च 2017

Ph.D Awarded
(April 2016 – March 2017)

Sl No.	Name	Thesis Title	Supervisor	University	Awarded
1	Sameera S	Synthesis and Characterization of Eco-friendly Inorganic Yellow pigments for Coloring Applications	Dr P Prabhakar Rao	CUSAT	April 2016
2	Sarath Chand	Lewis acid/palladium catalyzed synthetic transformations of pentafulvenes and its derivatives: Facile synthesis of indole appended carbocycles and heterocycles	Dr K V Radhakrishnan	AcSIR	April 2016
3	Challa Ravi Kiran	Thermal Degradation Studied on Edible Oils during Deep Fat Frying Process	Dr A Sundaresan	CUSAT	May 2016
4	Asha Krishnan	Novel Optical Properties in Size Tuned Cerium Oxide Crystals for Functional Applications	Dr S K Ghosh	CUSAT	May 2016
5	Anooja J Babu	Synthesis, Characterization and superconducting properties of $SmFeAsO_{1-x}F_x$ based iron pnictides	Dr Syamaprasad	KERALA	May 2016
6	Sajin Francis K	Isolation and characterization of Biologically active molecules form spices and medicinal plant of Kerala.	Dr Mangalam S Nair	KERALA	June 2016
7	Anees P	Squarine based fluorescent probes for sensing & imaging of various bioanalytes	Dr A Ajayaghosh	AcSIR	June 2016
8	Derry Holaday	Exploring the receptor, self-assembly and photophysical properties of monoformyl 3,5-Dialkyldipyrrolmethane based cyclic and acyclic derivatives	Dr M L P Reddy & Dr A Srinivasan	KERALA	June 2016

9	Anusree S S	Punic acid a partial PPAR gamma agonist, enhances inulin sensitivity in 3T3-Li adipocyte by safeguarding mitochondria and ameliorating inflammation	Dr K G Raghu	KERALA	July 2016
10	Vani Shankar	Strategies for improved enzymatic hydrolysis of lignocellulose	Dr Rajeev K Sukumaran/ Dr S Savithri	CUSAT	August 2016
11	Sabeela Beevi L	Micro algal biomass and oil production in non-potable waters for potential application in bio fuels and nutraceuticals	Dr Rajeev K Sukumaran	CUSAT	August 2016
12	Harikrishna Bhat K	Investigation on the reoxidation and acid leaching of beneficiated ilmenite in the production of high grade synthetic rutile from ilmenite of coastal Kerala, India	Dr M R Patil	Vijayanagara Sri Krishnadevaraya University, Bellary	September 2016
13	Sajina K V	Production characterization and applications of Bio-surfactants & exo-polysaccharide from pseudozyma species	Dr Ashok Pandey	KERALA	September 2016
14	Divya J B	Foliate production by probiotic lactic acid bacteria.	Dr K Madhavan Nampoothiri	KERALA	September 2016
15	Deepa C K	Isolation and characterization of plant growth promoting bacteria (PGPR) to improve plant growth.	Dr Ashok Pandey	KERALA	September 2016
16	Dhanya R	Mechanistic role of citrus flavonoids and their glycoconjugates in the management of type 2 diabetes	Dr P Jayamurthy	CUSAT	September 2016
17	Aneesh P S	Synthesis and self organisation properties of angular Pi- conjugated molecule possessing columnar order	Dr Suresh Das Dr K R Gopidas	KERALA	October 2016
18	Dhanya S R	Isolation characterization and development of novel Bioactive compounds from selected medical plants used in Ayurveda	Dr Mangalam S Nair	AcsIR	October 2016

19	Shanthil M	Core-shell Metal Nanostructures for Surface Enhanced Spectroscopy	Dr K George Thomas	KERALA	October 2016
20	Tony George Thomas	Study of selected aromatic amine radical cations: Generation, mechanistic and spectroscopic investigations	Dr K R Gopidas	KERALA	October 2016
21	Vaisakhan Thampi D S	Synthesis and characterization of ceramic oxide ionic conductors for solid oxide fuel cell applications	Dr P Prabhakar Rao	KERALA	October 2016
22	Arun Boby	Influence of Y on the Microstructure, Mechanical, Wear and Corrosion Properties of Modified AZ91 Magnesium Alloy	Dr U T S Pillai	CUSAT	November 2016
23	Ramakrishnan R	Nanostructured Conducing Polymer-Inorganic Composites for Opto-electronic Applications	Dr J D Sudha/ Dr Manoj Raama Varma	CUSAT	November 2016
24	Albish K Paul	Synthesis, photophysical, photobiological and ion binding properties of porphyrins and their conjugates	Dr Ramaiah	KERALA	November 2016
25	Sumi S	Investigation on structural, microstructural, electrical transport properties of cerium and transition metal based complex semiconducting oxides for high temperature NTC thermistor applications	Dr P Prabhakar Rao	KERALA	December 2016
26	Anusree M	Utilisation of agro residual biomass for L-Lysine Production by Coryne bacterium glutamicum	Dr K Madhavan Nampoothiri	CUSAT	December 2016
27	Rohini R N	Noble Materials entrapped hydrogel nanocomposite	Dr Sudha J D	CUSAT	January 2017
28	Karthik Narayanan	Production, Purification and Characterization of Chitinolytic Enzymes from Microbial Cultures Isolated from Coastal Environment Samples	Dr Ashok Pandey	AcSIR	January 2017

29	Baiju T V	Study on the Reactivity of Bis-π-allyl and Related Palladium Intermediates with Functionalized 1,3-Dienes and Carbonyl Compounds & Lewis Acid Catalyzed Povarov Reaction Using Pentafulvenes as Dienophiles	Dr K V Radhakrishnan	AcSIR	January 2017
30	Harsha N	Magnetic Nanocomposites for Organic Dye Removal from Aqueous Solutions	Dr Satyajit Shukla	AcSIR	February 2017
31	Aravind Madhavan	Development of an expression system for heterologous protein production in fungus	Dr Rajeev K Sukumaran	CUSAT	March 2017
32	Namitha L K	Ceramic reinforced silicone elastomer composites for flexible microwave application	Dr M T Sebastian Dr S Ananthakumar	KERALA	February 2017
33	George T M	Synthesis, characterization and photoluminescence properties of lanthanide β-diketonate complexes	Dr M L P Reddy	AcSIR	March 2017
34	Bejoy Mohan Das K S	Design and development of novel phosphorescent iridium(III) complexes for lighting and sensing applications	Dr M L P Reddy	AcSIR	March 2017
35	Arun K B	Development of evidence based Novel Synbiotic Components for the prevention and management of lifestyle associated diseases	Dr P Nisha	CUSAT	March 2017
36	Usha Gangan T V	Visible light excitable Eu 3+ -β-diketonate complexes: Synthesis, characterization, and photophysical properties	Dr M L P Reddy	AcSIR	March 2017
37	Gorantla Jaggaiah Naidu	Total synthesis of glycolipids of biological significance containing aza-sugars and structure elucidation of Uttroside B	Dr L Ravi Shankar	AcSIR	March 2017

अनुसंधान परिषद् के सदस्य

अध्यक्ष

प्रोफ. दिपांकर बनर्जी
सामग्री इंजीनियरिंग विभाग
भारतीय विज्ञान संस्थान
बेंगलूरु – 560 012

सदस्य

प्रो. जी.डी. यादव
कुलपति एवं आरटी मोदी
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रसायनिक प्रौद्योगिकी संस्थान,
मातुंगा, मुंबई – 400 019

प्रोफ. एम. के. मैथ्यु
झिल्ली जैवभौतिकी प्रयोगशाला
राष्ट्रीय जीव विज्ञान केन्द्र
टाटा मूलभूत अनुसंधान संस्थान
जी.के.वी.के. कैंपस, बेल्लारी रोड,
बेंगलूरु – 560 065

प्रो. विक्रम जयराम
सामग्री इंजीनियरिंग विभाग
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डॉ. पी.जी. राव
कुलपति
विज्ञान तथा प्रौद्योगिकी विश्वविद्यालय,
मेघालय – 793 101

श्री. ए.सी. सर्राफ़
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184 - 87, एस.वी. रोड,
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डॉ. विनयकुमार दघवाल
निदेशक
भारतीय अंतरिक्ष विज्ञान तथा प्रौद्योगिकी संस्थान
वलियमला पी.ओ.
तिरुवनन्तपुरम – 695 547

एजेंसी प्रतिनिधि

डॉ. आर. बृकस्पति
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विज्ञान तथा इंजीनियरिंग अनुसंधान बोर्ड
5 एंड 5 ए, लोवर ग्राउंड फ्लोर
वसन्त कुंज, नई दिल्ली – 110 070

महानिदेशक द्वारा नामित व्यक्ति

डॉ. विवेक वी. रानडे
प्रधान, कटैलिसीम, रिएक्टर्स तथा सेपरेटर्स यूनिट
सी.एस.आई.आर - राष्ट्रीय रासायनिक प्रयोगशाला
पुणे – 411 008

सहोदर प्रयोगशाला

डॉ. विजयमोहनन के. पिल्लै
निदेशक
केन्द्रीय विद्युतरासायन अनुसंधान संस्थान
कारैक्कुडी
तमिलनाडू - 630 006

क्लस्टर निदेशक

डॉ. एम.ओ. गर्ग
निदेशक
भारतीय पेट्रोलियम संस्थान (आईआईपी)
पी ओ आईआईपी, मोहकमपुर,
देहरादून - 248 005

निदेशक

डॉ. ए. अजयघोष
निदेशक
राष्ट्रीय अंतर्विषयी विज्ञान तथा प्रौद्योगिकी संस्थान
तिरुवनन्तपुरम – 695 019

स्थायी आमंत्रित व्यक्ति

प्रधान या उनके द्वारा नामित व्यक्ति
अनुसंधान योजना तथा निष्पादन प्रभाग (पी.पी.डी.)
वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद
अनुसंधान भवन, 2
रफी मार्ग
नई दिल्ली – 110 001

आमंत्रित व्यक्ति

श्री बी.एन. सरकार
वैज्ञानिक एफ
डी.एस.आई.आर
न्यू मेहरोली रोड
नई दिल्ली

सचिव

डॉ. ए. सुन्दरेशन
मुख्य वैज्ञानिक, एवं प्रधान, आर पी बी डी
राष्ट्रीय अंतर्विषयी विज्ञान तथा प्रौद्योगिकी संस्थान
तिरुवनन्तपुरम – 695 019

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Department of Materials Engineering
Indian Institute of Science,
Bengaluru-560 012

MEMBERS

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Vice- Chancellor and RT Mody
Distinguished Professor
Institute of Chemical Technology
Matunga, Mumbai- 400019

Prof M K Mathew
Laboratory of Membrane Biophysics
National Centre for Biological Sciences
Tata Institute of Fundamental Research
GKVK, Bellary Road, Bengaluru-560 065

Prof Vikram Jayaram
Department of Materials Engineering
Indian Institute of Science,
Bengaluru- 560012

Prof Gunasekaran
Vice Chancellor
Thiruvalluvar University
Serkkadu, Vellore- 632115

Dr P G Rao
Vice Chancellor,
University of Science & Technology
Meghalaya – 793 101

Shri A C Shroff
Chairman & MD
Excel Industries Limited,
184-87 S V Road, Jogeshwari (West),
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Dr Vinay kumar Dadhwal
Director
Indian Institute of Space Science &
Technology, Valiamala P O
Thiruvananthapuram- 695547

AGENCY REPRESENTATIVE

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Scientist G
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Vasant Square Mall , Sector- B
Pocket-5, Vasant Kunj, New Delhi- 110 070

DG NOMINEE

Dr Vivek V Ranade
Head, Catalysis, Reactors & Separators Unit
CSIR- National Chemical Laboratory
Pune- 411008

SISTER LABORATORY

Dr Vijayamohanan K Pillai
Director
Central Electrochemical Research Institute
Karaikudi-630 006
Tamil Nadu

CLUSTER DIRECTOR

Dr M O Garg
Director
Indian Institute of Petroleum (IIP)
P O IIP, Mohkampur
Dehradun-248 005

DIRECTOR

Dr A Ajayaghosh
Director
National Institute for Interdisciplinary
Science & Technology
Thiruvananthapuram-695 019

PERMANENT INVITEE

Head or His Nominee
Research Planning &
Performance Division (RPPD)
Council of Scientific & Industrial Research
Anusandhan Bhawan, 2
Rafi Marg,
New Delhi-110 001

INVITEE

Shri B N Sarkar
Scientist F
DSIR, New Mehrauli Road
New Delhi

SECRETARY

Dr A Sundaresan
Chief Scientist and Head, RPBD
National Institute for Interdisciplinary
Science & Technology
Thiruvananthapuram-695 019

प्रबंधन परिषद के सदस्य
01/01/2016 से 31/12/2017 तक की अवधि

अध्यक्ष
निदेशक, सी.एस.आई.आर, एन.आई.आई.एस.टी.

सदस्य
डॉ. विजयमोहनन के. पिल्लै
निदेशक, सी.एस.आई.आर,
सी.ई.सी.आर.आई., कारैकुडी

डॉ. राम ए. विश्वकर्म
निदेशक, सी.एस.आई.आर-आई.आई.आई.एम.,
जम्मू काश्मीर (विशेष आमंत्रित)

डॉ. ए. सुंदरेशन
मुख्य वैज्ञानिक तथा प्रमुख
आर.पी.बी.डी.

डॉ. (श्रीमती) एलिजाबेथ जेकब
मुख्य वैज्ञानिक

डॉ. एस. अनंतकुमार
वरिष्ठ प्रिंसिपल वैज्ञानिक

डॉ. राजीव के. सुकुमारन
वरिष्ठ वैज्ञानिक

डॉ. पी. निशा
वैज्ञानिक

श्री. आर. राजीव
व. अधीक्षण अभियंता

सी.ओ.एफ.ए/एफ.ए.ओ
एन.आई.आई.एस.टी

सदस्य सचिव
प्रशासन नियंत्रक/प्रशासन अधिकारी
एन.आई.आई.एस.टी.

MEMBERS OF THE MANAGEMENT COUNCIL
Period 01/01/2016 to 31/12/2017

CHAIRMAN
Director, CSIR-NIIST

MEMBERS
Dr Vijayamohanan K Pillai
Director, CSIR-CECRI, Karaikudi

Dr Ram A Vishwakarma
Director, CSIR-IIIM, Jammu & Kashmir
(Special Invitee)

Dr A Sundaresan
Chief Scientist & Head, RPBD

Dr Elizabeth Jacob
Chief Scientist

Dr S Ananthakumar
Senior Principal Scientist

Dr Rajeev K Sukumaran
Senior Scientist

Dr P Nisha
Scientist

Sri R Rajeev
Senior Superintending Engineer

CoFA/FAO, NIIST

MEMBER SECRETARY
CoA / AO, NIIST

सुखी और समृद्ध सेवानिवृत्त जीवन के लिए शुभकामनाएं
BEST WISHES FOR HAPPY AND PROSPEROUS RETIREMENT LIFE

डॉ. वी.जी. मोहनन नायर
मुख्य वैज्ञानिक
सेवानिवृत्ति की तारीख : 30/04/2016

Dr V G Mohanan Nair
Chief Scientist
Retired: 30/04/2016

डॉ. मंगलम एस. नायर
मुख्य वेज्ञानिक
सेवानिवृत्ति की तारीख : 31/05/2016

Dr (Mrs) Mangalam S Nair
Chief Scientist
Retired: 31/05/2016

श्रीमती श्रीलता नायर
निदेशक के निजी सचिव
सेवानिवृत्ति की तारीख : 31/05/2016

Smt Sreelatha Nair
Private Secretary to Director
Retired: 31/05/2016

डॉ. वी.बी. मणिलाल
वरिष्ठ प्रिंसिपल वैज्ञानिक
सेवानिवृत्ति की तारीख : 31/08/2016

Dr V B Manilal
Senior Principal Scientist
Retired: 31/08/2016

डॉ. ए.आर.आर. मेनोन
वरिष्ठ प्रिंसिपल वैज्ञानिक
सेवानिवृत्ति की तारीख : 30/11/2016

Dr A R R Menon
Senior Principal Scientist
Retired : 30/11/2016

श्री. के. मुरलीधरन
प्रशासन नियंत्रक
सेवानिवृत्ति की तारीख : 30/11/2016

Shri K Muraleedharan
Controller of Administration
Retired: 30/11/2016

श्री. एम. कृष्णकुमार
अनुभाग अधिकारी (वित्त एवं लेखा)
सेवानिवृत्ति की तारीख : 30/11/2016

Shri M Krishnakumar
Section Officer
(Finance & Accounts)
Retired: 30/11/2016

स्वैच्छिक सेवानिवृत्ति
VOLUNTARY RETIREMENT

श्री. एन. शशिधरन
बेयरर (एम.ए.सी.पी)
सेवानिवृत्ति की तारीख : 10/01/2017

Shri Sasidharan
BEARER (MACP)
Retired: 10/01/2017

पदोन्नतियां / PROMOTIONS

डॉ. (श्रीमती) एलिज़बेथ जेकब
मुख्य वैज्ञानिक
पदोन्नतति की तारीख - 27/07/2014

Dr (Mrs) Elizabeth Jacob
Chief Scientist

डॉ. टी.पी.डी. राजन
प्रिंसिपल वैज्ञानिक
पदोन्नतति की तारीख - 20/04/2013

Dr T P D Rajan
Principal Scientist

डॉ. एम. सुन्दरराजन
वरिष्ठ वैज्ञानिक
पदोन्नतति की तारीख - 30/09/2013

Dr M Sundararajan
Senior Scientist

नियुक्तियां/APPOINTMENTS

सुश्री शीबा सैतु
सहायक (भंडार व क्रय) ग्रेड III
कार्यग्रहण की तारीख - 11/05/2016

Smt Sheeba Saithu
Assistant (S & P)Gr III
Date of Joining : 11/05/2016

सुश्री सजिता ए.एल
सहायक (सा.) ग्रेड III
कार्यग्रहण की तारीख - 11/05/2016

Smt A L Sajitha
Assistant (G) Gr III
Date of Joining : 11/05/2016

श्री. चंद्रशेखर नीलम
सहायक कार्यकारी अभियंता
कार्यग्रहण की तारीख - 18/07/2016

Shri Chandra Shekar Neelam
Assistant Executive Engineer
Date of Joining : 18/07/2016

श्रीमती टी.एम. अश्वती
सहायक (सा.) ग्रेड III
कार्यग्रहण की तारीख - 01/08/2016

Smt T M Aswathy
Assistant (G) Gr III
Date of Joining : 01/08/2016

डॉ. सुनिल वर्गीस
वरिष्ठ वैज्ञानिक
कार्यग्रहण की तारीख - 14/10/2016

Dr Sunil Varughese
Senior Scientist
Date of Joining : 14/10/2016

डॉ. (श्रीमती) दीपा बालन
वैज्ञानिक
कार्यग्रहण की तारीख - 11/11/2016

Dr (Mrs) Deepa Balan
Scientist
Date of Joining : 11/11/2016

डॉ. सादत सलीम
चिकित्सा अधिकारी
कार्यग्रहण की तारीख - 08/12/2016

Dr Sadath Salim
Medical Officer
Date of Joining : 08/12/2016

सी.एस.आई.आर.- एन.आई.आई.एस.टी में स्वागत (स्थानांतरण पर)
WELCOME TO CSIR- NIIST (On Transfer)

श्री. वी. हरीश राज
तकनीकी सहायक
सी.एस.आई.आर - सी.एफ.टी.आर.आई. से स्थानांतरण
सी.एस.आई.आर.-एन.आई.आई.एस.टी में कार्यग्रहण की तारीख - 05/09/2016

Shri V Harish Raj
Technical Assistant
Transfer from CSIR-CFTRI
Date of Joining at CSIR – NIIST : 05/09/2016

श्री जोशी जोर्ज
व. तकनीकी अधिकारी (2)
जन्म तिथि - 26/05/1975
सी.एस.आई.आर - सी.एफ.टी.आर.आई. से स्थानांतरण
सी.आई.एम.आई.आर.-एन.आई.आई.एस.टी में कार्यग्रहण की तारीख - 01/12/2016

shri Joshy George
Senior Technical Officer (2)
Date of Birth : 26/05/1975
Transfer from CSIR-CIMFR
Date of Joining at CSIR – NIIST : 01/12/2016

श्री. ओ.वी. शशिकुमार
वरिष्ठ आशुलिपिक (एम.ए.सी.पी)
सी.एस.आई.आर - निस्केयर से स्थानांतरण
सी.एस.आई.आर.-एन.आई.आई.एस.टी में कार्यग्रहण की तारीख - 21/04/2016

Shri O V Sasikumar
Senior Stenographer
Transfer from NISCAIR, New Delhi
Date of Joining at CSIR – NIIST: 21/04/2016

स्मृति/OBITUARY

डॉ. जोस जेइम्स
Dr.Jose James / (1958 - 2016)

दिनांक 09.12.2016 को डॉ. जोस जेइम्स, मुख्य वैज्ञानिक तथा अनुसंधान योजना एवं व्यवसाय विकास प्रभाग के प्रमुख के दुखद निधन पर सी.एस.आई.आर-एन.आई.आई.एस.टी. परिवार शोक संतप्त हो गया। डॉ. जोस जेम्स एक प्रसिद्ध सामग्री वैज्ञानिक और भारतीय विज्ञान संस्थान, बैंगलोर का एक पूर्व छात्र था। उन्होंने लगभग तीन दशकों तक सी.एस.आई.आर की सेवा की। सी.एस.आई.आर - एन.आई.आई.टी. में शामिल होने से पहले, उन्होंने सी.एस.आई.आर. - ए.एम.पी.आर.आई, भोपाल और सी.एस.आई.आर-एन.एम.एल., जमशेदपुर में काम किया है।

CSIR-NIIST family is bereaved on the sad demise of Dr. Jose James, Head, Research Planning and Business Development and Chief Scientist on 09.12.2016. Dr. Jose James was a well-known materials scientist and was an alumnus of Indian Institute of Science, Bangalore. He served CSIR for about three decades. Prior to joining CSIR-NIIST, he had worked in CSIR-AMPRI, Bhopal and CSIR-NML, Jamshedpur

31/03/2017 को कर्मचारी समूह की सूची

डॉ. ए. अजयघोष	निदेशक

निदेशक का कार्यालय

श्री. किरन जे.एस	तकनीकी सहायक
श्री विष्णु गुर्जर	कनिष्ठ आशुलिपिक
श्री. पी. बी. विजयकुमार	प्रयोगशाला सहायक

कृषि प्रसंस्करण तथा प्रौद्योगिकी प्रभाग

डॉ. बी.एस. दिलीप कुमार	व. प्रिंसिपल वैज्ञानिक एवं प्रधान
डॉ. ए. सुन्दरेशन	मुख्य वैज्ञानिक तथा प्रधान, आरपीबीडी
श्री. एम.एम. श्रीकुमार	मुख्य वैज्ञानिक
डॉ. के.जी. रघु	प्रिंसिपल वैज्ञानिक
श्री. वी.वी. वेणुगोपाल	प्रिंसिपल वैज्ञानिक
श्रीमती एम.वी. रेश्मा	वरिष्ठ वैज्ञानिक
डॉ. (श्रीमती) पी निशा	वैज्ञानिक
डॉ. पी. जयमूर्ती	वैज्ञानिक
डॉ. (श्रीमती) प्रिया एस	प्रिंसिपल तकनीकी अधिकारी
श्री. डी. आर. शोभन कुमार	वरिष्ठ तकनीकी अधिकारी (1)

माइक्रोबियल प्रोसेस तथा प्रौद्योगिकी प्रभाग

डॉ. के माधवन नंपूतिरि	प्रिंसिपल वैज्ञानिक एवं प्रधान
डॉ. राजीवकुमार सुकुमारन	वरिष्ठ वैज्ञानिक
डॉ. पी. बिनोद	वैज्ञानिक
डॉ. एन. रमेश कुमार	वैज्ञानिक
डॉ. मुत्तु अरुमुगम	वैज्ञानिक
श्री. एम. किरन कुमार	वैज्ञानिक
श्री. के. एम. प्रकाश	वरिष्ठ तकनीशिन (2)

रसायन विज्ञान तथा प्रौद्योगिकी प्रभाग

डॉ. (श्रीमती) आर लक्ष्मी वर्मा	वरिष्ठ प्रिंसिपल वैज्ञानिक तथा प्रधान
डॉ. के. आर. गोपिदास	मुख्य वैज्ञानिक
डॉ. के.वी. राधाकृष्णन	प्रिंसिपल वैज्ञानिक
डॉ. सी.एच. सुरेश	प्रिंसिपल वैज्ञानिक
डॉ. के.एन. नारायणन उण्णी	प्रिंसिपल वैज्ञानिक
डॉ. कौस्ताभ कुमार मैती	वरिष्ठ वैज्ञानिक
डॉ. बिश्वप्रिया देब	वरिष्ठ वैज्ञानिक
डॉ. करुणाकरन वेणुगोपाल	वरिष्ठ वैज्ञानिक
डॉ. सुनिल वर्गीस	वरिष्ठ वैज्ञानिक
डॉ. युसफ करुवात	वैज्ञानिक
डॉ. एल. रविशंकर	वैज्ञानिक
डॉ. जोशी जोसफ	वैज्ञानिक
डॉ. बी.एस. शशिधर	वैज्ञानिक
डॉ. सी. विजयकुमार	वैज्ञानिक
डॉ. (श्रीमती) जे. डी. सुधा	प्रिंसिपल तकनीकी अधिकारी

श्रीमती सौमिनी मैथ्यू	वरिष्ठ तकनीकी अधिकारी (1)
श्री. रोबर्ड फिलिप	वरिष्ठ तकनीकी अधिकारी (1)
श्रीमती एस. विजी	वरिष्ठ तकनीकी अधिकारी (1)
श्री. किरन मोहन	तकनीकी अधिकारी

पदार्थ विज्ञान तथा प्रौद्योगिकी प्रभाग

डॉ. पी. प्रभाकर राव	मुख्य वैज्ञानिक तथा प्रधान
श्री. के. हरिकृष्ण भट्ट	मुख्य वैज्ञानिक
डॉ. यु.टी.एस. पिल्लै	मुख्य वैज्ञानिक तथा प्रधान, ई. एस. डी
श्री. एम.सी. षाजी	वरिष्ठ प्रिंसिपल वैज्ञानिक
डॉ. ए.आर.आर. मेनोन	वरिष्ठ प्रिंसिपल वैज्ञानिक
डॉ. मनोज रामवर्मा	वरिष्ठ प्रिंसिपल वैज्ञानिक
डॉ. एम. रवि	वरिष्ठ प्रिंसिपल वैज्ञानिक
डॉ. एस. अनन्तकुमार	वरिष्ठ प्रिंसिपल वैज्ञानिक
डॉ. टी.पी.डी. राजन	प्रिंसिपल वैज्ञानिक
डॉ. एस.वी. शुक्ला	वरिष्ठ वैज्ञानिक
डॉ. यु.एस. हरीश	वरिष्ठ वैज्ञानिक
डॉ. ई. भोजे गौड	वरिष्ठ वैज्ञानिक
डॉ. ए. श्रीनिवासन	वरिष्ठ वैज्ञानिक
डॉ. एम. सुन्दराराजन	वरिष्ठ वैज्ञानिक
डॉ. के.पी. सुरेन्द्रन	वैज्ञानिक
डॉ. सजु पिल्लै	वैज्ञानिक
डॉ.(श्रीमती) एम. वसुंधरा	वैज्ञानिक
डॉ. के.जी. निशांत	वैज्ञानिक
डॉ. वी.एस. प्रसाद	प्रिंसिपल तकनीकी अधिकारी
श्री. एम. ब्रह्मकुमार	प्रिंसिपल तकनीकी अधिकारी
डॉ. एस. रामस्वामी	वरिष्ठ तकनीकी अधिकारी (1)
डॉ. ए. पीर मोहम्मद	वरिष्ठ तकनीकी अधिकारी (1)
श्री. वी. आन्टणी	वरिष्ठ तकनीशियन
श्री. वी. हरीश राज	तकनीकी सहायक
श्री. एम.पी. वर्की	प्रोयोगशाला सहायक

पर्यावरण प्रौद्योगिकी प्रभाग

डॉ. (श्रीमती) एलिज़बत जेकब	मुख्य वैज्ञानिक तथा प्रधान
डॉ. अजित हरिदास	मुख्य वैज्ञानिक
डॉ. (श्रीमती) एस. सावित्री	वरिष्ठ प्रिंसिपल वैज्ञानिक
श्री. जे. अंसारी	वरिष्ठ प्रिंसिपल वैज्ञानिक
डॉ. बी. कृष्णकुमार	वरिष्ठ वैज्ञानिक
श्री. बी. अब्दुल हलीम	वैज्ञानिक
डॉ. के.पी. प्रतीश	वैज्ञानिक
श्रीमती विजयाप्रसाद	वरिष्ठ तकनीकी आधिकारी (3)
श्री. वी.के. षाजिकुमार	वरिष्ठ तकनीकी अधिकारी (1)
श्री. जोशी जोर्ज	वरिष्ठ तकनीकी अधिकारी (1)
श्रीमती पी.एस. सहरूबा	तकनीकी अधिकारी
श्री. टी.पी. पौलोस	वरिष्ठ तकनीशियन (3)

एस. एंड. टी सेवा प्रभाग

इंजीनियरिंग सेवा प्रभाग

डॉ. यु.टी.एस. पिल्लै	मुख्य वैज्ञानिक तथा प्रधान
श्री. आर. राजीव	वरिष्ठ अधीक्षण अभियंता
श्री. जी. चन्द्रबाबु	अधीक्षण अभियंता
श्री. चन्द्रशेखर नीलम	सहायक कार्यपालक अभियंता
श्री. बी. कार्तिक	सहायक अभियंता (सिविल)
श्री. पी. अरुमुखम	सहायक अभियंता (सिविल)
श्री. एन. सुधिलाल	वरिष्ठ तकनीशियन (3)
श्री. एस. हरिदासन पिल्लै	वरिष्ठ तकनीशियन (2)
श्री. बी. राधाकृष्णन	तकनीशियन (2)
श्री. एम. जयदीप	तकनीशियन (2)
श्री. के.एस. प्रमोद	तकनीशियन (2)
श्री. के. सुरेश कण्णन	तकनीशियन (2)
श्री. यु. धरणीपति	तकनीशियन (2)
श्री. सी.पी. नारायणन	प्रयोगशाला सहायक
श्री. पी. सोमन	प्रयोगशाला सहायक
श्री. टी.वी. सतीश	ग्रुप सी. गैर तक. (एम.ए.सी.पी)

नॉलिज रिसोर्ट सेंटर

श्रीमती पी. निशी	वरिष्ठ प्रिंसिपल वैज्ञानिक तथा प्रधान
श्री. वी. मणी	वैज्ञानिक
श्री. एस.बी. रिबिन जोन्स	वैज्ञानिक
श्री. एस. रामसामि पिल्लै	प्रिंसिपल तकनीकी अधिकारी
श्री. एस. पुश्किन	तकनीकी अधिकारी
श्री. पी.एन. शिवनकुट्टि नायर	वरिष्ठ तकनीशियन (2)
श्री. जी. नागश्रीनिवासु	वरिष्ठ तकनीशियन (2)
श्री. पुष्पाकुमार के.आर. नायर	ग्रुप सी. गैर तक. (एम.ए.सी.पी.)

योजना तथा व्यवसाय विकास

डॉ. सी. चन्द्रशेखरा भट्ट	वरिष्ठ प्रिंसिपल वैज्ञानिक
श्री. सी.के. चन्द्रकान्त	प्रिंसिपल वैज्ञानिक
श्री. आर. एस. प्रवीण राज	वरिष्ठ वैज्ञानिक
डॉ. दीपा बालन	वैज्ञानिक
श्री. बी. वेणुगोपाल	वरिष्ठ तकनीशियन (2)

प्रशासन

श्रीमती एस. शोभना	प्रशासन अधिकारी
श्री. के.एफ. जोसफ	अनुभाग अधिकारी (सा)
श्री. एम.के. शिवदासन	अनुभाग अधिकारी (सा)
श्री. टी.जे. बाबु	वरिष्ठ सुरक्षा अधिकारी
श्रीमती के.एस. लतीदेवी	हिन्दी अधिकारी
डॉ. सादत सलीम	चिकित्सा अधिकारी
श्री. के.पी. कृष्णन	सहायक (सा) ग्रेड I

सुश्री टी.एस. लता	सहायक (सा) ग्रेड I
श्रीमती पी.एस. पद्मिनी	वरिष्ठ आशुलिपिक (एम.ए.सी.पी)
श्री. ओ.वी. शशिकुमार	वरिष्ठ आशुलिपिक (एम.ए.सी.पी)
श्री. आर.के. रमेशकुमार	सहायक (सा) ग्रेड II
श्री. बी. सतीशकुमार	सहायक (सा) ग्रेड III
सुश्री सजिता ए.एल	सहायक (सा) ग्रेड III
सुश्री टी.एम. अश्वती	सहायक (सा) ग्रेड III
श्री. टी.एच. बशीर	वरिष्ठ तकनीशियन (2)
श्री. प्रवीण कण्णाल	तकनीशियन (2)
श्रीमती शाना एस. नायर	स्टाफ नर्स
श्रीमती एम. गीता	प्रयोगशाला सहायक
श्री. के. उण्णिकृष्णन	ग्रुप सी गैर तकनीकी (एस.ए.सी.पी)
श्री. के. मधु	बेयरर (एम.ए.सी.पी)
श्री. ए. श्रीकुमारन	वाशबॉय (एम.ए.सी.पी)

वित्त एवं लेखा

श्री. डी.पी. मारेट	वित्त एवं लेखा अधिकारी (एस.ए.सी.पी)
श्रीमती पी.वी. विजि	अनुभाग अधिकारी (वित्त एवं लेखा)
श्रीमती रमणी देवराज	अनुभाग अधिकारी (वित्त एवं लेखा)
श्रीमती जी. गीता	सहायक (वित्त एवं लेखा) ग्रेड I
श्री. संजीव सदानन्दन	सहायक (वित्त एवं लेखा) ग्रेड I
श्रीमती कोमला सोमन	सहायक (वित्त एवं लेखा) ग्रेड I
श्री. विष्णु वी.एल.	कनिष्ठ आशुलिपिक
श्री. पी. रजित	मल्टी टास्किंग स्टाफ

भण्डार एवं क्रय

श्री. दुलीप कुमार	भण्डार एवं क्रय नियंत्रक
श्री. सी.एम. कृष्णदास	सहायक (भण्डार एवं क्रय) ग्रेड I
श्री. एम. अनिलकुमार	सहायक (भण्डार एवं क्रय) ग्रेड I
श्री. सी.एम. कृष्णदास	सहायक (भण्डार एवं क्रय) ग्रेड I
श्री. एम. अनिलकुमार	सहायक (भण्डार एवं क्रय) ग्रेड I
श्री. एस. राजु	वरिष्ठ आशुलिपिक (एम.ए.सी.पी)
सुश्री शीबा सैतू	सहायक (भण्डार एवं क्रय) ग्रेड III
श्रीमती एल लता	वरिष्ठ तकनीशियन (2)
श्री. बी. अजयकुमार	वरिष्ठ तकनीशियन (2)
श्री. टी.आर. सुरेश कुमार	वरिष्ठ तकनीशियन (2)
श्री. टी.के घोष	ग्रुप सी गैर तकनीकी (एम.ए.सी.पी)
श्री जी भक्तवल्सलम	ग्रुप सी गैर तकनीकी

STAFF LIST AS ON 31/03/2017

Dr A Ajayaghosh	Director

DIRECTOR'S OFFICE

Mr J S Kiran	Technical Assistant
Mr Vishnu Gurjar	Junior Stenographer
Mr P B Vijayakumar	Lab Assistant

AGROPROCESSING & TECHNOLOGY DIVISION

Dr B S Dileep Kumar	Senior Principal Scientist & Head
Dr A Sundaresan	Chief Scientist
Mr M M Sreekumar	Chief Scientist
Dr K G Raghu	Principal Scientist
Mr V V Venugopal	Principal Scientist
Mrs M V Reshma	Senior Scientist
Dr (Mrs) P Nisha	Scientist
Dr P Jayamurthy	Scientist
Dr (Mrs) S Priya	Scientist
Dr (Mrs) Beena Joy	Principal Technical Officer
Mr D R Soban Kumar	Senior Technical Officer (1)

MICROBIAL PROCESSES &TECHNOLOGY DIVISION

Dr K Madhavan Nampoothiri	Principal Scientist & Head
Dr Rajeevkumar Sukumaran	Senior Scientist
Dr P Binod	Scientist
Dr N Ramesh Kumar	Scientist
Dr Muthu Arumugam	Scientist
Mr M Kiran Kumar	Scientist
Mr K M Prakash	Senior Technician (2)

CHEMICAL SCIENCES & TECHNOLOGY DIVISION

Dr (Mrs) R Luxmi Varma	Senior Principal Scientist & Head
Dr K R Gopidas	Chief Scientist
Dr K V Radhakrishnan	Principal Scientist
Dr C H Suresh	Principal Scientist
Dr K N Narayanan Unni	Principal Scientist
Dr Kaustabh Kumar Maiti	Senior Scientist
Dr Biswapriya Deb	Senior Scientist
Dr Karunakaran Venugopal	Senior Scientist
Dr Sunil Varughese	Senior Scientist
Dr Yoosaf Karuvath	Scientist
Dr L Ravi Shankar	Scientist
Dr Joshy Joseph	Scientist
Dr B S Sasidhar	Scientist
Dr C Vijayakumar	Scientist

Dr (Mrs) J D Sudha	Principal Technical Officer
Mrs Saumini Mathew	Senior Technical Officer (I)
Mr Robert Phillip	Senior Technical Officer (I)
Mrs S Viji	Senior Technical Officer (I)
Mr Kiran Mohan	Technical Officer

MATERIALS SCIENCE & TECHNOLOGY DIVISION

Dr P Prabhakar Rao	Chief Scientist & Head
Dr K Harikrishna Bhat	Chief Scientist
Dr U T S Pillai	Chief Scientist
Mr M C Shaji	Senior Principal Scientist
Dr Manoj Raama Varma	Senior Principal Scientist
Dr M Ravi	Senior Principal Scientist
Dr S Ananthakumar	Senior Principal Scientist
Dr T P D Rajan	Principal Scientist
Dr S V Shukla	Senior Scientist
Dr U S Hareesh	Senior Scientist
Dr E Bhoje Gowd	Senior Scientist
Dr A Srinivasan	Senior Scientist
Dr M Sundararajan	Senior Scientist
Dr K P Surendran	Scientist
Dr Saju Pillai	Scientist
Dr (Mrs) M Vasundhara	Scientist
Dr K G Nishanth	Scientist
Dr V S Prasad	Principal Technical Officer
Mr M Brahma Kumar	Principal Technical Officer
Dr S Ramaswamy	Senior Technical Officer(1)
Mr A Peer Mohammed	Senior Technical Officer (1)
Mr V Antony	Senior Technician (2)
Mr V Harish Raj	Technical Assistant
Mr M P Varkey	Lab Assistant

ENVIRONMENTAL TECHNOLOGY DIVISION

Dr (Mrs)Elizabeth Jacob	Chief Scientist & Head
Dr Ajit Haridas	Chief Scientist
Dr (Mrs) S Savithri	Senior Principal Scientist
Mr J Ansari	Senior Principal Scientist
Dr B Krishnakumar	Senior Scientist
Mr B Abdul Haleem	Scientist
Dr K P Prathish	Scientist
Mrs Vijaya Prasad	Senior Technical Officer(3)
Mr V K Shajikumar	Senior Technical Officer(1)
Mr Joshy George	Senior Technical Officer(1)
Mrs P M Saharuba	Technical Officer
Mr T P Paulose	Senior Technician(3)

S & T SERVICES

ENGINEERING SERVICES DIVISION

Dr U T S Pillai	Chief Scientist & Head
Mr R Rajeev	Senior Superintending Engineer
Mr G Chandra Babu	Superintending Engineer
Mr Chandra Shekar Neelam	Assistant Executive Engineer
Mr B Karthik	Assistant Engineer
Mr P Arumugam	Assistant Engineer
Mr N Sudhilal	Senior Technician (3)
Mr S Haridasan Pillai	Senior Technician(2)
Mr B Radhakrishnan	Technician(2)
Mr M Jayadeep	Technician (2)
Mr K S Pramod	Technician (2)
Mr K Suresh Kannan	Technician (2)
Mr U Dharanipathy	Technician(2)
Mr C P Narayanan	Lab Assistant
Mr P Soman	Lab Assistant
Mr T V Satheesh	Group C (NT) (MACP)

KNOWLEDGE RESOURCE CENTRE

Dr (Mrs) P Nishy	Senior Principal Scientist & Head
Mr V Moni	Scientist
Mr S B Ribin Jones	Scientist
Mr M Ramasamy Pillai	Principal Technical Officer
Mr S Pushkin	Technical Officer
Mr P N Sivankutty Nair	Senior Technician (2)
Mr G Nagasrinivasu	Senior Technician (2)
Mr Pushpakumar K R Nair	Group C (NT) (MACP)

RESEARCH PLANNING & BUSINESS DEVELOPMENT

Dr A Sundaresan	Chief Scientist & Head
Dr C Chandrasekhara Bhat	Senior Principal Scientist
Mr C K Chandrakanth	Principal Scientist
Mr R S Praveen Raj	Senior Scientist
Dr Deepa Balan	Scientist
Mr B Venugopal	Senior Technician(2)

ADMINISTRATION

Mrs S Sobhana	Administrative Officer
Mr K F Joseph	Section Officer (G)
Mr M K Sivadasan	Section Officer (G)
Mr T J Babu	Senior Security Officer
Mrs K S Lathidevi	Hindi Officer
Dr Sadath Salim	Medical Officer

Mr K P Krishnan	Assistant (G) Gr I
Mrs Mercy Joseph	Assistant (G) Gr I
Mrs T S Latha	Assistant (G) Gr I
Ms Neethu Induchoodan	Assistant (G) Gr I
Mrs P S Padmini	Senior Stenographer (MACP)
Mr O V Sasikumar	Senior Stenographer (MACP)
Mr R K Ramesh Kumar	Assistant(G)Gr II
Mr B Satheesh Kumar	Assistant(G)Gr III
Mrs A L Sajitha	Assistant(G)Gr III
Mrs T M Aswathy	Assistant(G)Gr III
Mr T H Basheer	Senior Technician(2)
Mr Praveen Kannal	Technician(2)
Mrs Shana S Nair	Staff Nurse
Mrs M Geetha	Lab Assistant
Mr K Unnikrishnan	Gr C (NT) (MACP)
Mr K Madhu	Bearer (MACP)
Mr A Sreekumaran	Washboy (MACP)

FINANCE & ACCOUNTS

Mr D P Maret	Finance and Accounts Officer
Mrs P V Viji	Section Officer (F&A)
Mrs Remani Devaraj	Section Officer (F&A)
Mrs G Geetha	Assistant(F&A)Gr I
Mr Sanjeev Sadanandan	Assistant(G)Gr I
Mrs Komala Soman	Assistant(F&A)Gr I
Mr Vishnu V L	Junior Stenographer
Mr P Rejith	Multi Tasking Staff

STORES & PURCHASE

Mr Dulip Kumar	Controller of Stores & Purchase
Mr C M Krishnadas	Assistant(S&P)Gr I
Mr M Anilkumar	Assistant(S&P)Gr I
Mr S Raju	Senior Stenographer (MACP)
Mrs Sheeba Saithu	Assistant(S & P)Gr III
Mrs L Latha	Senior Technician(2)
Mr B Ajayakumar	Senior Technician (2)
Mr T R Suresh Kumar	Senior Technician (2)
Mr T K Ghosh	Group C (NT) (MACP)
Mr G Bhakthavalsalam	Group C (NT)

आर.एंड.डी. - उद्योग बैठक

सी.एस.आई.आर-एन.आई.आई.एस.टी, तिरुवनंतपुरम ने 6 जनवरी 2017 को आपसी हित के मुद्दों की पहचान के लिए और एम.एस.एम.ई सहित निजी, सार्वजनिक क्षेत्रों में उद्योगों के साथ गठबंधन बनाने के लिए एक-दिवसीय आर.एंड.डी - उद्योग बैठक का आयोजन किया। देश के विभिन्न भागों से उद्योगों के प्रतिनिधियों, ज्यादातर निजी क्षेत्र से और उभरते उद्यमियों ने आर. एड डी. बैठक में भाग लिया। प्रतिभागियों कृषि और खाद्य प्रसंस्करण, ऊर्जा और पर्यावरण, रसायन और सामग्री, जैव प्रौद्योगिकी जैसे विभिन्न क्षेत्रों से थें। 6 जनवरी 2017 को प्रातः 9 बजे उद्घाटन समारोह शुरू हुआ। संस्थान निदेशक डॉ. ए. अजयघोष ने स्वागत भाषण दिया। केरल के माननीय मुख्यमंत्री श्री पिनरायी विजयन ने आर एंड डी उद्योग बैठक का उद्घाटन किया। केरल राज्य विधान सभा के माननीय सदस्य श्री ओ. राजगोपाल ने उद्घाटन समारोह की अध्यक्षता की और माननीय संसद सदस्य डॉ. शशि थरूर ने समारोह में मुख्य भाषण दिया।

माननीय मुख्यमंत्री श्री पिनरायी विजयन ने अपने उद्घाटन भाषण में राष्ट्र के विकास के लिए आर. एंड डी - उद्योग के साथ गठबंधन की आवश्यकता पर जोर दिया। उन्होंने आगे वैज्ञानिक ज्ञान का आर्थिक रूप से व्यवहार्य प्रौद्योगिकियों और उत्पादों में स्थानांतरण करने पर ज़ोर दिया, जो केवल शैक्षणिक बिरादरी, अनुसंधान एवं विकास संस्थानों और उद्योगों के सहयोग से ही संभव है। उन्होंने यह भी कहा कि विकसित देशों में आर एंड डी उद्योग के गठबंधन पर अत्यधिक ध्यान दिया जाता है, जब कि भारत में इसकी कमी है। उन्होंने यह भी ज़ोर देकर कहा कि आर. एंड. डी - उद्योग के गठबंधन से समाज की समस्याओं को दूर करना चाहिए और क्षेत्रीय स्तर पर समाज के लिए फायदेमंद होना चाहिए।

श्री ओ. राजगोपाल, केरल राज्य विधान सभा के माननीय सदस्य ने अपने अध्यक्षीय भाषण में देश के आर्थिक विकास के लिए आर. एंड डी. उद्योग के साथ गठबंधन की आवश्यकता पर जोर दिया। केरल के प्रासंगिक मुद्दों के समाधान के लिए केरल में उपलब्ध संसाधनों के बेहतर उपयोग के लिए उन्होंने वैज्ञानिकों का आह्वान किया।

डॉ. शशि थरूर ने अपने मुख्य भाषण में सूचना प्रौद्योगिकी, चिकित्सा अनुसंधान जैसे क्षेत्रों में उपलब्ध विभिन्न प्रौद्योगिकी नवप्रवर्तनों पर प्रकाश डाला। उन्होंने आर.एड डी. संस्थानों में छात्र बिरादरी के न्यून उपयोग पर अपनी चिंता व्यक्त की। अभिनव विचारों को बढ़ावा देने के लिए और भारत में नवीनता लाने के लिए छात्र समुदाय को अधिक अवसर प्रदान करने के लिए शिक्षा और अनुसंधान एवं विकास संस्थानों के साथ गठबंधन करने के लिए उन्होंने उद्योगों को आगे आने का अनुरोध किया। भारतीय उद्योगों द्वारा निम्न स्तर के आई.पी. उत्पादन पर उन्होंने अपनी चिंता व्यक्त की। उन्होंने कहा कि भारत में आर एंड डी. का 75% केंद्रीय सरकार द्वारा वित्त पोषित है, जबकि ओ.ई.सी.डी. देशों में आर. एड डी. एक बड़ी हद तक उद्योगों द्वरा वित्त पोषित है और सरकार का शेयर केवल 5% है। समाज की भलाई और भारत के विकास के लिए अत्याधुनिक नवाचार को लाने के लिए उन्होंने दर्शकों को प्रेरित किया। उन्होंने केरल के ज्ञान उद्योग में सुधार करके तिरुवनंतपुरम को एक ज्ञान शहर बनाने की अपनी कामना व्यक्त की।

श्री. एम.एम. श्रीकुमार, मुख्य वैज्ञानिक तथा अनुसंधान एवं विकास - उद्योग बैठक के संयोजक धन्यवाद ज्ञापन के साथ उद्घाटन समारोह संपन्न हुआ। अनुसंधान एवं विकास -

उद्योग बैठक के अवसर पर, एन.आई.आई.एस.टी. की प्रौद्योगिकियों/नॉलेजबेस की एक प्रदर्शनी भी आयोजित की गई। सी.एस.आई.आर – एन.आई.आई.एस.टी. में विकसित उत्पाद/प्रौद्योगिकी/प्रक्रियाओं का प्रदर्शन भी हुआ। उद्घाटन समारोह के बाद तकनीकी प्रस्तुतियां थी। डॉ. ए. अजयघोष, निदेशक ने प्रारंभिक टिप्पणियां दी। सी.एस.आई.आर-एन.आई.आई.एस.टी के पांच प्रभागों के यानी ए.पी.टी.डी, एम.पी.टी.डी., सी.एस.टी.डी., ईटीडी, एम.एस.टी.डी. के प्रतिनिधियों ने अपने संबंधित प्रभाग की तकनीकी हाइलाइट प्रस्तुत की।

स्थापना दिवस - 2016

सी.एस.आई.आर - एन.आई.आई.एस.टी.

6 अक्तूबर 2016 को सी.एस.आई.आर – एन.आई.आई.एस.टी. में सी.एस.आई.आर – एन.आई.आई.एस.टी. स्थापना दिवस मनाया गया। उक्त दिवस को आम दिवस मनाया गया और विभिन्न शैक्षणिक संस्थानों से लगभग 300 छात्रों ने संस्थान में उपलब्ध अनुसंधान एवं विकास सुविधाओं का दौरा किया। डॉ. ए. अजयघोष, निदेशक, सी.एस.आई.आर – एन.आई.आई.एस.टी. ने स्वागत भाषण दिया और उन्होंने स्थापना दिवस समारोह की अध्यक्षता की। केरल के माननीय राज्यपाल श्री न्यायमूर्ति (सेवानिवृत्त) पी. सदाशिवम समारोह में मुख्य अतिथि थे। उन्होंने प्रयोगशाला की वैज्ञानिक उपलब्धियों की सराहना की। मुख्य अतिथि ने सी.एस.आई.आर-एन.आई.आई.एस.टी. के वर्ष 2015-16 की वार्षिक रिपोर्ट का लोकार्पण किया। डॉ. ए. सुंदरेशन, मुख्य वैज्ञानिक, सी.एस.आई.आर. – एन.आई.आई.एस.टी, तिरुवनंतपुरम ने धन्यवाद ज्ञापित किया। मुख्य अतिथि ने संस्थान परिसर में सर सी.वी. रमन की प्रतिमा का भी अनावरण किया।

केरल के माननीय राज्यपाल श्री न्यायमूर्ती (सेवानिवृत) पी. सदाशिवम सी.एस.आई.आर. एन.आई.आई.एस.टी-स्थापना दिवस समारोह के दौरान सी.एस.आई.आर-एन.आई.आई.एस.टी. के वर्ष 2015-16 की वार्षिक रिपोर्ट का लोकार्पण करते हुये।

केरल के माननीय राज्यपाल श्री न्यायमूर्ति (सेवानिवृत्त) पी. सदाशिवम सी.एस.आई.आर - एन.आई.आई.एस.टी. - स्थापना दिवस समारोह के दौरान सर सी.वी. रमन की प्रतिमा का अनावरण करते हुये

सी.एस.आई.आर - स्थापना दिवस समारोह–2016

27 सितंबर 2016 को सी.एस.आई.आर – एन.आई.आई.एस.टी. में सी.एस.आई.आर स्थापना दिवस मनाया गया। संस्थान की गतिविधियों के प्रदर्शन के लिए उक्त दिवस को आम दिवस मनाया गया और विभिन्न शैक्षणिक संस्थानों से लगभग 300 छात्रों ने संस्थान में उपलब्ध अनुसंधान एवं विकास सुविधाओं का

दौरा किया। डॉ. ए. अजयघोष, निदेशक, सी.एस.आई.आर-एन.आई.आई.एस.टी. ने स्वागत भाषण दिया और उन्होंने समारोह की अध्यक्षता की। डॉ. विनय कुमार दधवाल, निदेशक, भारतीय अंतरिक्ष विज्ञान तथा प्रौद्योगिकी संस्थान, तिरुवनंतपुरम, जो समारोह में मुख्य अतिथि थे, ने सी.एस.आई.आर. स्थापना दिवस व्याख्यान दिया। अपने व्याख्यान में उन्होंने पृथ्वी अवलोकन उपग्रहों के महत्व और अनुप्रयोगों पर बल दिया। वर्ष 2015-16 के दौरान सी.एस.आई.आर-एन.आई.आई.एस.टी. से सेवानिवृत्त कर्मचारियों और सी.एस.आई.आर. में सेवा के 25 वर्ष पूरे कर्मचारियों को सम्मानित किया गया और छात्रवृत्ति पुरस्कार 2015-16 भी वितरित किया गया। डॉ. आर. लक्ष्मी वर्मा, अध्यक्ष, शैक्षणिक कार्यक्रम समिति ने धन्यवाद ज्ञापित किया।

डॉ. विनय कुमार दधवाल, निदेशक, भारतीय अंतरिक्ष विज्ञान तथा प्रौद्योगिकी संस्थान, तिरुवनंतपुरम सी.एस.आई.आर. स्थापना दिवस व्याख्यान देते हुये

प्रोमिस कार्यक्रम

"विज्ञान में नवाचार को प्रेरित करने के लिए आयोजित कार्यक्रम (प्रोमिस)" का मुख्य उद्देश्य विज्ञान के प्रति किसी के स्वाभाविक झुकाव का पुनः पता लगाना था। कार्यक्रम इस तरह बनाया गया था कि इससे छात्रों की वैज्ञानक प्रतिभा को जलाया व आकर्षित किया जाए।

प्रतिभा स्कोलर्स के एक चयनित संख्या को एक जानकार और समझदार कैरियर के चयन में मदद कराना कार्यक्रम का उद्देश्य है। प्रतिभा स्कोलर्स के लिए विज्ञान संवर्धन कार्यक्रम के तहत सी.एस.आई.आर - एन.आई.आई.एस.टी. तथा केरल राज्य विज्ञान, प्रौद्योगिकी एवं पर्यावरण परिषद (के.एस.सी.एस.टी.ई) के संयुक्त तत्वावधान में 25 अप्रैल 2016 से 29 अप्रैल 2016 तक प्रोमिस कार्यक्रम का आयोजन किया गया। सी.एस.आई.आर. – एन.आई.आई.एस.टी. में आयोजित पांच दिवसीय शिविर में सेमिनार, प्रयोगशाला का दौरा, और इंटरैक्टिव सत्र के माध्यम से सी.एस.आई.आर. – एन.आई.आई.एस.टी. की फैकल्टी के साथ संबंध स्थापित करने में छात्रों की मदद की। केरल के विभिन्न भागों से 33 प्रतिभा स्कोलर्स ने कार्यक्रम में भाग लिया। डॉ. सुरेश दास, कार्यकारी उपाध्यक्ष, के.एस.सी.एस.टी.ई ने मूल व्याख्यान दिया, जिसके पश्चात वी.एस.एस.सी. संग्रहालय के दर्शन के लिए छात्रों को अवसर प्रदान किया गया, जहाँ भारतीय अंतरिक्ष अनुसंधान की क्रांति और भारतीय अंतरिक्ष अनुसंधान संगठन द्वारा की गई उन्नतियों का प्रदर्शन किया गया था। समापन दिवस में (29.04.2016) डॉ. टेसी थॉमस, मिसाइल महिला, एवं उत्कृष्ट वैज्ञानिक व निदेशक, ए.एस.एल, डी.आर.डी.ओ. ने समापन व्याख्यान दिया। तत्पश्चात, डॉ. ए. अजयघोष, निदेशक सी.एस.आई.आर - एन.आई.आई.एस.टी. के साथ एक इंटरैक्टिव सत्र भी आयोजित किया गया।

राष्ट्रीय प्रौद्योगिकी दिवस समारोह

मंच पर दाएं ओर से – डॉ. आर लक्ष्मी वर्मा, डॉ. अजयघोष, तथा मुख्य अतिथि श्री पी.एच. कुरियन , आईएएस

सी.एस.आई.आर - एन.आई.आई.एस.टी में 11 मई 2016 को राष्ट्रीय प्रौद्योगिकी दिवस मनाया गया। डॉ. ए. अजयघोष, निदेशक, सी.एस.आई.आर.-एन.आई.आई.एस.टी. ने स्वागत भाषण दिया और मुख्य अतिथि का परिचय कराया। श्री. पी.एच. कुरियन, आई.ए.एस, प्रधान सचिव (उद्योग एवं आई.टी. विभाग), केरल सरकार, तिरुवनंतपुरम समारोह में मुख्य अतिथि थे और उन्होंने राष्ट्रीय प्रौद्योगिकी दिवस व्याख्यान दिया। उन्होंने अपने व्याख्यान में उद्योगों में आ रही तकनीकी समस्याओं को सुलझाने के लिए उद्योगों और विभिन्न संस्थानों के बीच बेहतर संपर्क की आवश्यकता पर जोर दिया। डॉ. आर. लक्ष्मी वर्मा, अध्यक्ष, शैक्षणिक कार्यक्रम समिति ने धन्यवाद ज्ञापित किया।

प्राकृतिक उत्पाद रसायन विज्ञान में हाल की प्रवृत्तियाँ

संगोष्ठी के विभिन्न दृश्य

सी.एस.आई.आर.- एन.आई.आई.एस.टी. और भारतीय केमिकल रिसर्च सोसायटी, तिरुवनंतपुरम चैप्टर के संयुक्त तत्वावधान में 13 मई, 2016 को सी.एस.आई.आर.-एन.आई.आई.एस.टी, तिरुवनंतपुरम में प्राकृतिक उत्पाद रसायन विज्ञान में हाल की प्रवृत्तियों पर एक दिवसीय संगोष्ठी का आयोजन किया गया। सी.एस.आई.आर. - एन.आई.आई.एस.टी के वैज्ञानिक बिरादरी के अलावा अमृता विश्वविद्यालय, केरल विश्वविद्यालय, जे.एन.टी.बी.जी.आर.आई, जैसे राज्य और राष्ट्रीय शैक्षिक संस्थानों और सी.एस.आई.आर. की सहधोदर प्रयोगशालाओं जैसे आई.आई.सी.टी., आई.आई.आई.एम. जम्मू से विभिन्न प्रख्यात प्राकृतिक उत्पाद केमिस्टों ने संगोष्ठी में भाग लिया। डॉ. के.आर. गोपिदास, मुख्य वैज्ञानिक एवं प्रधान, रसायन विज्ञान तथा प्रौद्योगिकी प्रभाग (सी.एस.टी.डी) के स्वागत भाषण के साथ कार्यक्रम शुरू किया गया। संस्थान निदेशक डॉ. ए. अजयघोष ने अध्यक्षीय भाषण दिया। पहला व्याख्यान प्रो. अशोक बनर्जी, विशिष्ट प्रोफेसर, जैव प्रौद्योगिकी स्कूल, अमृता विश्व विदायपीठम द्वारा दिया गया। बाद में, डॉ. सुरेश बाबू के. (वरिष्ठ वैज्ञानिक, सी.एस.आई.आर. आई.आई.सी.टी, हैदराबाद), डॉ. भहवल अली शाह (वैज्ञानिक, सी.एस.आई.आर-आई.आई.आई.एम., जम्मू) डॉ. एम.डी. अजिता बाई, (सेवानिवृत्त प्रोफेसर, एम.जी. कॉलेज, तिरुवनंतपुरम तथा डॉ. के.पी. रमेशकुमार (वैज्ञानिक, जे.एन.टी.बी.जी.आर.आई, पालोड, तिरुवनंतपुरम) द्वारा व्याख्यान दिया गया। संगोष्ठी में पादप रसायन अनुसंधान तथा प्रकृतिक उत्पादों के उपयोग पर प्रकाश डाला गया। एक समापन सत्र के साथ कार्यक्रम संपन्न हुआ। समापन समारोह में, डॉ. आर. लक्ष्मी वर्मा, वरिष्ठ प्रिंसिपल वैज्ञानिक, सी.एस.टी.डी. प्रभाग ने अतिथियों का स्वागत किया। डॉ. मंगलम एस. नायर, मुख्य वैज्ञानिक, जिन्होंने सी.एस.आई.आर - एन.आई.आई.एस.टी. में प्राकृतिक उत्पाद रसायन विज्ञान अनुसंधान शुरू करने में महत्वपूर्ण भूमिका निभाई थी और 31 मई 2016 को अधिवर्षिता पर सेवानिवृत्त हो रही थी। के सम्मान में सी.एस.टी.डी. प्रभाग में प्रिंसिपल वैज्ञानिक डॉ. के.वी. राधाकृष्णन ने सी.एस.आई.आर-एन.आई.आई.एस.टी. में पादप रसायन विज्ञान अनुसंधान पर व्याख्यान दिया।

संगोष्ठी में वैज्ञानिकों और छात्रों को प्राकृतिक उत्पादों के अनुसंधान में सहयोग, नेटवर्किंग और देश भर से आए विशेषज्ञों और शिक्षाविदों के साथ उत्तेजक विचारों के आदान के लिए एक उत्कृष्ट मंच प्रदान किया गया। डॉ. एल रविशंकर ने धन्यवाद ज्ञापन दिया।

दक्षिण भारत में स्वच्छता केलिए नवीन प्रौद्योगिकी एवं इंजीनियरिंग दृष्टिकोण पर कार्यशाला

सी.एस.आई.आर. - एन.आई.आई.एस.टी. के पर्यावरण प्रौद्योगिकी प्रभाग द्वारा 13 मई 2015 को दक्षिण भारत में स्वच्छता के लिए नवीन प्रौद्योगिकी एवं इंजीनियरिंग दृष्टिकोण पर एक दिवसीय कार्यशाला का आयोजन किया गया। कार्यशाला का मुख्य आकर्षण था प्रो. पीट लेंस, पर्यावरण इंजीनियरिंग विभाग और जल प्रौद्योगिकी, यूनेस्को-आई.एच.ई, इंजीनियर रॉबर्ट ए बैर, दक्षिण फ्लोररिडा विश्वविद्यालय, श्री. मिथु एस. वी. डी. जी.एम, अनुसंधान एवं विकास, ऐरम साइंटिफिक सोल्यूशन्स प्राइवेटलिमिटेड, डॉ. ए. साजी दास, प्रबंध निदेशक, बायोटेक अक्षय ऊर्जा प्राइवेट लिमिटेड जैसे पानी और स्वच्छता के क्षेत्र में प्रख्यात पेशेवर के तकनीकी सत्र। कार्यशाला में घरेलू अपशिष्ट जल प्रबंधन और इसकी पुनरावृत्ति विकल्प सहित भारतीय परिस्थितियों के लिए उपयुक्त नई प्रौद्योगिकी विकासों पर चर्चा हुई। प्रदूषण नियंत्रण बोर्ड, विश्वविद्यालय विभागों और सी.ई.डी. से प्रतिनिधियों ने कार्यशाला में भाग लिया। कार्यशाला में एक पैनल चर्चा भी शामिल थी। डॉ. अजित हरिदास, मुख्य वैज्ञानिक, पर्यावरण प्रौद्योगिकी, सी.एस.आई.आर - एन.आई.आई.एस.टी द्वारा इसका संचालन किया गया।

संस्थान के सामान्य प्रशासन कर्मचारियों केलिए हिन्दी में टिप्पण लिखने में प्रशिक्षण देने केलिए हिंदी कार्यशाला

डॉ. हरीन्द्र शर्मा, सहायक निदेशक, (रा.भा.) कार्यशाला का संचालन करते हुये

कार्यशाला की झलक

संस्थान के सामान्य प्रशासन के कर्मचारियों को हिंदी में टिप्पण लिखने में प्रशिक्षिण देने के लिए दिनांक 26.05.2016 को आधा दिन के लिए हिन्दी कार्यशाला आयोजित की गयी। डॉ. हरीन्द्र शर्मा, सहायक निदेशक, (रा.भा.) दूरदर्शन केंद्र, तिरुवनंतपुरम कार्यशाला में अतिथि संकाय थे। संस्थान निदेशक डॉ. अजयघोष ने कार्यशाला की अध्यक्षता की। उन्होंने अतिथि संकाय का स्वागत करते हुये बताया कि संस्थान संघ सरकार की राजभाषा नीति के कार्यान्वयन पर पूरी तरह से सचेत है और इसके कार्यान्वयन के लिए संस्थान में गंभीर प्रयास भी हो रहे हैं।

हिन्दी अधिकारी श्रीमती लती देवी ने अपने स्वागत वचन में हिन्दी में अपना अधिकतम कार्यालयीन कार्य करने के लिए सभी प्रतिभागियों से आग्रह किया और बताया कि केंद्रीय सरकार की राजभाषा नीति का कार्यान्वयन हर केंद्रीय सरकारी कर्मचारी का संवैधानिक दायित्व है। हिन्दी में प्रवीणता/कार्यसाधक ज्ञान रखने वाले 20 कर्मचारियों ने कार्यशाला में भाग लिया।

कार्यशाला को एक इंटरैक्टिव फैशन में आयोजित किया गया। आदर्श हिन्दी कार्यशाला के लिए राजभाषा विभाग के वेब पोर्टल में प्रदर्शित कार्यालय संदर्शिका (कार्यालय गाइड) में परिकल्पित मॉडल के अनुसार प्रतिभागियों को प्रशिक्षित किया गया। व्यावहारिक प्रशिक्षण के लिए प्रतिभागियों को नमूने भी वितरित किये गये। प्रतिभागियों ने व्यक्त किया कि कार्यशाला में प्राप्त प्रशिक्षण से हिन्दी में टिप्पणियाँ लिखने का उनका आत्मविश्वास बढ़ गया है। अतिथि वक्ता के प्रति धन्यवाद ज्ञापन के साथ कार्यशाला संपन्न हुई।

हिन्दी दिवस/हिन्दी सप्ताह का आयोजन

दीप प्रज्वलित करके हिन्दी दिवस समारोह का औपचारिक उद्घाटन करते हुये निदेशक डॉ. ए. अजयघोष

संस्थान में 19 सितंबर को हिन्दी दिवस तथा बाद के एक सप्ताह को हिन्दी सप्ताह मनाया गया। 19 सितंबर को सुबह 10.00 बजे हिन्दी दिवस समारोह शुरू हुआ। आयोजन समिति के अध्यक्ष डॉ. पी. प्रभाकर राव ने समारोह में उपस्थित सभी का स्वागत किया। उन्होंने अपने स्वागत भाषण में केंद्रीय सरकारी कार्यालयों में हिन्दी और हिन्दी सप्ताह के आयोजन की प्रासंगिकता पर संक्षिप्त जानकारी प्रस्तुत की और प्रतिभागियों से यह आग्रह किया कि वे अपने कार्यालयीन कार्यों में राजभाषा हिन्दी का अधिकाधिक प्रयोग करते हुये सरकार की राजभाषा नीति के कार्यान्वयन में सर्वोत्तम योगदान करें।

डॉ. ए. अजयघोष, निदेशक, सी.एस.आई.आर - एन.आई.आई.एस.टी. ने हिन्दी दिवस समारोह की अध्यक्षता की। अपने अध्यक्षीय भाषण में उन्होंने बताया कि एन.आई.आई.एस.टी में सरकारी कामकाज की भाषा के रूप में हिन्दी को लगातार व्यापक स्वीकृति मिली है। फिर भी हमें अभी और अधिक प्रयास किए जाने की ज़रूरत है। उन्होंने अपने भाषण में इंटरनेट, मोबाइल, एस.एम.एस. से हिन्दी को जोडने की ज़रूरत पर जोर दिया।

एन.आई.आई.एस.टी. परिवार के सभी कर्मियों को हिन्दी दिवस की बधाईयां और शुभकामनाएं देते हुए उन्होंने आग्रह किया कि राजभाषा हिन्दी के प्रचार-प्रसार में संस्थान की ओर से किए जा रहे प्रयासों में और अधिक गति लाने की कोशिश करें। समारोह में माननीय गृह मंत्री श्री राजनाथ सिंह के हिन्दी दिवस संदेश को सब की जानकारी के लिए प्रोजेक्टर की सहायता से दिखाया गया।

डॉ. सत्यजित शुक्ला

हिन्दी दिवस की शुरुआत को चिह्नित करने के लिए सबसे पहले संस्थान में वरिष्ठ वैज्ञानिक डॉ. सत्यजित शुक्ला ने अपने हाल के अनुसंधान जलीय विलयन से कार्बनिक डाई को हटाने में हाल की गतिविधियों पर तकनीकी प्रस्तुतीकरण दिया। उन्होंने बताया कि वस्त्र उद्योगों तथा रासायनिक कारखानों से छोडे जाने वाले रंजक जलाशय और जलजीवियों के लिए भारी खतरनाक है। उन्होंने अपनी सचित्र प्रस्तुति के माध्यम से अपने पिछले कुछ वर्षों की अनुसंधान गतिविधियों पर प्रकाश डालते हुये साबित किया कि जलाशयों को प्रदूषण मुक्त करके हमारी प्राकृतिक संपत्ति को बचा सकते है।

श्री चन्द्रशेखर नीलम

इसके पश्चात इलेक्ट्रिकल अनुभाग के सहायक कार्यपालक इंजीनियर श्री चन्द्रशेखर नीलम ने – पांच एस पर प्रस्तुति दी, जो पांच जापानीस शब्दों सीरी, सीतो, सीसो, सकेत्सु और शितसुके का पहला अक्षर है, जिनका हिन्दी अर्थ है- सही छटाई, सुसज्जित व्यवस्था, स्वच्छता, स्वच्छता प्रबंध, और स्व-अनुशासन। इलेक्ट्रिकल उपकरण, वैज्ञानिक उपस्कर आदि को कार्यस्थल पर किस प्रकार व्यवस्थित किया जाना है और उनकी कार्यक्षमता बढ़ाने के लिए प्रणाली का संचालन किस प्रकार किया जाना है आदि पर उन्होंने प्रतिभागियों को सोदाहरण समझाया।

श्री विष्णु गुर्जर

निदेशक सचिवालय में कनिष्ठ आशुलिपिक श्री विष्णु गुर्जर ने जयपुर-पर्यटन की दृष्टी से विषय पर अपनी प्रस्तुति दी जिसमें जयपुर का इतिहास, भौगोलिक स्थिति, जलवायु, और पर्यटन की दृष्टि से दर्शनीय मनमोहक स्थानों के बारे में प्रतिभागियों से अपनी जानकारी साझ की।

पूरे सप्ताह के दौरान परियोजना स्टाफ, अनुसंधान छात्र आदि सहित संस्थान के संपूर्ण स्टाफ सदस्यों के लिए हिन्दी ऑनलाइन प्रश्नोत्तरी, हिन्दी प्रश्नोत्तरी, हिंदी गीत, हिन्दी अतांक्षरी हिन्दी शब्द पहेली और हिन्दी वाद-विवाद प्रतियोगिताएं आयोजित की गयी।

स्टाफ सदस्यों के स्कूली छात्रों के लिए हिन्दी निबंध लेखन, हिन्दी अनुवाद और हिन्दी गीत प्रतियोगिताएं आयोजित की गईं।

समापन समारोह व पुरस्कार वितरण दिनांक 23 सितंबर 2016 शाम 4.30 बजे आयोजित किया गया। डॉ. पी. प्रभाकर राव, अध्यक्ष, हिन्दी सप्ताह आयोजन समिति ने समारोह की अध्यक्षता की। श्रीमती पी. निशी, प्रमुख, के आर सी तथा सदस्य, आयोजन समिति ने स्वागत भाषण दिया और समारोह में उपस्थित सभी को मुख्य अतिथि का परिचय दिया। डॉ. आर. जयचन्द्रन, प्रोफेसर एवं अध्यक्ष, हिन्दी विभाग, केरल विश्वविद्यालय समारोह में मुख्य अतिथि थे। उन्होंने हिन्दी सप्ताह समापन भाषण दिया और विभिन्न प्रतियोगिताओं के सफल भागीदारों को पुरस्कार एवं प्रमाण पत्र वितरित किये।

समापन समारोह के विविध दृश्य

सतर्कता जागरूकता सप्ताह

स्टाफ सदस्यों को सतर्कता शपथ दिलाते हुये निदेशक डॉ. ए. अजयघोष

संस्थान में तारीख 31 अक्तूबर से 4 नवंबर 2016 तक सतर्कता जागरूकता सप्ताह आयोजित किया गया। 31 अक्तूबर 2016 को प्रातः 11.00 बजे निदेशक द्वारा स्टाफ सदस्यों को सतर्कता जागरूकता शपथ दिलाते हुये सप्ताह की शुरुवात हुई। उसके पश्चात 31 अक्तूबर से 4 नवंबर 2016 तक स्टाफ सदस्यों एवं अनुसंधान छात्रों के लिए निबंध लेखन, कार्टून चित्रण, वाद-विवाद, वक्तृता आदि पर प्रतियोगिताएं चलाई गयीं। दिनांक 04.11.2016 को समापन समारोह आयोजित किया गया। श्री राजशेखरन, पूर्व सी.ई.ओ., युनाइटेड इंडिया इंश्योरेंस कंपनी एवं महाप्रबंधक न्यू इंडिया इंश्योरेंस कंपनी समारोह में मुख्य अतिथि थे। डॉ. ए अजयघोष निदेशक ने समारोह की अध्यक्षता की। मुख्य अतिथि ने अपने सतर्कता दिवस व्याख्यान में यूनाइटेड इंडिया इंश्योरेंस कंपनी में सी.ई.ओ. के रूप में अपने कार्यकाल के दौरान सामना किये कुछ अनुभव साझा किया और बाद में विभिन्न प्रतियोगिताओं के विजेताओं को पुरस्कार वितरित किए गए।

सतर्कता जाकरूकता सप्ताह-समापन समारोह के विविध दृश्य

एक दिवसीय साइंस आउटरीच कार्यक्रम

छात्रों और जनता को शामिल करके 15 नवंबर, 2016 को सी.एस.आई.आर.-एन.आई.आई.एस.टी में एक दिवसीय साइंस आउटरीच कार्यक्रम आयोजित किया गया। सी एस.आई.आर. और सी.एस.आई.आर-एन.आई.आई.एस.टी. की अनुसंधान एवं विकास गतिविधियों तथा दूसरे भारतीय अंतर्राष्ट्रीय विज्ञान महोत्सव (आई.आई.एस.एफ.-2016) के बारे में उन्हें जानकारी प्रदान करना कार्यक्रम का उद्देश्य था। कार्यक्रम में आमंत्रित लोकप्रिय विज्ञान व्याख्यान, प्रयोगशाला दौरा, प्रौद्योगिकियों की प्रदर्शनी, वैज्ञानिकों के साथ छात्रों का इंटरैक्शन, स्थानीय आधारभूत आविष्कारों और स्कूली बच्चों के सम्मान और आई.आई.एस.एफ – 2016 के बारे में जागरूकता शामिल थी। तिरुवनंतपुरम और आसपास के विभिन्न स्कूलों और कॉलेजों से 280 से ज्यादा छात्रों और शिक्षकों ने कार्यक्रम में भाग लिया। साइंस आउटरीच कार्यक्रम के नोडल अधिकारी डॉ. जोस जेम्स ने स्वागत भाषण दिया और उन्होंने एक दिवसीय साइंस आउटरीच कार्यक्रम के बारे में बताया। डॉ. ए. अजयघोष, निदेशक, सी.एस.आई.आर-एन.आई.आई.एस.टी. ने उद्घाटन भाषण दिया। उन्होंने अपने भाषण में अंतर्राष्ट्रीय मानकों के समतुल्य विज्ञान शिक्षा और अनुसंधान करने की और देश की प्रगति के लिए प्रतिभाशाली सबसे अच्छे दिमाग को बनाए रखने की आवश्यकता पर जोर दिया। किसी भी राष्ट्र की उन्नति में विज्ञान तथा प्रौद्योगिकी के क्षेत्र की प्रगति महत्वपूर्ण है, जो बदले में समृद्धि और आर्थिक वृद्धि लाती है।

डॉ. ए. अजयघोष, निदेशक, सी.एस.आई.आर. - एन.आई.आई.एस.टी द्वारा उद्घाटन भाषण

प्रसिद्ध अंतरिक्ष वैज्ञानिक श्री. पी. राधाकृष्णन, पूर्व उप निदेशक, एल.पी.एस.सी., इसरो तिरुवनंतपुरम ने अंतरिक्ष अन्वेषण पर प्रेरक व्याख्यान दिया और अंतरिक्ष अनुसंधान के क्षेत्र में नए विकास पर, विशेष रूप से पृथ्वी से दूर एक नए घर के लिए मनुष्य की खोज पर जानकारी दी। उन्होंने एक चुनौतीपूर्ण कैरियर के रूप में अंतरिक्ष विज्ञान को लेने के लिए छात्रों को प्रोत्साहित किया और उम्मीद की कि युवा पीढ़ी निश्चित रूप से कई ग्रहों पर मानव बस्तियों को देखेंगी।

श्री. पी. राधाकृष्णन, अंतरिक्ष वैज्ञानिक एवं पूर्व उप निदेशक एल.पी.एस.सी., इसरो तिरुवनंतपुरम अंतरिक्ष अन्वेषण पर आमंत्रित व्याख्यान देते हुये।

प्रो. जोर्ज वर्गीज, पूर्व निदेशक, केरल राज्य विज्ञान, प्रौद्योगिकी और पर्यावरण परिषद (के.एस.सी.एस.टी.ई), तिरुवनंतपुरम ने 'रमन और उनके अविश्वसनीय डिस्कवरी' पर व्याख्यान दिया। वैज्ञानिक अनुसंधान के लिए अपने जुनून का पालन करने के लिए छात्रों को सर सी.वी. रामन का जीवन प्रोत्साहन और प्रेरणा प्रदान करेगा।

राष्ट्रीय बाल विज्ञान कांग्रेस में पुरस्कार जीत केन्द्रीय विद्यालय, आक्कुलम के छात्रों को तथा राष्ट्रीय स्तर पर आयोजित विज्ञान प्रदर्शनियों में पुरस्कार जीत भारतीय विद्या भवन, कोडुंगानूर के छात्रों को समारोह के दौरान सम्मानित किया गया। कार्यक्रम के दौरान आयोजित प्रदर्शनी में छात्रों को अपने नवाचारों के प्रदर्शन के लिए भी व्यवस्था की गयी थी। कार्यक्रम के संयोजक डॉ. टी.पी.डी. राजन ने धन्यवाद ज्ञापित किया। डॉ. यू.एस. हरीश, वरिष्ठ वैज्ञानिक, सी.एस.आई.आर -एन.आई.आई.एस.टी ने 'सामग्री विज्ञान में लोकप्रिय उन्नति' पर व्याख्यान दिया। सामग्री विज्ञान पर अनुसंधान के महत्व और नई प्रगति और दैनिक जीवन में उनके अनुप्रयोगों पर वर्णन करने के लिए उन्होंने कुछ दिलचस्प केस अध्ययन प्रस्तुत किये। कार्यक्रम के दौरान, अनुसंधान की प्रगति को समझने के लिए छात्रों ने सी. एस.आई.आर-एन.आई.आई.एस.टी. के कई वैज्ञानिकों के साथ बातचीत की और विभिन्न अनुसंधान प्रभागों और प्रयोगशालाओं का दौरा किया। प्रौद्योगिकियों, उत्पादों, अनुसंधान प्रगति और उत्तेजक वैज्ञानिक प्रयोगों की सी.एस.आई.आर-एन.आई.आई. एस.टी. की प्रदर्शनी छात्रों के लिए एक अतिरिक्त आकर्षण था।

प्रो. जोर्ज वर्गीज, पूर्व निदेशक, केरल राज्य विज्ञान, प्रौद्योगिकी और पर्यावरण परिषद (के.एस.सी.एस.टी.ई), तिरुवनंतपुरम 'रमन और उनके अविश्वसनीय डिस्कवरी' पर आमंत्रित व्याख्यान देते हुये

विज्ञान की भाषा पर कार्यशाला

23 नवंबर 2016 को विज्ञान की भाषा पर एक दिवसीय कार्यशाला आयोजित की गयी। प्रतिभागी द्वारा लिखे जाने वाले प्रत्येक दस्तावेज़ में स्पष्ट रूप से और प्रभावी ढंग से तकनीकी जानकारी को संप्रेषित करने की क्षमता में सुधार लाना कार्यशाला का उद्देश्य था। चार सत्रों में आयोजित कार्यशाला में संसाधन व्यक्ति डॉ. टी. प्रेमकुमार, वरिष्ठ प्रधान वैज्ञानिक (सेवानिवृत्त), सी.ई.सी.आर.आई, कारैकुडी ने जर्नल लेखों और रिपोर्टों के रूप में वैज्ञानिक परिणामों के संक्षिप्त और सरल लेखन को सुधारने के लिए अंग्रेज़ी व्याकरण, काल, बहुवचन, आम लैटिन शब्द आदि के उपयोग में आम भाषा के मुद्दों से बचने के लिए

वैज्ञानिक लेखन के सभी पहलुओं पर विस्तार से बताया। डॉ. ए. सुंदरेशन, मुख्य वैज्ञानिक, सी.एस.आई.आर. – एन.आई.आई.एस.टी. ने कार्यशाला का उद्घाटन किया। एन.आई.आई.एस.टी. के 80 प्रतिभागी कार्यक्रम से लाभान्वित हुये।

ई-ऑफिस और राजभाषा कार्यान्वयन पर कार्यशाला का आयोजन

संघ सरकार की ई-ऑफिस की अवधरणा को लागू करने की दिशा में आजकल सभी कार्यालयों में गंभीर प्रयास हो रहे हैं। राजभाषा हिन्दी के माध्यम से ई-ऑफिस के कार्यान्वयन में संस्थान के कर्मचारियों को प्रशिक्षित कराने के लिए 9 दिसंबर 2016 को ई-ऑफिस और राजभाषा कार्यान्वयन पर एक पूर्ण दिवसीय कार्यशाला का आयोजन किया गया। श्री सोमेश्वर पाण्डेय, हिन्दी अधिकारी, सी.एस.आई.आर.-सी.ई.सी.आर.आई, कारैकुडी कार्यशाला में वक्ता रहे। श्रीमती लती देवी, हिन्दी अधिकारी ने संकाय सदस्य एवं उपस्थित सभी का स्वागत किया। डॉ. ए. सुन्दरेशन, निदेशक प्रभारी ने कार्यशाला की अध्यक्षता की। उन्होंने राजभाषा कार्यान्वयन की अनिवार्यता और संस्थान में इस ओर हो रहे क्रियाकलापों की संक्षिप्त जानकारी प्रस्तुत की। श्री सोमेश्वर पाण्डेय ने ई-फाईल के मुख्य मॉड्यूल्स पर तथा ई-फाइल के विभिन्न लाभों पर प्रतिभागियों को समझाया।

कार्यशाला में इलेक्ट्रॉनिक फाइल बनाने की प्रक्रिया, फाइलों में नोटिंग को जोड़ने का तरीका और अनुमोदन के लिए मसौदे की तैयारी और उपयोगकर्ता अनुकूल आसान तरीके से पत्राचार को संलग्न करने की प्रक्रिया आदि पर प्रतिभागियों को व्यावहारिक प्रशिक्षण दिया। कार्यशाला में फाइलों पर हिन्दी के प्रयोग को आसान बनाने के लिए भाषा इंडिया की साइट से माइक्रोसॉफ्ट इंडिक इनपुट टूल्स या गूगल से गूगल इनपुट टूल्स को डाउनलोड करने की विधि से प्रतिभागियों को परिचित कराया गया।

राष्ट्रीय विज्ञान दिवस समारोह

सी.एस.आई.आर - एन.आई.आई.एस.टी में 28 फरवरी, 2017 को राष्टीय विज्ञान दिवस मनाया गया। सी.एस.आई.आर-एन.आई.आई.एस.टी. के निदेशक डॉ. ए. अजयघोष ने स्वागत भाषण दिया और मुख्य अतिथि का परिचय दिया। मुख्य अतिथि डॉ. आर.वी. जसरा, वरिष्ठ उपाध्यक्ष (आर. एंड डी.), रिलायंस इंडस्ट्रीज लिमिटेड, वडोदरा ने राष्ट्रीय विज्ञान दिवस व्याख्यान दिया। उन्होंने 'रासायनिक उद्योग में नवाचार' पर व्याख्यान दिया। उन्होंने मुख्य रूप से पेट्रोकेमिकल उद्योगों से संबंधित अनुसंधान के लिए संभावित क्षेत्रों पर प्रकाश डाला। डॉ. आर. लक्ष्मी वर्मा, अध्यक्ष, शैक्षणिक कार्यक्रम समिति ने धन्यवाद प्रस्तावित किया।

हल्की धातु, सम्मिश्र और विनिर्माण प्रक्रियाओं पर राष्ट्रीय संगोष्ठी (एल.एम.सी.एस.पी-2017)

3 मार्च 2017 को हल्की धातु, सम्मिश्र और विनिर्माण प्रक्रिया (एल.एम.सी.एम.पी-2017) पर राष्ट्रीय संगोष्ठी आयोजित की गयी। बेहतर गुणों और निष्पादन के साथ धातु सामग्री के विकास और प्रसंस्करण में प्राप्त वैज्ञानिक और तकनीकी प्रगति ने मोटर वाहन, एयरोस्पेस, परमाणु, रक्षा और ऊर्जा क्षेत्रों की प्रगति में काफी योगदान दिया है। ईंधन दक्षता, ऊर्जा की बचत और पर्यावरण संबंधी चिंताओं को सुधारने की आवश्यकता हल्के वजन वाली धातु सामग्री, विशेष रूप से एल्यूमीनियम, मैग्नीशियम, टाइटेनियम और उनके कंपोजिट के उपयोग की मांग करती है। डॉ. वेंकिटकृष्णन, निदेशक, आई.एस.आर.ओ., प्रणोदन केंद्र ने संगोष्ठी का उद्घाटन किया। उन्होंने लॉन्च वाहन सिस्टम के विभिन्न भागों में हल्के मिश्र धातुओं के महत्व पर और विभिन्न एल्यूमीनियम, मैग्नीशियम और टाइटेनियम मिश्र धातु और निचोड़ कास्टिंग जैसे विनिर्माण प्रक्रियाओं में आगे के संभावित विकास पर प्रकाश डाला। डॉ. ए. अजयघोष, निदेशक, सी.एस.आई.आर-एन.आई.आई.एस.टी. ने अध्यक्षीय भाषण दिया। डॉ. एस. दास, पूर्व निदेशक, सी.एस.आई.आर.-ए.एम. पी.आर.आई, भोपाल ने विभिन्न औद्योगिक अनुप्रयोगों के लिए एल्यूमीनियम मिश्र, कंपोजिट और फोम के विकास पर मुख्य व्याख्यान दिया। डॉ. के.जी. सत्यनारायण, पूर्व मुख्य वैज्ञानिक, सी.एस.आई.आर-एन.आई.आई.एस.टी., तिरुवनंतपुरम को सम्मानित किया गया। डॉ. के. हरिकृष्णा भट्ट ने स्वागत भाषण दिया और संगोष्ठी के संयोजक डॉ. एम. रवि ने धन्यवाद प्रस्तावित किया। संगोष्ठी में 80 प्रतिनिधियों ने भाग लिया था।

आर. एंड डी. संगठनों, उद्योगों और शिक्षाविदों के विशेषज्ञों द्वारा नौ आमंत्रित व्याख्यान दिए प्रो उदय चक्किंगल, आई.आई.टी- मद्रास, चेन्नई, डॉ. मैथ्यू अब्राहम, महिंद्रा एंड महिंद्रा, चेन्नई, डॉ. के. वेंकटेश्वरलू, सी.एस.आई.आर-एन.ए.एल, बैंगलोर, डॉ. बी. गोविंद, वी.एस.एस.सी., इसरो., तिरुवनंतपुरम डॉ. के. शेकर, एन.आई.टी, कालिकट, डॉ. यू.टी.एस. पिल्लै, सी. एस.आई.आर-एन.आई.आई.एस.टी, श्री, एम.सी. शाजी, सी. एस.आई.आर-एन.आई.आई.एस.टी, डॉ. के.आर. रवि, पी.एस. जी. इंस्टीट्यूट ऑफ एडवांस्ड स्टडीज, कोयंबटूर और डॉ. एम. सुरेश, आई.आई.एस.सी., बैंगलोर ने संगोष्ठी में आमंत्रित व्याख्यान दिया। वक्ताओं ने विभिन्न हल्की मिश्र धातुओं और कंपोजिट, उनकी विनिर्माण प्रक्रियाओं और अनुप्रयोगों की क्षमता पर प्रकाश डाला।

पेशेवरों के बीच विचार-विमर्श, भविष्य के दिशा-निर्देशों के लिए और योजना, प्रसंस्करण और अभिलक्षण के संबंध में उपरोक्त क्षेत्रों के लक्ष्यों को पूरा करने की दिशा में एक व्यापक दृष्टि कोण तैयार करने में और आने वाले वर्षों में उन्नत हल्की धातु सामग्री और विनिर्मण प्रक्रियाओं को अपनाने की योजना बनाई थी। संगोष्ठी में संस्थान-उद्योगों के बीच इंटरैक्शन के लिए तथा हल्की धातुओं में तकनीकी विकास के लिए संभावित क्षेत्रों की पहचान में और 'मेक इन इंडिया' के लक्ष्यों को प्राप्त करने में टीमों को एक साथ काम करने के लिए आगे बढ़ाने पर विशेष सत्र था। संगोष्ठी सी.एस.आई.आर. प्लेटिनम जयंती समारोह का हिस्सा था, जिसमें इस क्षेत्र में किए गए योगदान पर प्रकाश डाला गया था।

सुविधाएं और बुनियादी ढांचे

Creche opening

NMR Spectroscopy

Medical laboratory inauguration-Dispensary

Foundation stone laying of Dispensary

R&D- INDUSTRY MEET

CSIR-NIIST, Thiruvananthapuram organized a one day R&D Industry meet on 6th January 2017 to identify the issues of mutual interest and to forge alliances with industries from private, public sectors including MSMEs. Representatives of industries from various parts of the country, mostly from private sectors and budding entrepreneurs participated in the R&D Meet. Participants were from various sectors such as Agro & food processing, Energy and Environment, Chemicals & Materials, Biotechnology etc. The inaugural function started at 9 am. Dr. A. Ajayaghosh, Director, NIIST delivered the Welcome address. Honourable Chief Minister of Kerala Shri Pinarayi Vijayan inaugurated the R&D-Industry meet. The Inaugural function was chaired by Shri O. Rajagopal, Honourable Member of Kerala State Legislative Assembly. Dr. Shashi Tharoor, Honourable Member of Parliament delivered the keynote address in the function. The CM in his inaugural address emphasized the need for R&D-industry alliance for the growth of the country. He further emphasized on translation of scientific knowledge into economically viable technologies and products which according to him is possible only through cooperation of academic fraternity, R & D institutions and industries. He also said that in developed countries R&D-industry alliance is highly noticed, while it is lacking in India. He also insisted that the R&D-industry alliance should address problems of society and also shall be beneficial to society at a regional level.

The MLA in his presidential address stressed the need for R&D industry alliance for the economic growth of the country. He also called upon the scientists for better utilization of resources available in Kerala to address the issues relevant to Kerala.

Dr. Shashi Tharoor in his keynote address highlighted upon various technology innovations in the field of information technology, medical research etc. He expressed his concern over under utilization of student fraternity in R&D institutes. He requested industries to come forward to make alliance with academia and R& D institutes so as to promote innovative ideas and create more opportunities for student community in India to innovate. He also expressed his concerns over low level of IP generation by Indian industries (1.6%). He stated the fact that 75% of the R&D expenses in India is funded by Central govt. whereas in OECD countries it is industries that fund the R&D to a greater extent and govt. share is only 5%. He motivated the audience to take to cutting edge innovations for betterment of the society and development of the nation. He also expressed his wishes for improving Knowledge industry of Kerala and making Thiruvananthapuram a knowledge city.

The inaugural function concluded with Vote of thanks delivered by Mr. M.M. Sreekumar, Chief Scientist and Convenor of R&D Industry meet. On the sidelines of R&D – Industry meet, an exhibition of NIIST Technologies/Knowledgebase also was arranged.

There was display of Products/Technologies/ Processes developed in CSIR-NIIST. The inaugural function was followed by technical presentations. The introductory remarks were given by the Director, Dr.A. Ajayaghosh. The representatives of the Divisions of CSIR-NIIST viz., APTD, MPTD, CSTD, ETD, MSTD and RPBD presented the highlights of the respective Division.

CSIR-NIIST Foundation Day - 2016

Shri Justice (Retd.) P. Sathasivam, Honourable Governor of Kerala releasing the Annual Report of CSIR-NIIST for the year 2015-16 during CSIR-NIIST foundation day celebration.

Shri Justice (Retd.) P. Sathasivam, Honourable Governor of Kerala unveiled the statue of Sir C.V. Raman during CSIR-NIIST foundation day celebration

The CSIR-NIIST Foundation Day was celebrated at CSIR-NIIST on 6th October 2016. The day was observed as an open day and about 300 students from various educational institutions visited the R&D facilities. Dr. A. Ajayaghosh, Director, CSIR-NIIST delivered the welcome address and presided over the function. **Shri Justice (Retd.) P. Sathasivam, Honourable Governor of Kerala** was the Chief Guest for the function. He appreciated the scientific achievements of the lab. The Annual Report of CSIR-NIIST for the year 2015-16 was released by the Chief Guest. Dr. A. Sundaresan, Chief Scientist, CSIR-NIIST, Thiruvananthapuram proposed vote of thanks. The Chief Guest also unveiled the statue of Sir C.V. Raman in the campus.

CSIR Foundation Day - 2016

Dr. Vinay Kumar Dadhwal, Director, IIST, Thiruvananthapuram delivering the CSIR Foundation Day lecture.

CSIR Foundation Day was celebrated at CSIR-NIIST on 27th September 2016. The day was observed as an open day for show-casing the activities of the institute and about 300 students from various educational institutions visited the R&D facilities. Dr. A. Ajayaghosh, Director, CSIR-NIIST delivered the welcome address and presided over the CSIR Foundation Day function. Dr. Vinay Kumar Dadhwal, Director, Indian Institute of Space Science and Technology, Thiruvananthapuram, the Chief Guest for the function, delivered the CSIR Foundation Day lecture. In his talk, he emphasised the importance and applications of earth observing satellites. The employees of CSIR-NIIST superannuated during 2015-16 and the employees who completed 25 years of service in CSIR were felicitated. The studentship award 2015-16 also was distributed. Dr. R. Luxmi Varma, Chairperson, Academic Programme Committee proposed vote of thanks.

PROMISE Program

The key objective of the program entitled "Programme for Motivating Innovation in Science (PROMISE)" is to rediscover one's natural inclination to science. It is structured to attract and kindle the scientific talent of students. The program is intended to help selected number of Pratibha Scholars to make an informed and wiser career choice. The program was jointly organized by CSIR-NIIST & Kerala State Council for Science, Technology & Environment (KSCSTE) under Science Enrichment Programme for Prathibha Scholars from 25th April 2016 – 29th April 2016. The five day camp at CSIR-NIIST facilitated students to engage with CSIR-NIIST faculty through seminars, laboratory visits, and interactive sessions.

It was attended by 33 Pratibha scholars from different parts of Kerala. The keynote lecture was delivered by Dr. Suresh Das, Executive Vice President, KSCSTE. Later the students visited VSSC museum and had a glance at the exhibition depicting the revolution of Indian Space Research and advances made by Indian Space Research Organization. On the concluding day (29-4-16), the valedictory lecture was given by the MISSILE LADY Dr. Tessy Thomas, Outstanding Scientist and Director, ASL, DRDO, followed by an interactive session with Dr. A. Ajayaghosh, Director, CSIR-NIIST.

National Technology Day Celebrations

On the stage from left- Dr. R. Luxmi Varma, Dr. A. Ajayaghosh and Chief Guest Shri P.H. Kurian, IAS

CSIR-NIIST celebrated **National Technology Day** on **May 11, 2016.** Dr. A. Ajayaghosh, Director, CSIR-NIIST delivered the welcome address and introduced the Chief Guest. The National Technology Day Lecture was delivered by the chief guest **Shri. P.H. Kurian IAS**, Principal Secretary (Industries & IT Dept.), Govt. of Kerala, Thiruvananthapuram. He emphasised the need for better interaction between industries and institutes in solving technical problems faced by the industries. Dr. R. Luxmi Varma, Chairperson, Academic Programme Committee proposed vote of thanks.

Symposium on Recent Trends in Natural Product Chemistry

Various scenes from the symposium

CSIR-NIIST and Chemical Research Society of India, Trivandrum Chapter jointly organized a one-day Symposium entitled "Recent Trends in Natural Product Chemistry" on May 13, 2016 at CSIR- NIIST, Trivandrum. It was attended by eminent natural product chemists from various State and National academic institutions like Amrita University, Kerala University, JNTBGRI and sister laboratories of CSIR like IICT, IIIM Jammu, as well as the scientific fraternity of CSIR-NIIST. The programme commenced with welcome address by Dr. K.R. Gopidas, Chief Scientist, Chemical Sciences and Technology Division (CSTD), followed by the presidential address by Dr. A. Ajayaghosh, Director, NIIST

The first lecture was given by, Prof. Asoke Banerji, Distinguished Professor, School of Biotechnology, Amrita Vishwa Vidyapeetham. This was followed by the lectures of Dr. Suresh Babu K. (Senior Scientist, CSIR- IICT, Hyderabad), Dr. Bhahwal Ali Shah (Scientist, CSIR-IIIM, Jammu), Dr. M. D. Ajitha Bai, (Retired Professor, M.G. College, Trivandrum) and Dr. K. B. Rameshkumar (Scientist, JNTBGRI, Palode, Trivandrum). The symposium highlighted Phytochemical research and the use of natural products.

The Programme concluded with a valedictory session. Dr. R. Luxmi Varma, Senior Principal Scientist, CSTD welcomed the guests in the Valedictory function. Dr. K. V. Radhakrishnan, Principal Scientist, CSTD gave a lecture on the topic ***'Phytochemistry Research at CSIR-NIIST'*** in the honour of Dr. Mangalam S. Nair, Chief Scientist who was instrumental in starting Natural Products Chemistry Research at CSIR-NIIST and was superannuating on 31st May 2016. The symposium provided an excellent platform for the Scientists and students in natural products for collaboration, networking and exchange of exciting ideas with experts and academicians across the country. Dr. L. Ravi Shankar proposed the vote of thanks.

Workshop on Novel Technologies & Engineering Approaches to Sanitation in South India

A one day workshop was organized by the Environmental Technology Division in CSIR NIIST on May 13, 2016 on "Novel Technologies & Engineering Approaches to Sanitation in South India". Technical sessions were handled by eminent professionals in the field viz. Prof. Piet Lens, Department of Environmental Engineering and Water Technology, UNESCO-IHE, Er. Robert A. Bair, University of South Florida, Mr. Midhu SV, DGM, R&D, Eram scientific solutions Pvt. Ltd. and Dr. A. Saji Das, Managing Director, BIOTECH Renewable Energy Pvt. Ltd. The workshop covered new technology developments for managing household wastewater and its recycle options suitable to Indian conditions. Participants from pollution control boards, university departments and Centre for Environment & Development (CED) attended the workshop. The workshop was followed by a panel

discussion which was moderated by Dr. Ajit Haridas, Chief Scientist, Environmental Technology Division, CSIR-NIIST.

Hindi workshop for employees of General Administration

Dr. Hareendra Sharma conducting the workshop

A Glimpse of the workshop

A half a day workshop for employees of General Administration of Institute was held on 26.05.2016 to train them in writing notings and Correspondence in Hindi Dr. Hareendra Sharma, Assistant Director (OL.) Doordarshan Kendra, Thiruvananthapuram was the guest faculty. Welcoming the Guest Faculty Dr. A. Ajayaghosh, Director NIIST said that the Institute is fully conscious on the implementation of the Official Language Policy of the Union and sincere efforts were done in this direction.

Smt. Lathi Devi, Hindi Officer urged all participants to perform their maximum official work in Hindi as implementation of official language policy of the Union Government is the constitutional obligation on the part of every central government employee . Twenty employees possessing proficiency / working knowledge in Hindi took part in the workshop.

The Workshop was conducted in an interactive fashion; participants were trained as per model envisaged in the Karyalay Sandarshika (Office Guide) displayed in the Department of Official Language's web portal. The participants were given handouts for practical / hands on training. The participants expressed that their confidence to write notes in Hindi has increased by the workshop. The workshop concluded with a vote of thanks to the faculty.

Hindi Day/ Hindi Week Celebrations

Dr. A. Ajayaghosh, Director,
CSIR-NIIST inaugurating the Hindi day

Institute observed 19th September 2016 as the Hindi day and the week succeeding as Hindi Week. The Hindi Day Celebration started on 19th September 2016. Dr. P. Prabhakar Rao, Chairman, Hindi Week Celebration Committee welcomed the participants. In his welcome address he elucidated the relevance of the observance of Hindi week in Central government offices and urged the participants for their best contribution in the implementation of the Official Language Policy of the Government by performing more and more official work in Hindi. Dr. A. Ajayaghosh, Director, CSIR-NIIST presided over the function. In his presidential address he told that

in CSIR- NIIST, Hindi is constantly getting widespread acceptance as the official language. But we still need more efforts. In his speech, he emphasized the need to connect Hindi with Internet, mobile, SMS etc.

While congratulating and giving best wishes to the NIIST family on the occasion of the Hindi Day, he urged the participants to put more efforts in the promotion of Hindi in official work. Hon'ble Home Minister Shri Rajnath Singh's Hindi Day message was shown to all with the help of the projector.

To mark the beginning of Hindi Day, Dr. Satyajit Shukla, Senior Scientist gave a technical presentation on his latest research "Recent activities on removal of organic dyes from aqueous solution ". According to him, dyes that are drained to reservoirs from textile industries and chemical factories are very dangerous to aquatic animals. Through the presentation he illustrated that his research activities over the years have proven how the reservoirs could be made pollution-free and our natural assets could be protected.

Dr. Satyajit Shukla

Thereafter, Shri Chandrashekhar Neelam, Assistant Executive Engineer of Electrical section gave his presentation on the topic - "Five S", which is the short form of five Japanese words, Siri, Sito, Siso, Seketsu and Shitsuke, the meaning of which are proper sorting , well equipped system, cleanliness, hygiene management, and self-discipline. He illustrated on how to maximize the performance of electrical and scientific equipments at the workplace, and how the systems are to be operated to maximise their efficiency by following Five S.

Sri. Chandrasekhar Neelam

Shri Vishnu Gurjar, Junior stenographer at Director's Secretariat in his presentation "Jaipur- from the tourism point "shared some of his information on the history of Jaipur and its serene, geography and climate in the perspective of tourism. During the entire week, competitions were organized for the staff members of the Institute including research students, project staff and their school children on Hindi online Quiz, Hindi Quiz, Hindi word puzzle, Hindi Anthakshari, Hindi Song, and Hindi debate.

Sri. Vishnu Gurjar

For school going children of staff members, competitions on Hindi Essay writing, Hindi translation and Hindi recitation were held.

Valedictory function and prize distribution were held on 23rd September 2016 at 4.30pm. Dr. P. Prabhakar Rao, Chairman, Organizing Committee presided over the function. Smt. P. Nishy, Head, KRC welcomed the participants and introduced the Chief Guest to the participants. Dr. R. Jayachandran, Professor & Head, Hindi Department, Kerala University was the chief guest. He gave the valedictory address and distributed prizes and certificates to the successful participants of various competitions.

Various scenes of Valedictory Function

Observance Of Vigilance Awareness Week

Director Dr. A. Ajayaghosh administering the Vigilance pledge to staff members

The Vigilance Awareness Week-2016 was observed in this institute from 31st October to 4th November, 2016. The week started with administration of Vigilance Pledge by the Director on 31st October, 2016. Thereafter, various competitions such as Essay writing, Cartoon Drawing, Debate and Elocution were conducted for staff members and students inclusive of project students during 31st October to 3rd November, 2016

The valedictory function and prize distribution were held on 4th November, 2016. Shri Rajasekharan, former CVO, United India Insurance Co.& General Manager, New India Insurance Co. was the Chief Guest. Dr. Ajayaghosh, Director, CSIR-NIIST presided over the function. The Chief Guest, in his Vigilance Day lecture shared some of the experiences he had while serving as CVO in United India Insurance Company and gave away the prizes to the winners of various competitions.

Various scenes from Valedictory function of Vigilance awareness week

One Day Science Outreach Programme

The CSIR-NIIST had organised a one day Science Outreach Programme involving students and public on November 15, 2016 to make them aware of the R&D activities of CSIR, CSIR-NIIST and about the 2nd India International Science Festival (IISF-2016). The programme comprised of invited popular science lectures, open house laboratory visits, exhibition of technologies, interaction of students with scientists, felicitation of local grass root innovators and school children and also creation of awareness about IISF-2016. The programme was attended by more than 280 students and teachers from various schools and colleges in and around Thiruvananthapuram city. Welcome address was delivered by Dr. Jose James, Nodal Officer, Science Outreach Programme. He described about the one-day science outreach programme. Inaugural address was delivered by Dr. A. Ajayaghosh, Director, CSIR-NIIST. He emphasised the need for taking up science education and research at par with international standards, and retaining the talented best brains for the progress of the country. The progress of any nation depends on the advancements in science and technology, which in turn brings prosperity and economic growth.

Inaugural address delivered by Dr. A. Ajayaghosh, Director, CSIR-NIIST

The famous space scientist Shri P. Radhakrishnan, Ex-Deputy Director, LPSC, ISRO, Trivandrum delivered a motivational lecture on "Space Explorations" and gave insight to the new developments in space research especially man's search for a new home away from earth. He encouraged students to take up the space science as a challenging career and hope that the young generation will certainly see human colonies on many planets.

Space scientist Shri P. Radhakrishnan, Ex-Deputy Director, LPSC, ISRO, Trivandrum delivering the invited lecture on "Space Explorations"

A lecture on 'Raman and His Incredible Discovery' was delivered by Prof.George Varghese, Ex-Director, Kerala State Council for Science Technology and Environment (KSCSTE), Trivandrum. The life of Sir C V Raman is an encouraging and motivating example to students to follow their passion for scientific research. Students from Kendriya Vidhayala, Akkulam who won awards in National Children Science Congress and Bharatya Vidya Bhawan, Koduganoor who won awards in national level science exhibitions were felicitated during the function. The students exhibited there innovations in the exhibition arranged during the event. Vote of thanks was proposed by Dr. T.P.D. Rajan, convenor of the programme. Dr. U.S. Hareesh, Senior Scientist, CSIR-NIIST delivered a lecture on "Popular Advancements in Materials Science' He presented few interesting case studies to illustrate the importance of material science research and new advancements and applications in day to day life. During the event, students interacted with scientists and visited various research divisions and laboratories in CSIR-NIIST to have awareness and understand the research progress. The exhibition of technologies, products, research advancements and exciting scientific experiments from CSIR-NIIST was an added attraction to students.

Prof.George Varghese, Ex-Director, Kerala State Council for Science Technology and Environment (KSCSTE), Trivandrum, delivering a lecture on 'Raman and His Incredible Discovery'

Workshop on Language of Science

One day workshop on 'Language of Science' was held on 23rd November 2016. The workshop was aimed to improve the ability of participant to communicate technical information clearly and effectively in every document they write. The resource person Dr. T Premkumar, Sr. Principal Scientist (Retd), CECRI, Karaikudi conducted the workshop in four sessions covering, all aspects of scientific writing to avoid

common language issues in English grammar, tenses, plurals, usage of common latin words etc. to improve the concise and simple writing of scientific results as journal articles and reports. Dr. A Sundaresan, Chief Scientist, CSIR-NIIST inaugurated the Workshop. Eighty participants from NIIST benefited from the programme.

Workshop on e-office and Official Language Implementation

Nowadays, serious efforts are made in all offices in implementing the concept of e-office of the Union Government. In order to train the employees in the implementation of e-office through Official Language Hindi, a full-day workshop on "e-office and Official Language Implementation" was organized on 9 December 2016. Mr. Someshwar Pandey, Hindi Officer, CSIR-CECRI, Karaikudi was the Guest Speaker

Smt. Lathi Devi, Hindi Officer welcomed the faculty member and participants. Dr. A. Sundaresan, the Director in Charge presided over the workshop. He presented brief information on the Constitutional obligation of implementation of the Official Language and the activities being done in the Institute towards this cause. Mr. Someshwar Pandey, Guest speaker, in his speech explained the main modules of e-files and various benefits of e-files. Participants were given practical training on the procedure of creating electronic files, method of adding notes to electronic files, process of preparing drafts for approval and the process of engaging user friendly and easy access method of attaching correspondences etc. In order to facilitate the use of Hindi on files participants were introduced to Microsoft Indic Input Tools available in Bhasha India's site and Google Input Tools in Google's site and its downloading.

National Science Day Celebrations

The National Science Day was celebrated in CSIR-NIIST on February 28, 2017. Dr. A. Ajayaghosh, Director, CSIR-NIIST delivered the welcome address and introduced the Chief Guest of the day. The National Science Day Lecture was delivered by the chief guest, Dr. R.V. Jasra, Senior Vice President (R&D), Reliance Industries Limited, Vadodara. He delivered the talk on "Innovating in chemical Industry". He highlighted the potential areas for research mainly related to petrochemical industries. Dr. R. Luxmi Varma Chairperson, Academic Programme Committee proposed the vote of thanks.

National Symposium on Light Metals , Composites and Manufacturing Processes(LMCMP-2017)

The National Symposium on Light Metals, Composites and Manufacturing Process (LMCMP-2017) was organised on March 3, 2017. The scientific and technological advancements in the development and processing of metallic materials with better properties and performance significantly contributed in the progress of automotive, aerospace, nuclear, defence and energy sectors. The need for improving fuel efficiency, energy saving and environmental concerns demands use of light weight metallic materials in particular aluminium, magnesium, titanium and their composites. The symposium was inaugurated by Dr. Venkitakrishnan, Director, ISRO Propulsion Centre. He highlighted the importance of light alloys in various parts of launch vehicle systems and the potential for further developing various aluminium, magnesium and titanium alloys and manufacturing processes such as squeeze casting. Dr. A. Ajayaghosh, Director, CSIR-NIIST delivered the presidential address. Dr. S. Das, Former Director, CSIR-AMPRI, Bhopal delivered the keynote lecture on the development of aluminum alloys, composites and foams for various industrial applications. Dr. K.G. Satyanarayana, Former Chief Scientist, CSIR-NIIST, Trivandrum was felicitated. The welcome address was given by Dr. K. Harikrishna Bhat and vote of thanks was proposed by the convenor of symposium Dr. M. Ravi. Nine invited lectures were delivered by experts from R&D organisations, industries and academia. The symposium was attended by 80 delegates.

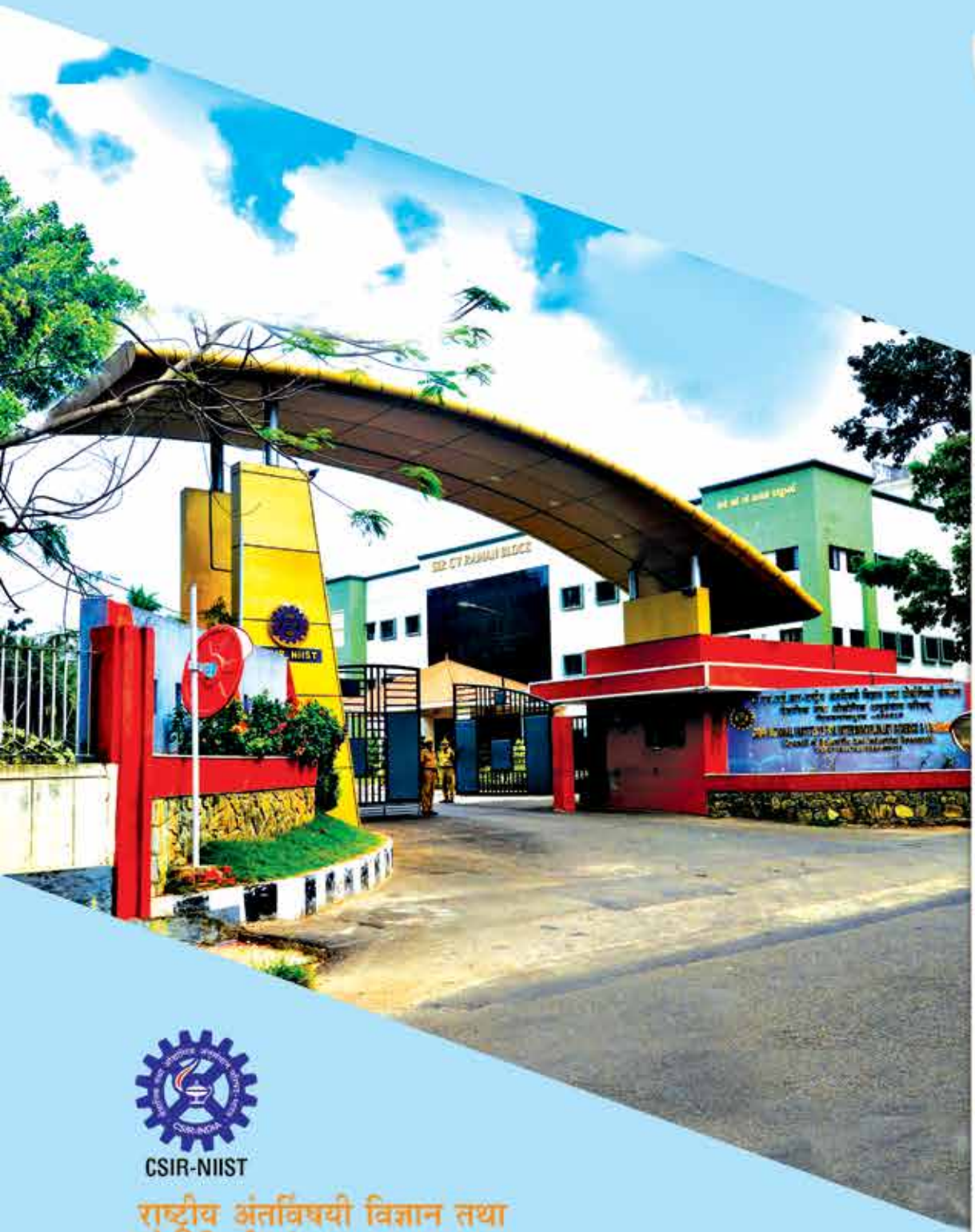
The invited lectures in the symposium were delivered by Prof. Uday Chakkingal, IIT-Madras, Chennai, Dr. Mathew Abraham, Mahindra & Mahindra, Chennai, Dr.K.Venkateswarlu,CSIR-NAL,Bangalore, Dr.B.Govind, VSSC, ISRO, Trivandrum, Dr. K. Sekar, NIT Calicut, Dr. U.T.S. Pillai, CSIR-NIIST, Mr. M.C. Shaji, CSIR-NIIST, Dr. K.R. Ravi, PSG Institute of Advanced Studies, Coimbatore and Dr. M. Suresh, IISc, Bangalore. The speakers highlighted the potential of various light alloys, composites, their manufacturing processes and applications.

The deliberations among the professionals had planned for future directions and formulating a comprehensive approach towards meeting the goals of the above sectors with respect to planning, processing, characterization and adoption of advanced light metal metallic materials and manufacturing processes. The symposium had special sessions on Institute-industries interaction in identifying potential areas for technological developments in light metals and building ahead the teams to work together in achieving the goals of "Make in India". The symposium is part of the CSIR Platinum Jubilee Celebrations highlighting contributions made in this sector.

Platinum Jubilee 1942-2016

75 Years of

CSIR Touching Lives



CSIR-NIIST

राष्ट्रीय अंतर्विषयी विज्ञान तथा प्रौद्योगिकी संस्थान

(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद्)

तिरुवनंतपुरम

National Institute for Interdisciplinary Science & Technology

(Council of Scientific & Industrial Research)

Thiruvananthapuram

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