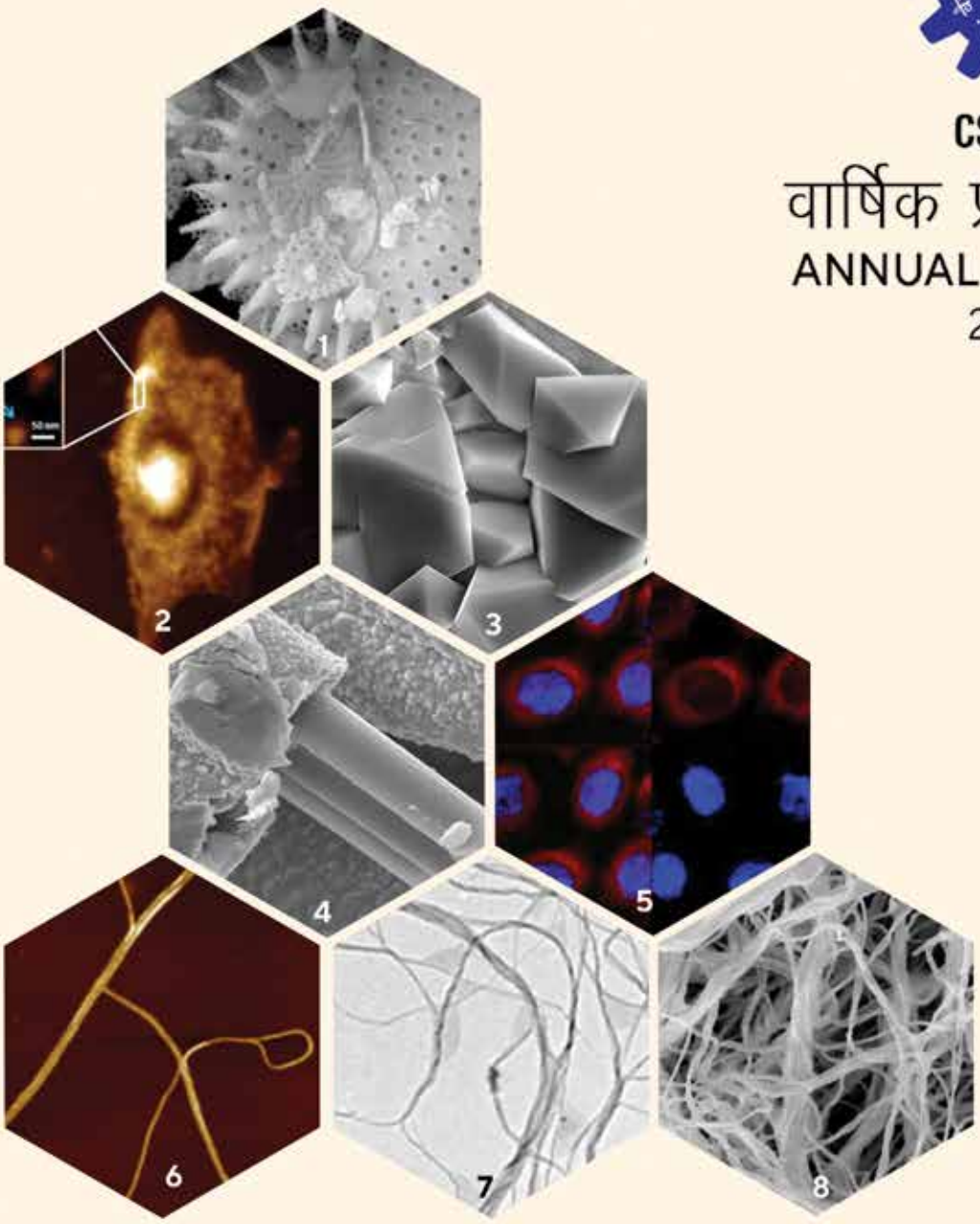

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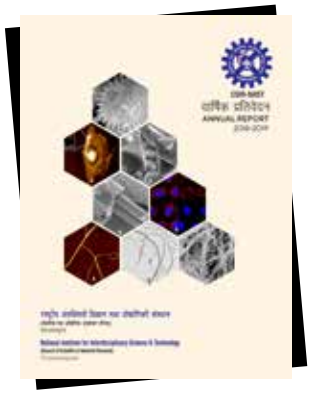

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प्रस्तावना

2018-19 अवधि के लिए सीएसआईआर-एनआईआईएसटी की वार्षिक रिपोर्ट पेश करना मेरे लिए खुशी और सौभाग्य की बात है। रिपोर्ट में सीएसआईआर - एनआईआईएसटी द्वारा अंतर्विषयी अनुसंधान एवं विकास के सीमांत क्षेत्रों में किए गए महत्वपूर्ण योगदानों के समर्थन के साथ, सीएसआईआर और केंद्र और राज्य सरकारों, सार्वजनिक और निजी क्षेत्र के उद्योगों और शिक्षाविदों सहित अन्य हितधारकों के विवरण शामिल है। रिपोर्टिंग अवधि के दौरान प्राप्त पुरस्कार और उपलब्धियों, उच्च प्रभाव प्रकाशन और आईपी जनरेशन, मानव संसाधन का विकास, प्रमुख गतिविधियों और आयोजित कार्यक्रमों का ब्यौरा प्रस्तुत किया हैं।

सीएसआईआर के मिशन और विजन को पूरा करने वाले विभिन्न विषयों के तहत कार्यक्रम संस्थान द्वारा किए जा रहे हैं, जो नॉलेज जनरेशन और ट्रांसलेशनल अनुसंधान के बीच एक समान संतुलन बनाए रखते हैं। सीएसआईआर के समर्थन से, हमारे संस्थान ने निम्नलिखित विषयों के तहत कई महत्वपूर्ण परियोजनाओं को सफलतापूर्वक कार्यान्वित किया: निचे क्रिएटिंग प्रोजेक्टस, फोकस्ड बेसिक रिसर्च, फास्ट ट्रैक ट्रांसलेशनल और फास्ट ट्रैक व्यावसायीकरण परियोजनाएँ।

इस अवधि के दौरान संस्थान की प्रमुख उपलब्धियों में से एक डाई सेंसिटाइज्ड सोलर सेल फैब्रिकेशन उपकरण का कमीशनिंग है। डीएसएससी सुविधा विदेशी विकल्पों की तुलना में डीएसएससी सौर सेल निर्माण की लागत को 60 से 70% तक कम करने के लिए अपार संभावनाएं हैं। सीएसआईआर-एनआईआईएसटी सौर फोटोवोल्टिक के आगामी क्षेत्रों में व्यावसायिक हित के साथ अन्य सीएसआईआर- प्रयोगशालाओं, आर एंड डी संस्थानों और उद्योगों के लिए निर्माण प्रक्रियाओं से संबंधित बौद्धिक संपदा के हस्तांतरण के लिए अपनी विशेषज्ञता का लाभ उठाने के लिए तैयार है। भारतीय विमानपत्तन प्राधिकरण की सहायता से त्रिवेंद्रम हवाई अड्डे पर 500 किलोग्राम / दिन जैव-अपशिष्ट उपचार संयंत्र की स्थापना एक अन्य उपलब्धि थी। संयंत्र प्रति दिन पूर्ण लोडिंग पर 80m3 बायोगैस का उत्पादन करता है जो बिजली में परिवर्तित हो जाता है।

ग्राहकों की संतुष्टि के लिए कई महत्वपूर्ण संस्थागत परामर्श परियोजनाओं को सफलतापूर्वक पूरा किया गया है, जिसमें मैसर्स अवंति फीड्स लिमिटेड के लिए गंध नियंत्रण, मैसर्स वैपकोस लिमिटेड के लिए गंध नियंत्रण और प्रवाह पूर्व उपचार, बीपीसीएल – कोच्चि रिफाइनरी के लिए इटीपी डिज़ाइन, टाटा कैमिकल्स के लिए स्विटनर्स के प्रोबायोटिक गतिविधि और पोषण संबंधी इन्विट्रो मूल्यांकन, मैसर्स आदित्य बिड़ला लि. के लिए पोर्सिलेन इन्सुलेटर हाइड्रोफोबिक ग्लेज का विकास शामिल है।

गेल इंडिया लिमिटेड के साथ थर्मोइलेक्ट्रिक सामग्रियों में एक परियोजना सफलतापूर्वक पूरी हो गई है। गेल इंडिया लिमिटेड के सहयोग से परियोजना का दूसरा चरण 2019 में शुरू होगा। मुद्रा के लिए सुरक्षा सामग्री का विकास, निदान और गुणवत्ता जांच के लिए हैंडहेल्ड रामन स्पेक्ट्रोफोटोमीटर, निस्पंदन और शोधन के लिए सिरेमिक झिल्ली और 2 जी जैव- जैसी महत्वपूर्ण गतिविधियां इथेनॉल उत्पादन प्रगति पर है।

पर्यावरण प्रभाव आकलन और डाइऑक्सिन निगरानी पर्यावरण संरक्षण और संबंधित गतिविधियों में मदद कर रहे हैंइस रिपोर्ट की अवधि के दौरान चार अंतरराष्ट्रीय सहयोगी परियोजनाएं सीएसआईआर-एनआईआईएसटी को प्रदान किया गया जो वर्तमान में प्रगति पर हैं, नामतः ऑस्ट्रेलिया और भारत के लिए बड़े क्षेत्र ऑप्टो-इलेक्ट्रॉनिक्स: सामग्री से उन्नत उपकरणों पर, ऑटोमोटिव और एयरोस्पेस अनुप्रयोगों के लिए स्क्विज तकनीक द्वारा हल्के वजन उच्च शक्ति एल्यूमीनियम मिश्रित और इंजीनियरिंग घटकों के लिए उन्नत उपकरणों के लिए सामग्री का डिजाइन और निकट शुद्ध आकार निर्माण प्रक्रिया का विकास। अभिनव नैनो फास्फोरस पर आधारित नैनोवायर व्हाइट एलईडी, कागज मिल कचरे को रासायनिक संपदा में परिवर्तित करने के लिए एकीकृत बायोरिफाइनरी।

इस दौरान आयोजित इंडस्ट्री मीट, स्किल डेवलपमेंट प्रोग्राम्स, जिज्ञासा, विज्ञान दिवस, प्रौद्योगिकी दिवस, सीएसआईआर स्थापना दिवस, सीएसआईआर-एनआईआईएसटी स्थापना दिवस आदि पर सार्वजनिक और निजी क्षेत्र के उद्योगों, अकादमियों और आम जनता से भारी प्रतिक्रियाएँ आईं।

केरल राज्य का बड़ा हिस्सा बड़े पैमाने पर बाढ़ से तबाह हो गया, जिससे जान-माल की व्यापक क्षति हुई। सीएसआईआर-एनआईआईएसटी के संकटपूर्ण कॉल का जवाब देते हुए, संपूर्ण सीएसआईआर ने खड़े होकर नकदी और संवेदना का बड़ा योगदान दिया। हमारी सिस्टर प्रयोगशालाओं ने प्रभावित क्षेत्रों में ताज़ा स्वच्छ पेयजल उपलब्ध कराने के लिए विशेषज्ञता के अपने क्षेत्र के आधार पर मदद की पेशकश की, उच्च पोषक मूल्य और बड़े शेल्फ लाइफ, दवाओं और कीट रिपलैंटस आदि के साथ खाद्य सामग्री पैक किया। सीएसआईआर-एनआईआईएसटी ने कई दिनों तक चौबीसों घंटे काम करने वाले अपने कर्मचारियों और छात्रों की मदद से इन प्रयासों को समन्वित किया ताकि यह सुनिश्चित किया जा सके कि मदद और सामग्री ज़रूरतमंदों तक पहुँचे। मैं उन सभी को धन्यवाद देता हूं जिन्होंने मदद की है, खासकर सीएसआईआर-एनआईआईएसटी के छात्र समुदाय ने।

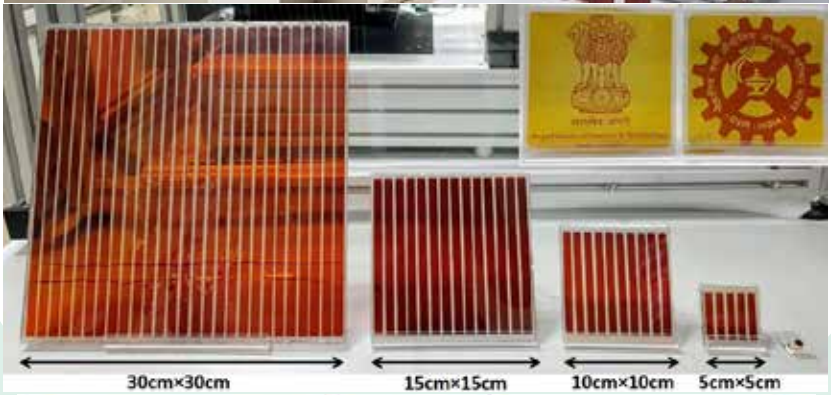
मैं, सभी सीएसआईआर-एनआईआईएसटी को धन्यवाद देने का अवसर लेता हूं जिन्होंने अपने समर्पित समर्थन के माध्यम से संस्थान की प्रगति में योगदान दिया है। मैं सीएसआईआर, केंद्र और राज्य सरकारों, सार्वजनिक और निजी क्षेत्रों के हितधारकों, हमारे विभिन्न ग्राहकों, शुभचिंतकों और मीडिया का भी धन्यवाद करता हूं जिन्होंने सीएसआईआर-एनआईआईएसटी को एक जीवंत संगठन में बदलने में योगदान दिया है। यह हमारा प्रयास रहेगा कि हम प्रतिबद्ध रहें और उच्च लक्ष्यों को प्राप्त करने के लिए प्रयास करें।

महानिदेशक सीएसआईआर, सीएसआईआर – मुख्यालय और आर सी सदस्यों को उनके पूरे समर्थन के लिए सराहना का एक विशेष शब्द

ए. अजयघोष

Indigenous Development of Semi-Automatic Equipment for Large Area Dye-Sensitized Solar Module Fabrication

- Installed and commissioned at CSIR-NIIST in November 2018 funded by DST-SERI.
- Indigenization of the process - Semi-automatic production line indigenously manufactured for the first time in the country in association with the industrial partner Elixir Technologies, Bangalore.
- 60-70% Cost reduction in module fabrication equipment in comparison with the imported ones by indigenization of technology.
- Capable of producing modules in 5×5, 10×10, 15×15 and 30×30 cm^2 sizes.
- Presently involved in integration of these indoor PV modules with self-powered IoTs.
- Selected by PMO on high priority implementation category.



CSIR-NIIST

FOREWORD

It is my pleasure and privilege to present the Annual Report of CSIR-NIIST for the period 2018-19. The report encompasses the details of significant contributions made by CSIR-NIIST on frontier areas of interdisciplinary R&D, with the support of CSIR and other stake holders comprising of Central and State Governments, Public and Private Sector Industries and academia. Achievements and accolades received, details of high impact publications and IP generation, development of human resources, major activities and programs organized during reporting period are presented.

Programs under various themes, meeting the mission and vision of CSIR are being carried out by the Institute maintaining a uniform balance between knowledge generation and translational research. With the support of CSIR, our Institute successfully implemented several important projects under the following themes: Niche Creating Projects, Focused Basic Research, Fast Track Translational and Fast Track Commercialization Projects.

One of the major achievements of the Institute during the period is the commissioning of the Dye Sensitized Solar Cell Fabrication equipment. The DSSC facility has immense potential for bringing down the cost of DSSC solar cell fabrication by 60 to 70% when compared to the foreign alternatives. CSIR-NIIST is all poised to leverage its expertise for the transfer of intellectual property related to the fabrication processes to other CSIR-Labs, R&D institutions and industries with business interest in the upcoming areas of solar photovoltaics.

Another achievement was the installation of a 500 Kg/day bio-waste treatment plant at the Trivandrum airport with the help of the Airport Authority of India. The plant produces 80m3 biogas on full loading per day which is converted to electricity.

Several important institutional consultancy projects have been successfully completed to the satisfaction of the customers, which includes odour control for M/s. Avanti Feeds Limited, odour control and effluent pretreatment for M/s. WAPCOS Ltd., ETP design for BPCL -Kochi refinery, In vitro evaluation of nutritional and probiotic activity of sweeteners for TATA chemicals, Development of hydrophobic glaze for porcelain insulator M/s. Adithya Birla Ltd.

A project in the thermoelectric materials with GAIL India Limited has been successfully completed. The second phase of the project with the support of the GAIL India Ltd will be commencing in 2019. Important activities such as development of security materials for currency, handheld Raman Spectrophotometer for diagnostics and quality check, ceramic membranes for filtration and purification and 2G bio-ethanol production are in progress.

Environmental Impact Assessment (EIA) and Dioxin monitoring are helping in the environment protection and related activities. During the period of this report four international collaborative projects on Large area Opto-electronics for Australia and India: From materials to advanced devices, Design and development of near net shape manufacturing process for light weight

high strength aluminium composite and engineering components by squeeze infiltration technique for automotive and aerospace applications, Nanowire white LEDs based on innovative nano phosphors, Integrated biorefinary for converting paper mill waste into chemical wealth were awarded to CSIR-NIIST which are currently in progress.

The Industry Meet, Skill Development Programs, Jigyasa, Science Day, Technology Day, CSIR Foundation Day, CSIR-NIIST Foundation Day etc conducted during this period had overwhelming responses from public and private sector Industries, Academia and also from the common public.

Major part of the State of Kerala was devastated by massive flood causing extensive damage to life and property. Responding to the distress call of CSIR-NIIST, the entire CSIR stood by and made massive contribution in cash and kind. Our sister laboratories offered help based on their area of expertise providing fresh clean drinking water to the affected areas, packed food materials with high nutritive value and large shelf life, medicines and insect repellants etc. CSIR-NIIST coordinated these efforts with the help of its staff and students working round the clock for several days ensuring that the help and materials reached the needy. I thank all those who have helped, particularly the student community of CSIR-NIIST.

I take this opportunity to thank one and all of CSIR-NIIST who had contributed to the progress of the Institute through their dedicated support. I also thank CSIR, Central and State Governments, stake holders from Public and Private sectors, our various clients, well-wishers and media who have all contributed in transforming CSIR-NIIST into a vibrant organization. It will be our endeavor to remain committed and strive for achieving higher goals.

A special word of appreciation to DG CSIR, CSIR-Head Quarters and RC members for their wholehearted support

A. Ajayaghosh

महत्वपूर्ण उपलब्धियां 2018-2019

सी एस आई आर-राष्ट्रीय अंतर्विषयी विज्ञान तथा प्रौद्योगिकी संस्थान (एनआईआईएसटी) मूल रूप से केरल सरकार के तहत औद्योगिक परीक्षण और अनुसंधान प्रयोगशाला था जो 1975 में सीएसआईआर परिवार में प्रवेश किया, जिसका नाम 1978 में क्षेत्रीय अनुसंधान प्रयोगशाला रखा गया। यह देश के दक्षिणी क्षेत्र के समृद्ध संसाधनों के प्रभावी उपयोग के लिए आवश्यक विज्ञान और प्रौद्योगिकी प्रदान करने के लिए अनिवार्य था। इन वर्षों में, प्रयोगशाला वास्तव में अंतःविषय अनुसंधान प्रयोगशाला के रूप में विकसित हुई है जो अनुसंधान क्षेत्रों, अर्थात् रसायन विज्ञान, सामग्री विज्ञान, कृषि-प्रसंस्करण, माइक्रोबियल और पर्यावरण प्रौद्योगिकियों के व्यापक स्पेक्ट्रम पर काम कर रही है। सीएसआईआर-एनआईआईएसटी को उद्योग और समाज की जरूरतों को पूरा करने के लिए उच्च गुणवत्ता वाले बुनियादी अनुसंधान और अभिनव समाधान के लिए जाना जाता है। संस्थान के अंतःविषय अनुसंधान गतिविधि के प्रमुख क्षेत्रों को मोटे तौर पर चार क्षेत्रों में वर्गीकृत किया गया है 1. प्राकृतिक संसाधन 2. अपशिष्ट और पर्यावरण 3. ऊर्जा 4. अणु, सामग्री और उपकरण। प्राकृतिक संसाधनों के अंतर्गत गतिविधियाँ समुद्र तट खनिज प्रसंस्करण, दुर्लभ पृथ्वी पिगमेंट, हल्की धातु मिश्र धातु, एग्रोप्रोसेसिंग, कार्यात्मक खाद्य पदार्थ, न्यूट्रास्यूटिकल्स, फाइटोकेमिकल्स, औषधीय पौधों, रोगाणुओं और एंजाइमों के क्षेत्र में हैं। अपशिष्ट और पर्यावरण के अंतर्गत अनुसंधान क्षेत्रों में अपशिष्ट / अपशिष्ट उपचार, अपशिष्ट उपयोग, प्रक्रिया मॉडलिंग, पर्यावरण प्रभाव मूल्यांकन और निगरानी शामिल हैं। ऊर्जा क्षेत्रों के अंतर्गत आने वाले क्षेत्रों में जैव ईंधन, सौर ऊर्जा और ऊर्जा की बचत सामग्री शामिल है। सीएसआईआर - एनआईआईएसटी सुरक्षा स्याही, स्मार्ट कोटिंग्स, नैदानिक जांच, रासायनिक मध्यवर्ती और संगणना और मॉडलिंग विकसित करने वाले रणनीतिक क्षेत्रों पर उच्च मूल्य विज्ञान में शामिल है। चौदह युवा और प्रतिभाशाली नए वैज्ञानिकों को जैव प्रौद्योगिकी, रासायनिक प्रौद्योगिकी और प्रक्रिया इंजीनियरों की विशेषज्ञता के साथ रिपोर्टिंग अवधि के दौरान प्रणाली में शामिल किया गया था जो कि अनुवादकीय अनुसंधान की क्षमता को मजबूत करेगा।

2018-19 की अवधि के दौरान, सीएसआईआर-एनआईआईएसटी ने केंद्र, राज्य सरकार की एजेंसियों, शैक्षिक संस्थानों, सार्वजनिक और निजी क्षेत्रों के हितधारकों से निरंतर निवेश के साथ वैज्ञानिक, तकनीकी और जनशक्ति विकास पर अपने विकास की प्रवृत्ति को बनाए रखा। औद्योगिक, निजी और सार्वजनिक क्षेत्रों और प्रौद्योगिकी हस्तांतरण से जुड़े नए सहयोगों में होने वाली वृद्धि से बाहरी स्रोतों से राजस्व में पर्याप्त वृद्धि होती है। इस रिपोर्टिंग अवधि के दौरान सीएसआईआर से निरंतर फंडिंग के साथ-साथ बाहरी फंडिंग में लगातार बढ़ोतरी ने सीएसआईआर-एनआईआईएसटी को उच्च गुणवत्ता वाले प्रकाशनों से समझौता किए बिना ट्रांसलेशनल रिसर्च और टेक्नोलॉजी डेवलपमेंट पर ध्यान केंद्रित करने में मदद की है।

वर्ष 2018-2019 में सीएसआईआर के द्वारा दिए गए परियोजनाओं के सफल कार्यान्वयन को भी चिन्हित किया है निच बनाने वाली परियोजनाएं, फोकस्ड बेसिक रिसर्च, फास्ट ट्रैक ट्रांसलेशनल, फास्ट ट्रैक व्यावसायीकरण और मिशन मोड योजनाएँ निम्नलिखित विषयों के तहत 1. खनन, खनिज, धातु और सामग्री 2. रसायन (चमड़ा और पेट्रोकेमिकल्स सहित) 3. ऊर्जा (पारंपरिक और गैर-पारंपरिक) और ऊर्जा उपकरण 4. पारिस्थितिकी, पर्यावरण, पृथ्वी विज्ञान और जल 5. कृषि पोषण और जैव प्रौद्योगिकी 6. हेल्थकेयर।

समीक्षाधीन अवधि के दौरान प्रमुख सफलता की कहानियों में से एक डाई-सेंसिटाइज्ड सोलर सेल (DSSC) मॉड्यूल फैब्रिकेशन उपकरण का स्वदेशीकरण हैं। देश में पहली बार यह क्षमता हासिल की गई हैं, जिससे 60-70% की भारी लागत में कमी हैं। सीएसआईआर-एनआईआईएसटी, अपनी विशेषज्ञता का लाभ उठाने के लिए इस निर्माण संबंधी प्रक्रियाओं से संबंधित बौद्धिक संपदा को स्थानांतरित करने तैयार जो सौर फोटोवोल्टिक के आगामी क्षेत्रों में रुचि रखते हैं, अन्य सीएसआईआर-लबरोटरी, आरएंडडी संस्थानों और उद्योगों। अधिक पर्यावरण के अनुकूल तरीके से स्मार्ट कृषि, ऊर्जा, शहरी और जल प्रबंधन की दिशा में योगदान करके, सीएसआईआर-एनआईआईएसटी भारत के जीओआई मिशनों में, इनोवेट इन इंडिया, क्लीन एंड रिन्यूएबल एनर्जी, स्किल इंडिया और स्मार्ट सिटीज एंड विलेजेज के अनुरूप आर्थिक और औद्योगिक विकास के साथ-साथ जीवन की गुणवत्ता में सुधार के लिए पहल करने के लिए प्रतिबद्ध है।।

सीएसआईआर-एनआईआईएसटी को एन ए बी एल मान्यता प्राप्त है और केरल में एक परामर्शदाता संगठन है, जो दो क्षेत्रों में खनन और बंदरगाहों और हार्बर में मान्यता प्राप्त है। सरकारी और निजी क्षेत्र द्वारा ईआईए सेवाओं का उपयोग परियोजनाओं की वैधानिक मंजूरी के लिए किया जाता है। परीक्षण और विश्लेषण प्रयोगशाला को जल, अपशिष्ट जल, डाइऑक्सिन, फुरान और पॉली क्लोरीनयुक्त बाइफिनाइल (पीसीबी) के विश्लेषण के लिए आईएसओ / आईईसी 17025: 2005 के अनुसार एनएबीएल द्वारा मान्यता प्राप्त है। इसके अलावा, हम पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय (MoEFCC), भारत सरकार द्वारा अनुशंसित पर्यावरणीय मंजूरी के लिए डाइऑक्सिन विश्लेषण के लिए एक रेफरल प्रयोगशाला भी हैं। कॉम्पैक्ट फूड वेस्ट बायोगैस संयंत्र को मौजूदा 50 किलोग्राम / दिन के स्तर से 500 किलोग्राम / दिन की क्षमता तक बढ़ाया गया था। तिरुवनंतपुरम अंतरराष्ट्रीय हवाई अड्डे पर निजी उद्योग, स्वैच फ्यूचर एनर्जी सॉल्यूशन (NIIST प्रौद्योगिकी लाइसेंसधारी) के साथ संयुक्त रूप से 500 किलोग्राम खाद्य अपशिष्ट-बायोगैस-बिजली इकाई स्थापित की गई थी। इस संयंत्र से हर दिन लगभग 90-100 क्यूबिक मीटर बायोगैस उत्पन्न होने की उम्मीद है, जिसे ~ 110-120 kWh बिजली में परिवर्तित किया जाएगा। संयंत्र दिसंबर 2018 में स्थापित किया गया था और परीक्षण रन अभी चल रहे हैं।

संस्थान के पास एक उत्कृष्ट विश्लेषणात्मक सुविधा है जो उच्च गुणवत्ता वाले बुनियादी और अनुवाद अनुसंधान के लिए पूरी क्षमता के साथ उपयोग की जाती है, इसके अलावा यह उद्योग और शिक्षा से नमूनों के परीक्षण से राजस्व उत्पन्न करता है। सीएसआईआर-एनआईआईएसटी ने सीएसआईआर कौशल पहल कार्यक्रम के तहत विभिन्न खंडों के तहत लघु अवधि के पाठ्यक्रम पेश किए। संस्थान उच्च गुणवत्ता वाले मानव संसाधनों का पोषण करना जारी रखता है, हर साल 30 से अधिक पीएचडी प्रदान करता है। एनआईआईएसटी उच्च प्रभाव कारक पत्रिकाओं में हर साल 200 से अधिक पत्र प्रकाशित करता है और एक मजबूत पेटेंट पोर्टफोलियो है।

केरल राज्य का बड़ा हिस्सा बड़े पैमाने पर बाढ़ से तबाह हो गया, जिससे जान-माल की व्यापक क्षति हुई। सीएसआईआर-एनआईआईएसटी के संकटपूर्ण कॉल का जवाब देते हुए, संपूर्ण सीएसआईआर ने खड़े होकर नकदी और संवेदना का बड़ा योगदान दिया। हमारी सिस्टर प्रयोगशालाओं ने प्रभावित क्षेत्रों में ताज़ा स्वच्छ पेयजल

उपलब्ध कराने के लिए विशेषज्ञता के अपने क्षेत्र के आधार पर मदद की पेशकश की, उच्च पोषक मूल्य और बड़े शेल्फ लाइफ, दवाओं और कीट रिपलैंटस आदि के साथ खाद्य सामग्री पैक किया। सीएसआईआर-एनआईआईएसटी ने कई दिनों तक चौबीसों घंटे काम करने वाले अपने कर्मचारियों और छात्रों की मदद से इन प्रयासों को समन्वित किया ताकि यह सुनिश्चित किया जा सके कि मदद और सामग्री ज़रूरतमंदों तक पहुँचे। मैं उन सभी को धन्यवाद देता हूं जिन्होंने मदद की है, खासकर सीएसआईआर-एनआईआईएसटी के छात्र समुदाय ने।

इस पृष्ठभूमि के खिलाफ, 2018-2019 की अवधि के लिए वार्षिक रिपोर्ट सीएसआईआर-एनआईआईएसटी द्वारा नवाचार, उपलब्धियों, प्रगति और प्रभाव को निर्धारित करती है, जो कि सामने की ओर अनुसंधान के अंतःविषय वातावरण में एक सख्त और चुनौतीपूर्ण वातावरण में अपनी योजनाओं के साथ संरेखित करती है।

आर एंड डी कार्यक्रमों में प्रगति और प्रदर्शन

2018-19 में, प्रत्येक विभाग ने उत्पाद विकास, प्रक्रिया निर्माण, शैक्षणिक उत्कृष्टता, और अनुसंधान सहयोग के क्षेत्र में केंद्रित अनुसंधान गतिविधियों के माध्यम से महत्वपूर्ण प्रगति की। प्रमुख रिपोर्ट और रसायन, सामग्री, माइक्रोबियल प्रक्रियाओं, कृषि-प्रसंस्करण और पर्यावरण प्रौद्योगिकियों के क्षेत्रों में वर्तमान अनुसंधान गतिविधियों को इस रिपोर्ट में संक्षेपित किया गया है।

एग्रो-प्रोसेसिंग एंड टेक्नोलॉजी डिवीजन एक बहु-विषयक केंद्र है जिसमें प्रक्रिया पर मुख्य फोकस (शेल्फ लाइफ एन्हांसमेंट, स्टोरेज, वैल्यू एडिशन) और उत्पाद विकास (न्यूट्रास्युटिकल्स, कार्यात्मक खाद्य पदार्थ, आहार पूरक, फाइटो फार्मास्यूटिकल्स, जैव-उर्वरक और जैव कीटनाशक) शामिल हैं। प्रभाग के मुख्य उद्देश्यों में से एक कृषि उत्पादन और संयंत्र संसाधनों पर जोर देना और वैज्ञानिक और तकनीकी हस्तक्षेप और नवाचार के माध्यम से अपनी उपज के उच्च रिटर्न के माध्यम से किसानों के सामान्य कल्याण में सुधार लाना है। डिवीजन में कृषि प्रसंस्करण के क्षेत्र में प्रमुख पायलट संयंत्र सुविधाएं और एक प्रौद्योगिकी व्यवसाय ऊष्मायन केंद्र है। ए पि टि डि भी इस क्षेत्र में प्रचुर मात्रा में पारंपरिक ज्ञान की उपलब्धता और प्रभाग में उपलब्ध जैव विविधता की खोज, न्यूट्रास्यूटिकल्स और फाइटो फार्मास्यूटिकल्स के विकास और सत्यापन में शामिल है। ए पि टि डि एंडोफाइटिक रोगाणुओं से जैव-उर्वरकों और जैव-कीटनाशकों के विकास पर भी काम कर रहा है, मसाले और फलों से सक्रिय सामग्री के अलगाव के लिए औद्योगिक रूप से महत्वपूर्ण कई एंजाइमों का उत्पादन करने में सक्षम उपन्यास स्वदेशी माइक्रोबियल उपभेदों का खनन। डिवीजन भी यौगिकों के इन-विट्रो स्क्रीनिंग और मधुमेह, हृदय, सूजन, कैंसर और गैर-अल्कोहल फैटी लिवर रोगों के लिए तंत्र आधारित अध्ययन के लिए सुविधाओं से लैस है।

रासायनिक विज्ञान और प्रौद्योगिकी प्रभाग अणुओं और कार्यात्मक सामग्रियों के विकास और विभिन्न डिवाइस प्लेटफार्मों में उनके अनुप्रयोग पर ध्यान केंद्रित कर रहा है। संस्थान के तीन प्राथमिकता वाले क्षेत्रों का नेतृत्व प्रभाग द्वारा किया जाता है - (1) ऑर्गेनिक और हाइब्रिड इलेक्ट्रॉनिक्स (ऊर्जा उत्पादन और भंडारण, क्रोमोजेनिक कोटिंग्स, ठोस राज्य प्रकाश व्यवस्था, कम्प्यूटेशनल रसायन विज्ञान); (2) फ्लोरोसेंट सामग्री (सुरक्षा अनुप्रयोगों, निदान और इमेजिंग जांच और अल्ट्राफास्ट कैनेटीक्स); (3) फाइटोफार्मास्युटिकल्स एंड ड्रग इंटरमीडिएट (औषधीय पौधों और उन्नत दवा मध्यवर्ती का जैव मूल्यांकन)। प्रभाग संस्थान स्तर पर सीएसआईआर की विभिन्न विषयगत गतिविधियों का समन्वय करता है, अर्थात् ऊर्जा (पारंपरिक और गैर-पारंपरिक) सामग्री और ऊर्जा उपकरण, हेल्थकेयर और रसायन। इसके अलावा, डिवीजन दो सीएसआईआर मिशन मोड परियोजनाओं में एक प्रमुख भूमिका निभाता है - (1) स्वास्थ्य देखभाल अनुप्रयोगों और (2) न्यूट्रास्युटिकल्स मिशन के लिए नैनोबायोजर्स और माइक्रोफ्लुइडिक्स। यह प्रभाग विभिन्न सरकारी एजेंसियों और उद्योगों द्वारा वित्त पोषित महत्वपूर्ण परियोजनाओं का संचालन भी करता है।

पर्यावरण प्रौद्योगिकी प्रभाग क्षेत्र के प्राकृतिक संसाधनों के प्रदूषण नियंत्रण और मूल्य संवर्धन के लिए स्वदेशी प्रौद्योगिकियां बनाने में सक्रिय रूप से लगा हुआ है। पर्यावरणीय प्रौद्योगिकी प्रभाग की संपूर्ण गतिविधियों को इन दो विषयों के अंतर्गत रखा जा सकता है, 1. अपशिष्ट प्रबंधन के लिए सफाई समाधान और 2. पर्यावरण निगरानी, प्रभाव मूल्यांकन और प्रबंधन। संभागीय गतिविधियाँ अपशिष्ट प्रबंधन, डाइऑक्सिन अनुसंधान और पर्यावरण प्रभाव आकलन (ईआईए) के क्षेत्रों में परिवर्तित होती हैं। अपशिष्ट प्रबंधन के समाधान, अपशिष्ट उपचार, मिट्टी के शोधन आदि में विकसित विशेषज्ञता से, विभाजन ने अत्याधुनिक तकनीकी समाधान और शमन उपायों की स्थिति में एक जगह बनाई है। प्रभाग के अधिकांश आरएंडडी परिणाम सफल, नवीन और लागत प्रभावी प्रौद्योगिकियों के रूप में हैं, जो "विनाश के बिना विकास" का एक पारिस्थितिकी तंत्र बनाने के लिए प्रयासरत हैं।

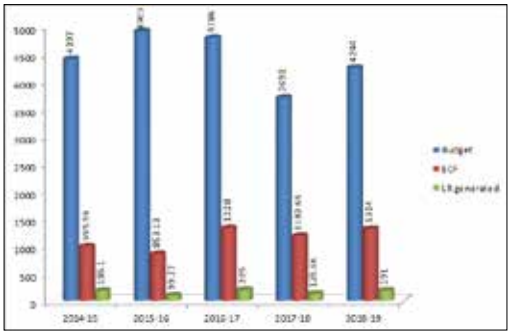
सामग्री विज्ञान और प्रौद्योगिकी प्रभाग सक्रिय रूप से खनिज, धातु सामग्री, चीनी मिट्टी की चीज़ें, पॉलिमर और कंपोजिट, इलेक्ट्रॉनिक और चुंबकीय सामग्री के क्षेत्रों में उच्च विज्ञान और प्रासंगिक प्रौद्योगिकियों के लिए अग्रणी अनुसंधान और विकास गतिविधियों को काटने में शामिल है। इसके अलावा, अंतःविषय प्रकृति का मौलिक अनुसंधान इस प्रभाग के वैज्ञानिकों द्वारा किया जा रहा है और इस तरह उच्च गुणवत्ता वाले प्रकाशनों और पेटेंट के लिए अग्रणी है। डिवीजन में राष्ट्रीय और अंतर्राष्ट्रीय संगठनों के साथ बड़ी संख्या में इंडो-जर्मन साइंस एंड टेक्नोलॉजी सेंटर की वित्त पोषित सहयोग परियोजना है, जो एल्युमिनियम कंपोजिट के 'नियर नेट मैन्युफैक्चरिंग' पर है और इंडो-फ्रेंच सेंटर फॉर प्रमोशन ऑफ़ एडवांस्ड रिसर्च के तहत एक प्रोजेक्ट है। डिवीजन में नेशनल कॉयर रिसर्च एंड मैनेजमेंट इंस्टीट्यूट से पॉलिमर और कंपोजिट का एक बड़ा प्रोजेक्ट है।

माइक्रोबियल प्रक्रियाओं और प्रौद्योगिकी प्रभाग डिवीजन सक्रिय रूप से माइक्रोबियल संसाधनों की खोज और दोहन करके बायोप्रोसेस और उत्पादों के विकास के लिए फोकस्ड क्षेत्रों में अनुसंधान में शामिल है। अनुसंधान का वर्तमान फोकस (i) औद्योगिक एंजाइमों और मूल्य वर्धित रसायनों (ii) जैव ईंधन (iii) जैव सक्रिय अणु iv) स्वास्थ्य और जीनोमिक्स (v) पादप-सूक्ष्म जीव अंतःक्रिया और (vi) प्रोबायोटिक और पौष्टिक-औषधीय अल्गल पदार्थों के क्षेत्रों में है। दूसरी पीढ़ी के बायोटेनॉल पर विशेष अनुसंधान और विकास के लिए डिवीजन के पास एक समर्पित "बायोफ्यूल के लिए केंद्र" है। लिग्नोसेल्युलोसिक बायोएथेनॉल के उत्पादन के लिए पायलट प्लांट को अब साइट-सॉलिड-स्टेट किण्वन एंजाइम उत्पादन पायलट प्लांट द्वारा समर्थित किया गया है, जिससे

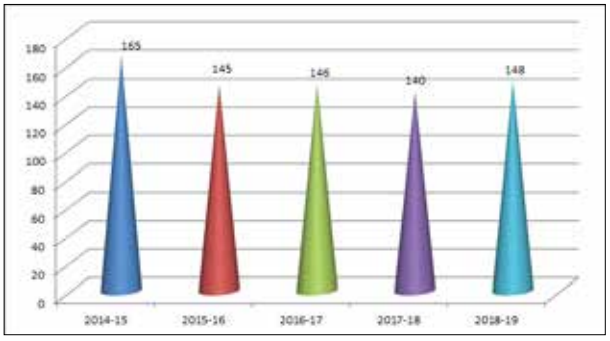
बेहतर लागत-प्रभावी और हैंडलिंग अवसर प्राप्त हुए हैं। 9 सीएसआईआर प्रयोगशाला से भागीदारी के साथ 2G इथेनॉल पर एक PANCSIR कार्यक्रम और एनआईआईएसटी द्वारा समन्वित 2G इथेनॉल उत्पादन की लागत को कम (<Rs 100 / L) करने के लक्ष्य के साथ शुरू किया गया था

संस्थान ने विभिन्न महत्वपूर्ण राष्ट्रीय और अंतर्राष्ट्रीय कार्यक्रम और अन्य राष्ट्रीय स्तर पर मनाया जाने वाले दिन / सप्ताह आयोजित किए। हमारे कई वैज्ञानिक और अनुसंधान फेलो ने कई प्रतिष्ठित पुरस्कारों, सम्मानों और पहचानों के माध्यम से संस्थान के लिए कई प्रशंसाएं हासिल कीं। अनुसंधान विद्वानों ने प्रतिष्ठित सेमिनार और संगोष्ठी में सर्वश्रेष्ठ पोस्टर, सर्वश्रेष्ठ मौखिक प्रस्तुति और कागजी पुरस्कार प्राप्त करके अपनी जीत का सिलसिला जारी रखा।

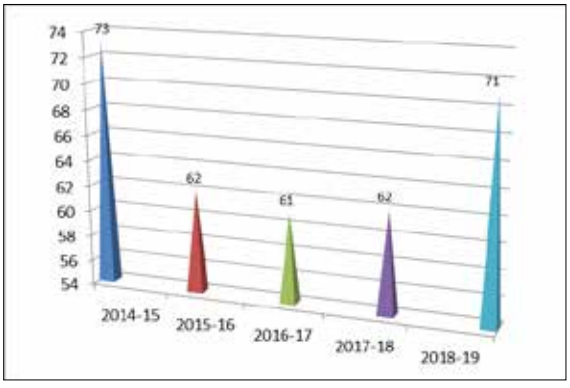
बजट/ ईसीएफ/ एलआर(लाखों में)
BUDGET/ECF/LR (in lakhs)



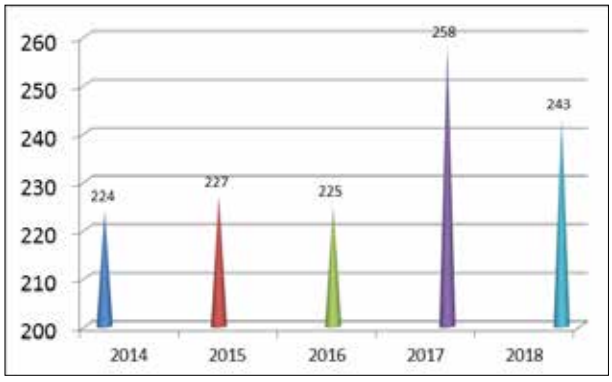
कर्मचारियों की संख्या
STAFF STRENGTH



वैज्ञानिकों की स्थिति
SCIENTIST POSITION



प्रकाशनों
PUBLICATIONS



SIGNIFICANT ACHIEVEMENTS 2018-2019

CSIR- National Institute for Interdisciplinary Science & Technology (NIIST) originally Industrial Testing and Resesarch Laboratory under Govt. of Kerala entered the CSIR family in 1975 was renamed as Regional Research Laboratory in 1978. It is mandated to provide the Science & Technology needed for the effective utilization of the rich resources of the southernmost region of the country. Over the years, the laboratory has grown into a truly interdisciplinary research laboratory working on broad spectrum of research areas, namely chemistry, materials science, agro-processing, microbial, and environmental technologies. CSIR-NIIST is known for its high-quality basic research and innovative solutions to meet the needs of the industry and society. The niche areas of interdisciplinary research activity of the Institute is broadly classified into four sectors namely 1. Natural resources 2. Waste and Environment 3. Energy 4. Molecules, Materials & Devices. The activities under natural resources are in the field of beach mineral processing, rare earth pigments, light metal alloys, agroprocessing, functional foods, nutraceuticals, phytochemicals, medicinal plants, microbes and ezymes. The research areas under Waste and Environment comprises of waste/ effluent treatment, waste utilization, process modelling, Environmental Impact Assessment (EIA) and monitoring. The niche areas under energy sectors encompasses biofuels, solar energy and energy saving materials. CSIR-NIIST is involved in high value science on strategic sectors developing security inks, smart coatings, diagnostic probes, chemical intermediates and computation and modelling. Fourteen young and talented new Scientists were inducted into the system during the reporting period with expertise ranging biotechnology, chemical technology and process engineers which will strengthen the potential of translational research.

During the period 2018-19, CSIR-NIIST sustained its growth trend on Scientific, Technological and manpower development with continued investment from stakeholders comprising of Central, State Government agencies, educational institutes, public and private sectors. The upsurge in new collaborations involving industrial, private and public sectors and technology transfers lead to an substantial increase in revenue from external sources. The sustained funding from CSIR during this reporting period along with a steady rise in external funding, have helped CSIR-NIIST in focusing on translational research and technology development without compromising on high-quality publications.

The year 2018-2019 also marked the successful implementation of projects from CSIR under NCP (Niche creating projects), FBR (Focused Basic Research), FTT (Fast Track Translational), FTC (Fast Track Commercialization) and mission mode schemes under the following themes: 1. Mining, Minerals, Metals and Materials 2. Chemicals (including leather and Petrochemicals) 3. Energy (Conventional and non-conventional) and Energy devices 4. Ecology, Environment, Earth Sciences and Water 5. Agri. Nutrition and Biotechnology 6. Healthcare.

One of the major success stories during the reporting period was the indigenization of the Dye-Sensitized Solar Cell (DSSC) Module Fabrication Equipment For the first time in the country this capability was achieved thereby paving way for huge cost reduction of 60-70% with respect to the imported ones. CSIR-NIIST, is all poised to leverage its expertise to transfer intellectual property related to the fabrication processes to other CSIR-Labarotary, R&D institutions and industries who are interested in upcoming areas of solar photovoltaics. By contributing towards smart agriculture, energy, urban and water management in a more environmentally friendly way, CSIR-NIIST is committed to the initiative for the improvement in quality of life along with economic and industrial growth in line with the GOI missions such as "Make in India", "Innovate in India", "Clean & Renewable Energy","Skill India" and "Smart Cities & Villages".

CSIR-NIIST is a NABET accredited, Category A consultant organisation in Kerala with accreditation in two areas i.e Mining and Ports & Harbour. The EIA services are used by government and private sector for statutory clearance of projects. The Testing and Analysis Laboratory is accredited by NABL as per ISO/ IEC 17025: 2005 for analysis of Water, Wastewater, Dioxins, Furans and Poly Chlorinated Biphenyls (PCBs). In addition, we are also a referral laboratory for Dioxin analysis for environmental clearances recommended by Ministry of Environment, Forest and Climate Change (MoEFCC), Govt. of India. The compact food waste biogas plant was scaled up from the existing 50 kg/day level to 500 kg/day capacity. A 500 kg food waste-biogas-power unit was installed at Thiruvananthapuram International Airport jointly with private industry, Swatch Future Energy Solution (the NIIST technology licensee). The plant is expected to generate around 90-100 cubic meter biogas every day, that will be converted into ~110-120 kWh of electricity. The plant was installed in December 2018 and trial runs are currently in progress.

Institute has an excellent analytical facility which is utilized with full capacity for high quality basic and translation research, besides generating revenue from testing of samples from industry and academia. CSIR-NIIST introduced short term courses under various segments under CSIR Skill Initiative programme. The Institute continues to nurture high quality human resources, awarding over 30 Ph.D.s every year. NIIST publishes over 200 papers every year in high impact factor journals and has a robust patent portfolio.

During the reporting period, the State of Kerala was severly affected by flood calamity. The entire southern part was enundated causing damage to life and property. CSIR-NIIST rose to the occasion and with conceited effort involving staff students and sister laboratories from all over the country contributed in a significant way dealing with food, water and medical problems arising out of the situation. During this hour of emergency, CSIR-NIIST played a pivotal role functioning for 24 hours for several days as the nodal laboratory coordinating and channelizing the flow of help in cash and kind from its sister concerns ensuring the correct delivery in required areas.

Against this backdrop, the Annual Report for the period 2018-2019 sets out the innovation, achievements, progress, and impact made by CSIR-NIIST aligning with its plans in a vigorously changing and challenging interdisciplinary environment of frontier research.

Progress and Performance in R&D Programs

In 2018-19, each division made significant progress through focused research activities in the field of product development, process formulations, academic excellence, and research collaborations. Major achievements and current research activities in the areas of chemicals, materials, microbial processes, agro-processing, and environmental technologies summarized in this report.

Agroprocessing and Technology Division (APTD) is a multidisciplinary centre with main focus on process (shelf life enhancement, storage, value addition) and product development (nutraceuticals, functional foods, dietary supplements, phyto pharmaceuticals, bio-fertilizers & bio pesticides) emphasizing agri produce & plant resources. One of the main objectives of the division is improvement of general welfare of farmers through high returns of their produce via scientific and technological intervention and innovation. Division has major pilot plant facilities and a technology business incubation centre (TBIC) in the area of agro-processing. APTD is also involved in the development and validation of nutraceuticals and phyto pharmaceuticals exploring rich biodiversity, availability of abundant traditional knowledge in this region and available expertise in the division. APTD is also working on development of bio-fertilizers & bio-pesticides from endophytic microbes, mining of novel indigenous microbial strains capable of producing industrially important multiple enzymes for isolation of active ingredients from spices and fruits. Division is also equipped with facilities for in-vitro screening of compounds and mechanism based studies for diabetes, cardiovascular, inflammation, cancer and non-alcoholic fatty liver diseases.

The Chemical Sciences and Technology Division has been focusing on the development of molecules and functional materials and their application in various device platforms. The three priority areas of the Institute are led by the division – (1) Organic and Hybrid Electronics (Energy generation and storage, chromogenic coatings, solid state lighting, computational chemistry); (2) Fluorescent Materials (Security applications, diagnostics and imaging probes and ultrafast kinetics); (3) Phytopharmaceuticals and Drug Intermediates (Bio-evaluation of medicinal plants and advanced pharmaceutical intermediates). The division coordinates various thematic activities of CSIR at the institute level, namely Energy (conventional and non-conventional) Materials and Energy Devices, Healthcare, and Chemicals. Besides, the division plays a major role in two CSIR Mission Mode projects – (1) Nanobiosensors and microfluidics for healthcare applications and (2) Nutraceuticals Mission. The Division also undertakes a large number of important projects funded by various government agencies and industries.

The Environmental Technology Division (ETD) is actively engaged in creating indigenous technologies for pollution control and value addition to the region's natural resources. The entire activities of Environmental Technology Division can be put under these two topics viz. 1. Clean-up solutions for waste management and 2. Environmental monitoring, impact assessment and management. The divisional activities converge into the areas of waste management, dioxin research and Environmental Impact Assessment (EIA). From the expertise developed in waste management solutions, effluent treatment, soil remediation etc., the division has made a niche in state of the art technological solutions and mitigation measures. Most of the R&D outcomes of the division are in the form of successful, innovative and cost-effective technologies striving to create an ecosystem of "development without destruction".

Materials Science and Technology Division of CSIR-NIIST is actively involved in cutting edge R&D activities leading to high science and relevant technologies in the areas of Minerals, Metallic materials, Ceramics, Polymers and composites, Electronic and Magnetic materials. Also, fundamental research of interdisciplinary nature is being carried out by the scientists of this division thus leading to high quality publications and patents. The Division has a large number of projects with national and international organizations Indo-German Science and Technology centre (IGSTC) funded collaborative project on 'Near Net Manufacturing' of aluminium composites and a project under Indo-French Centre for Promotion of Advanced Research (CEFIPRA). The Division also has a major ongoing project from National Coir Research and Management Institute (NCRMI) on polymers and composites.

Microbial Processes and Technology Division (MPTD) division is actively involved in research in the focussed areas for bioprocesses and products development by exploring and exploiting the microbial resources. The current focus of research is in the areas of (i) Industrial enzymes and value-added chemicals (ii) Biofuels and biorefinery (iii) bioactive molecules iv) Health and genomics (v) plant-microbe interactions and (vi) probiotic and algal nutraceuticals. The Division has a dedicated "Centre for Biofuels" for exclusive R&D on 2nd generation bioethanol. The pilot plant for the production of lignocellulosic bioethanol is now supported by on-site solid-state fermentation enzymes production pilot plant, bringing better cost-effective and handling opportunities. A PANCSIR program on 2G ethanol with participation from 9 CSIR labs and coordinated by NIIST was kick started with a target of reducing the cost of 2G ethanol production to < Rs 100/L.

Institute organized various important national and international events and other nationally observed days/weeks. Several of our 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 the best poster, best oral presentation, and paper awards in prestigious seminars and symposia.

AGRO PROCESSING AND TECHNOLOGY DIVISION

Expertise
Post-Harvest Technologies, Nutraceuticals and Functional Foods, Value addition of Agro Produces, Phytopharmaceuticals, Metabolic syndrome and Cancer biology.

Scientist	:	10
Technical staff	:	3
Students	:	45

Facilities
Pilot Plant Facilities for Evaporation, Distillation and Drying, HPLC, GC-MS, Flow Cytometer, RT PCR, Lyophiliser, Multi mode Plate Reader, High content bioimager - BD Pathway TM 855

Ongoing projects (Grant-in-aid, Sponsored, Consultancy and Technical Services, In-house)	:	22
Publications (SCI+non SCI)	:	13
Ph. D. awarded	:	2

कृषि प्रसंस्करण तथा प्रौद्योगिकी प्रभाग

कृषि प्रसंस्करण तथा प्रौद्योगिकी प्रभाग एक बहु-विषयक केंद्र है, जो कृषि उपज और पादप संसाधनों पर जोर देते हुए प्रक्रिया (शेल्फ लाइफ एन्हांसमेंट, भंडारण, मूल्यवर्धन) तथा उत्पाद विकास (न्यूट्रास्यूटिकल्स, कार्यात्मक खाद्य पदार्थ, आहारीय पूरक, फाइटोफार्मास्यूटिकल्स, बायो-उर्वरक और बायो-कीटनाशक) पर मुख्य ध्यान देता है। प्रभाग के मुख्य उद्देश्यों में से एक है- वैज्ञानिक तथा तकनीकी नवाचार के माध्यम से अपने उपज के लिए उच्च लाभ प्रदान कराते हुए किसानों के सामान्य कल्याण में सुधार। प्रभाग में कृषि प्रसंस्करण के क्षेत्र में प्रमुख पायलट संयंत्र सुविधाएं और एक तकनीकी व्यापार ऊष्मायन केंद्र (टीबीआईसी) वर्तमान है।

प्रभाग की गतिविधियों में समृद्ध जैव विविधता की खोज तथा इस क्षेत्र में प्रचुर मात्रा में उपलब्ध पारंपरिक ज्ञान और प्रभाग की विशेषज्ञता का उपयोग करते हुए न्यूट्रास्यूटिकल्स और फाइटो फार्मास्यूटिकल्स के विकास और सत्यापन शामिल हैं। एंडोफेटिक सूक्ष्म जीवों से जैव उर्वरक और जैव कीटनाशकों का विकास तथा मसालों और फलों से सक्रिय तत्व के अलगाव के लिए औद्योगिक रूप से महत्वपूर्ण एंजाइमों के उत्पादन में सक्षम नूतन स्वदेशी माइक्रोबियल उपभेदों के खनन पर प्रभाग सक्रिय है। यौगिकों के *इन विट्रो* स्क्रीनिंग के लिए तथा मधुमेह, हृदय रोग, कैंसर और गैर- एल्कोहॉलिक फैटी यकृत रोगों के लिए मैकेनिजम आधारित अध्ययन के लिए प्रभाग में सुविधाएं उपलब्ध है। प्रभाग में मानव संसाधन विकास के लिए अकादमिक कार्यक्रम है (पीएचडी) और उद्योगों और अकादमिक संस्थानों की आवश्यकता के लिए खाद्य विज्ञान और जैव चिकित्सा विज्ञान के तहत भी कार्यक्रम है।

हाइलाइट

- उत्पाद और प्रक्रिया विकास, प्रौद्योगिकी उन्नयन और स्वास्थ्य लाभ के वैज्ञानिक सत्यापन के लिए आर एंड डी, उद्योग इंटरफेस कार्यक्रम (प्रायोजित और परामर्श)
- विटामिन ए की कमी के लिए रेड पामओलेन (आरपीओ) आधारित कार्यात्मक खाद्य उत्पाद (कार्यात्मक वनस्पति तेल और मुलायम जेल)
- चयापचय विकारों और कैंसर के लिए पौधों से बायोएक्टिव यौगिकों का फार्माकोलॉजिकल मूल्यांकन
- देशी सूक्ष्मजीव से औद्योगिक रूप से महत्वपूर्ण एंजाइमों के माध्यम से सक्रिय घटकों के निष्कर्षण के लिए वानस्पतिकों का जैव प्रसंस्करण
- एंडोफाइटिक जीवों पर विशेष जोर देने के साथ सूक्ष्मजीव से जैव उर्वरक और जैव कीटनाशक
- प्राकृतिक उत्पादों के साथ ट्राइफिनाइल फॉस्फोनियम के संयोग के माध्यम स माइटोकॉन्ड्रियल एंटीऑक्सीडेंट का विकास
- चयापचय वर्धक के रूप में कृषि / खाद्य प्रसंस्करण अवशेष सामग्री से आहार फाइबर
- खाद्य पदार्थों में एक्रिलमाइड और शमन रणनीतियों
- पोषण और बायोएक्टिव घटकों के लिए गैर-डेयरी पेय पदार्थ और वितरण प्रणाली
- जराचिकित्सा स्वास्थ्य देखभाल अनुप्रयोगों के लिए शाकाहारी प्रोटीन की स्रोत पहचान और सत्यापन।
- पारंपरिक अनाज और कम फल और सब्जियों से मूल्य वर्धित उत्पाद।
- आयुर्वेद में नियोजित विशिष्ट उपचार के जैव रासायनिक, सेलुलर और आणविक स्तर सत्यापन अध्ययन।

Agroprocessing and Technology Division (APTD) is a multidisciplinary centre with main focus on process (shelf life enhancement, storage, value addition) and product development (nutraceuticals, functional foods, dietary supplements, phyto pharmaceuticals, bio-fertilizers & bio pesticides) emphasizing agri produce & plant resources. One of the main objectives of the division is improvement of general welfare of farmers through high returns of their produce via scientific and technological intervention and innovation. Division has major pilot plant facilities and a technology business incubation centre (TBIC) in the area of agro-processing. APTD is also involved in the development and validation of nutraceuticals and phyto pharmaceuticals exploring rich biodiversity, availability of abundant traditional knowledge in this region and available expertise in the division. APTD is also working on development of bio-fertilizers & bio-pesticides from endophytic microbes, mining of novel indigenous microbial strains capable of producing industrially important multiple enzymes for isolation of active ingredients from spices and fruits. Division is also equipped with facilities for in-vitro screening of compounds and mechanism based studies for diabetes, cardiovascular, inflammation, cancer and non-alcoholic fatty liver diseases. The division has academic programmes (PhD) for human resource development in the field of food science and biomedical sciences for meeting the needs of industries and academics institutes.

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 (functional vegetable oil & soft gel) for vitamin A deficiency
- Pharmacological evolution of bioactive compounds from plants for metabolic disorder 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
- Development of mitochondrial antioxidant micronutrients through conjugation of triphenyl phosphonium with natural products
- Dietary fibre from agri/food processing spent materials as metabolic enhancers
- Acrylamide in foods and its mitigation strategies
- Non-dairy beverages and delivery systems for nutritional and bioactive components
- Source identification and validation of vegetarian proteins for geriatric health care applications.
- Value added products from traditional grains and underutilised fruits and vegetables.
- Biochemical, cellular and molecular level validation studies of specific treatment regimens employed in Ayurveda.

FOOD SCIENCES AND TECHNOLOGIES

Post-Harvest Technologies and Processing of Agri Produces

Post-harvest operations for value addition of indigenous Agri crops- Jackfruit

Govt. of Kerala had sponsored a project for the benefit of agri entrepreneurs and MSME's of the State, the primary focus of which is to develop and commercialize the technologies for value addition of various agri crops of the State. As a part of this ongoing project technologies were developed in pilot scale level for making various dehydrated and ready to use agri& food products based on indigenous agri produces. This include millet based ready to eat breakfast mixes, soups and porridges, dehydrated ready to use vegetables/vegetable mixes for various culinary applications, dehydrated ready to constitute coconut based chutneys and gravy and dehydrated fruits. The products and the process were optimized based on nutritional &sensory analysis and shelf life evaluation. The nutritional composition and health benefits of the indigenous produce were also evaluated. Studies were also undertaken to establish the nutritional and health benefits of jackfruit, the official fruit of Kerala. Preliminary studies indicated that the raw jackfruit is a very good source of bio actives and dietary polysaccharides with interesting functional properties. The technologies will be transferred as part of the programme to interested entrepreneurs / MSME's for commercialization.

Occurrence of acrylamide in traditional deep fried snack products and use of spices as mitigating agents against acrylamide formation

Acrylamide is a induced toxicant formed in foods when exposed to high temperature processing e.g., baking, roasting, frying etc. Long-term exposure to acrylamide is reported to cause health risks such as diabetes, cardiovascular diseases and cancer. In view of this, the occurrences of acrylamide in various food products have been investigated and mitigation strategies have been recommended by various regulatory authorities like European Food Safety and Standards Authority (ESFA) and U. S. Food and Drugs Administration (U. S.FDA). As part of the initiative by Food Safety and Safety Standards Authority of India (FSSAI)' to survey the occurrence of acrylamide in traditional Indian foods, a study was conducted with the support of FSSAI to find out the acrylamide content in deep fried snack products. The samples included namkeen (sev, mixtures and dal products), traditional deep fried snacks (samosa, vada, murukku, achappam, pakkavada) and sweets (halwa, jalebi, laddoo, Mysore pak). The presence of acrylamide was detected in all the samples studied. The occurrence of acrylamide followed the pattern Navrathan mixture>Aloobhujia>Tasty Nuts> cutlet. Acrylamide content in the samples under evaluation was found to be within the safe limit as suggested by ESFA. However, further population exposure studies are required to confirm the safe use of the food products.

Further to this, in order to formulate mitigation strategies to reduce the acrylamide formation in namkeens, preliminary studies were conducted to evaluate the effect of various spices viz., turmeric, chilly and pepper powder, that are traditionally being incorporated in the namkeen preparation. Namkeen samples were prepared as gram flour as the main ingredient. Turmeric, chilly and pepper were incorporated in to the dough separately and the namkeens were prepared by deep frying. The amount of acrylamide formed in the samples was analysed using HPLC with Diode Array Detector and compared with the control, without any spices. Colour, texture profile, moisture content and crude fat of the

samples were also analysed. Addition of spices was found to decrease the acrylamide formation. Among the 4 samples, the control sample was found to be high in acrylamide (430 µg /kg). The samples with spices incorporated showed significant reduction in acrylamide content when compared to the control, the one with turmeric exhibited minimum acrylamide content (14.03 µg/kg). The study indicates reduction in acrylamide formation when spices were incorporated in the preparation of deep fried mixtures. This may be correlated with the higher bioactive components of spices, which is under investigation.

As a part of CSIR mission project FOCUS, further studies are initiated to find out the acrylamide content in various baked products and its mitigation strategies.

Sample	Acrylamide Concentration (µg/Kg)	HPLC chromatograms
Control	435±0.032	
A	14.03±0.012	
B	15.88±0.032	
C	56.02±0.12	

Figure 2: Concentration of Acryl amide in various samples

Value addition of spent turmeric: BIRAC-ARJUNA Naturals and CSIR-NIIST

The development of novel processed products and value chain for agri and food by-products for higher economic returns had always attracted scientific interventions. These by products/agriculture-food processing residues are rich source of dietary fibre and bioactive compounds and studies reveal that there is immense potential to develop value added products in the form of functional foods with metabolic enhancing properties such as dietary fibre and its prebiotic activities are reported to improve the ADME of dietary carbohydrates and fats. The bioactive molecules bound to dietary fibre, which are released during digestion along with the fermentation metabolites by probiotic bacteria, are reported to act as metabolic enhancers. Modulation of gut micro biomass has been reported to play important role in ADME. In this respect, dietary fibre soluble & insoluble and prebiotic dietary fibre are gaining lots of importance in modulation of many metabolic activities in the management of lifestyle associated diseases.

The collaborating industry generates a huge amount of industrial residue, which consists of spices, fruits and other agri crops. On preliminary evaluation, we found that these spent materials are rich source of dietary fibre and bioactive phytochemicals. Subsequently, a Proof of Concept (POC) at bench level was developed for the extraction of dietary fibre and bioactivities from spent turmeric, amla and red spinach generated from the industry. Based on the POC, Biotechnology Industry Research Assistance Council (BIRAC) has recently sanctioned a project to develop process for extraction of dietary fibre and bioactivities from spent turmeric generated from M/s Arjuna Naturals, extraction of dietary fibre and its prebiotic efficacy as well as the metabolic enhancing properties. The *in vitro* studies will be carried out at CSIR-NIIST followed by the *in vivo* efficacy studies at M/s Arjuna Naturals. The present work is of great significance to food/nutraceutical/ Ayurveda industries in terms of better utilization of natural resources for sustainable development and to address the issue of environmental pollution by better management of industrial waste.

Technology development for preservation & value addition of matured coconut water

The parts of its fruit like coconut kernel and tender coconut water have very wide global market through different levels of product manufacture and export. Matured Coconut water (MCW) is a by-product in all coconut related industries, which is rich in energy sources and can be consumed as a drink. It is one of nature's perfect packages as a health drink, particularly to overcome problems related to body dehydration, but unfortunately in India the coconut water is seldom used by the industries for product making while in many foreign countries matured coconut water is more exploited commercially through different types of drinks, concentrates, formulated products etc. The market of coconut water in India has all long suffered

a handicap as the water's shelf life lasts barely a few hours once decanted from the harvested coconut. Moreover, many coconut producing companies are facing environmental issues to address the disposal of coconut water which is disposed currently as industrial effluent. Hence Proper technology development is needed for the value addition of the MCW which can lead to better income generation through the by-product utilization and also to solve the environmental issues related to pollution. In this scenario a project sponsored by Coconut development Board has been initiated, which is focused on (a) the development of a need based technology for preservation of coconut water by suitable in situ processing and (b) value addition of coconut water through product diversification. The project is in progress and the design and fabrication of the prototype processing unit is in completion stage which will be demonstrated before user industries for commercialization.

Industrial linkages for sponsored projects

During the last year many industrial projects were undertaken for need based collaborative research in identified thrust areas. The services offered for the industry were product development & validation, quality and processing related issues, fine tuning of the newly developed formulations etc. Some of the major beneficiaries were: M/s. Tata chemicals, M/s. Pankajakasthuri Herbals India Limited, M/s. KSE Limited etc. Collaborative research projects were also initiated on identified areas with manufacturing industries.

BIOACTIVES AND ITS APPLICATION IN HEALTH

Diindolylmethane derivatives inhibit the cervical cancer cells growth by inhibiting cell migration, angiogenesis and p38 Mitogen-activated protein kinases (MAPK) activation

Cancer cells needs a good blood supply to provide itself with food and oxygen and to remove waste products. Angiogenesis means the growth of new blood vessels and cancer cells initiate this process by producing the initiator Vascular Endothelial Growth Factor (VEGF). Anti angiogenic compounds help to block this process by inhibiting the secretion of VEGF and thus inhibiting the tumour cells from growing their own blood vessels. Anti-angiogenesis has become the focus of study for controlling cancer recurrence and metastasis. Malignant cells possess the ability to invade and metastasize in addition to uncontrolled proliferation and inhibition of this process also have potential in cancer drug discovery. The activity of many anticancer drugs is achieved through the activation of MAPK pathway and p38 MAPK has a major role in the activation of Bax translocated to the mitochondria and can interact with p53 to trigger apoptosis or induce cell cycle arrest. The effects of two potential diindolyl methane compounds (DIM-1 and DIM-4) in reducing the cell migration, inhibiting angiogenesis and activation of p38 MAPK in cervical cancer cells have been studied. The results indicated that DIM derivatives have the potential to reduce cell migration as revealed by scratch wound assay, reduced VEGR and phosphorylation p38 MAPK expression by western blot analysis. Thus the compounds have promising potential to be developed as anticancer compounds.

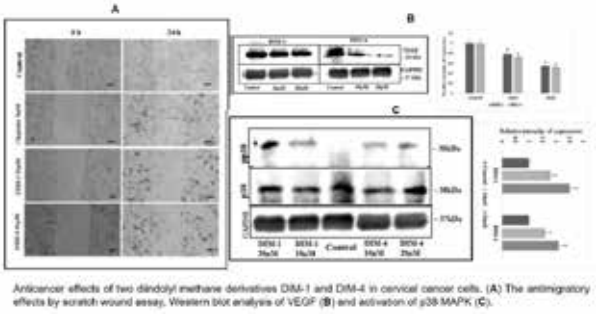


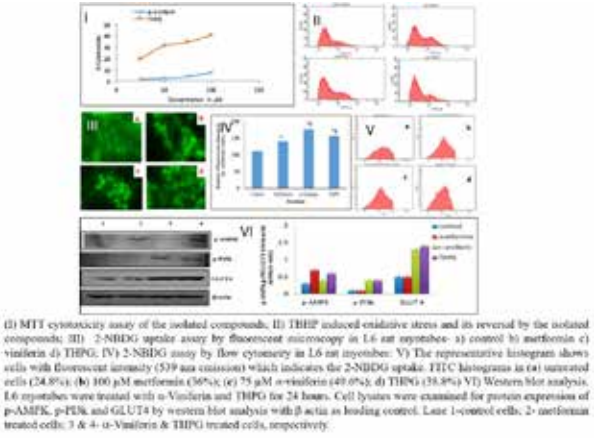
Figure 3: Anticancer effects of two dindolyl methane derivatives

Antidiabetic potential of two resveratrol oligomers isolated from the stem bark of Hopeaponga in skeletal muscles cell lines.

The oxidative stress stimulated pathways is recognized to be related with the onset of diabetes and its complications, which is the actual cause of the morbidity and mortality connected with diabetes. In diabetic conditions, along with other factors, oxidative stress is also stated to be accountable for the impaired insulin secretion and glucose consumption

in peripheral tissues. It is reported that diabetic complications can be prevented by the inhibition of ROS production or its neutralization. Antioxidant treatments have established favourable effects in animal models of diabetes. Conversely, these effects were not deciphered in larger clinical trials proposing the necessity for new and more proficient antioxidants, aiming multiple factors of diabetes and its complications. Therefore, an effective antioxidant having antidiabetic properties will be an assuring remedy for the treatment of both diabetes and its complications. There has been an upsurge in the usage of plant extracts or their active components for care and wellbeing requirements over the last few years.

The current study had screened two resveratrol based compounds (α–Viniferin and THPG) isolated from the stem bark of Hopea ponga from Dipterocarpaceae family for their antioxidant as well as antidiabetic potential. Both the compounds were showing decreased TBHP induced ROS production in skeletal muscle cell lines (Fig 1). The effect of glucose uptake performed by 2-(N-(7-Nitrobenz-2-oxa-1,3-diazol-4-yl) amino)-2-deoxyglucose (2-NBDG) in L6 myoblast were measured by fluorescent microscopy and flow cytometry. The compounds, α-Viniferin and THPG showed 2-NBDG uptake of 49.6% and 38.8% respectively. By examining the molecular pathway through which the compounds elicit their glucose uptake potential, it was observed that both the compounds mainly

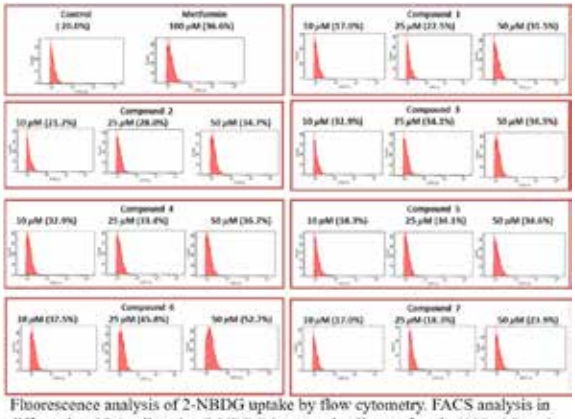


(I) MTT cytotoxicity assay of the isolated compounds. II) TBHP induced oxidative stress and its reversal by the isolated compounds; III) 2-NBDG uptake assay by fluorescent microscopy in L6 rat myotubes- a) control b) metformin c) viniferin d) THPG. IV) 2-NBDG assay by flow cytometry in L6 rat myotubes. V) The representative histogram shows cells with fluorescent intensity (539 nm emission) which indicates the 2-NBDG uptake. FITC histograms in (a) untreated cells (24.8%); (b) 100 µM metformin (36%); (c) 75 µM α-viniferin (49.6%); d) THPG (38.8%) VI) Western blot analysis. L6 myotubes were treated with α-Viniferin and THPG for 24 hours. Cell lysates were examined for protein expression of p-AMPK, p-PI3k and GLUT4 by western blot analysis with β actin as loading control. Lane 1-control cells, 2- metformin treated cells; 3 & 4- α-Viniferin & THPG treated cells, respectively.

Figure 4: MTT cytotoxicity assay

Hypoglycemic Potential of Acylphenols Isolated from the Stem Bark of Myristicafatua in rat myobalsts

Phytochemical investigation on the stem bark of *Myristicafatua* led to the isolation of new compounds that enhances 2-deoxyglucose uptake in L6 myotubes and demonstrated some acylphenols isolated from *Myristicafatua* as a natural lead scaffold for the treatment of type II diabetes mellitus. The skeletal muscle is a key player of glucose exploitation in the body and more than 70 % insulin stimulated glucose uptake appears here. Impaired glucose uptake results in an imbalance of glucose homeostasis that leads to T2DM. To study the effect of the isolated natural products on the utilization of glucose in skeletal muscles, MTT assay to evaluate their cytotoxicity in L6 myocytes was primarily carried out. Results revealed that up to 50 μM for 24 h did not produce any sign of cytotoxicity; therefore, 50 μM concentrations of all the isolates were selected for further 2-NBDG uptake studies. Compounds 1 to 5 showed a significant stimulation of glucose uptake by $1.52 \pm 0.13, 1.62 \pm 0.04, 1.65 \pm 0.02, 1.65 \pm 0.56$ and 1.71 ± 0.78 fold, respectively, whereas compound 6 enhanced the uptake by 2.6 ± 0.35 compared with the control. Metformin, as a positive control, showed 1.69 ± 0.02 - fold stimulation of glucose uptake at 100 μM under identical experimental conditions. Further studies are in progress to establish the therapeutic efficacy and safety of isolated molecules, as a promising antihyperglycemic agent from *M. fatua*.



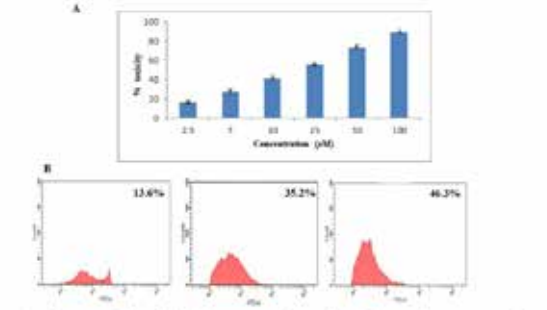
Fluorescence analysis of 2-NBDG uptake by flow cytometry. FACS analysis in differentiated L6 cells using 2-NBDG in control cells, metformin (100 µM) and compounds (1–7) pretreated cells.

Figure 5: Fluorescence analysis of 2-NBDG uptake by flow cytometry

Antidiabetic potential of Promalabaricone B from *Myristicafatua* Houtt. seeds through the modulation of glucose uptake *via* the upregulation of AMPK in L6 myotubes

Promalabaricone B (PMB), an acylphenol was isolated from dichloromethane-soluble extract of the seeds of *Myrisiticafatua* Houtt. There is no detailed phytochemical and pharmacological evaluation of the seeds of *M. fatua*. Incidentally, in the present study, the phytochemical investigation of the seeds of *M. Fatua* have been carried out and resulted in the isolation of six major compounds. Among the isolates, the antidiabetic potential of Promalabaricone B (PMB) has never been investigated. Hence, the detailed investigation on antidiabetic potential of PMB and its underlying molecular mechanisms, leading to improved glucose uptake in L6 skeletal muscle cells have been carried out.

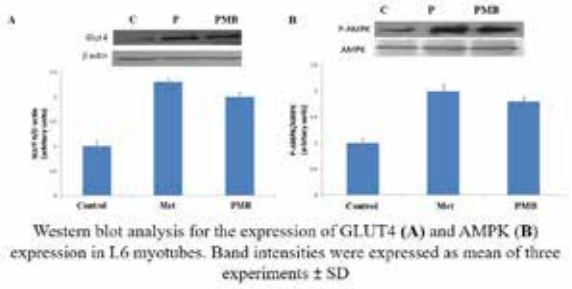
MTT assay was carried out to check the toxicity of PMB in L6 cell lines (Fig1(A)). Potential of PMB to uptake NDDG (a glucose analogue) was carried out by flow cytoimetry analysis. PMB exhibited an enhanced glucose uptake in L6 myotubes with 46.3 % in 2.5 μM, (Fig1(B)). Encouraged with these results, the molecular mechanism of PMB through the upregulation of AMPK was also investigated.



(A) Cytotoxicity of PMB was evaluated in L6 myoblast at varying concentrations. **(B)** 2-NBDG uptake in skeletal myotubes

Figure 6: Cytotoxicity of PMB

To gain further insight into the mechanisms, GLUT4 upregulation in L6 myotubes were examined by immunoblot analysis (Fig2(A)). Further to elucidate the mechanism by which PMB exerts its antidiabetic potential, involvement of AMPK signalling in PMB treated myotubes were examined by immunoblot analysis (Fig 2(B)). The results revealed that PMB promoted the glucose uptake in myocytes by stimulating the translocation and expression of GLUT4.



Western blot analysis for the expression of GLUT4 **(A)** and AMPK **(B)** expression in L6 myotubes. Band intensities were expressed as mean of three experiments ± SD

Figure 7: Western blot analysis

From this, it is clear that PMB can acts as a potential therapeutic option for diabetes treatment, and its hypoglycaemic effect may be mediated by AMPK upregulation and induction of GLUT4 translocation. The results clearly indicate that PMB is a potential therapeutic option for diabetes treatment, and its hypoglycaemic effect may be mediated by a main mechanism that includes AMPK upregulation and induction of GLUT4 translocation.

Palm Neera syrups and immunomodulation

Borassus flabellifer Linn. (Palmyra palm) belonging to *Arecaceae* family grows ubiquitously throughout India and widely distributed in tropical Asian countries. It produces a sweet sap which is called "neera" in local language, and this is taken as a drink or it is processed into palm gur. A process for developing shelf stable neera syrup has already been optimized. Under the objectives of the present project, two formulations based on spices have been developed; one of them is a product prepared from decoction out of dry ginger, long pepper and pepper, which is called as Trikatu in classical preparation; the decoction was made into a syrup using palm neera. Another product was prepared from decoction prepared out of ajwain, jeera and black pepper and made into syrup using palm neera similar to Trikatu syrup preparation.

Immunomodulatory and toxicity studies of plain palm syrup, Trikatu syrup and ajwain syrup was done on Wistar albino male rats and Swiss albino

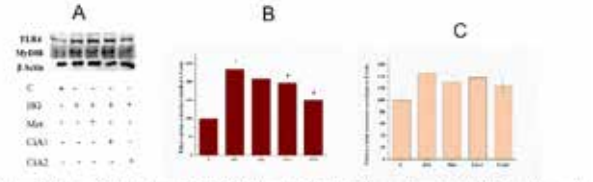
mice. Palm sap enriched syrups were used to draw immunomodulatory effect they had on selectively immune compromised/challenged animals. Trikatu enriched syrup exhibited critical protective role in tests like CTX induced myelosuppression, neutrophil adhesion test, SRBC induced DTH reaction and carbon clearance assay along with Ajwain syrup. Alongside cell mediated immunity, another aspect of the test treatment was the tests that were carried out to find the endurance capacity of the groups. Elevated levels of chemical indicators (lactate and urea nitrogen) of exhaustion in the blood of treatment groups were seen to be lesser than control groups. Trikatu syrup outperformed other test formulations and hence toxicity study was done only for trikatu syrup. Studies showed no signs of cellular damage or depositions. Normal cellular architecture was seen in treatment groups in oral toxicity studies (sub chronic and chronic). These findings show the potential of using trikatu based formulations as immunomodualators.

Generation of potential VEGF, JAK1/JAK2 and IL-17 modulators for rheumatoid arthritis from traditional medicinal plants

The study is aimed at investigating the immunomodulatory effect of hydroalcoholic extract of three traditional medicinal plants *Alpinia galanga* (AGE), *Tinospora cordifolia* (TCE) and *Boerhavia diffusa* (BDE) in LPS (1 µg/ml) stimulated RAW 264.7 macrophage cell line. Polyphenols in the extracts were first identified by retention time and reconfirmed by spiking with the individual standards. The HPLC profile showed that the hydroalcoholic extracts of all three plants (TCE, AGE and BDE) were rich source of polyphenols (chromatogram not shown). The prepared extracts were investigated for cell viability using MTT assay. The extracts ranging from 6.25 to 200 µg/ml (6.25, 12.5, 25, 50, 100 and 200 µg/ml) yielded greater than 90% viability. Various concentrations (25, 50, 100 and 200 µg/ml) were used to study the anti-inflammatory effect of the extracts. The inhibition of NO production was investigated using Griess assay and the expression of inflammatory mediators (TNF-α and IL-6) and anti-inflammatory mediators (IL-10) were investigated using ELISA. Effect of the extracts on LPS induced expression of MMPs was investigated using zymography. The AGE and TCE at concentrations of 50, 100 and 200 µg/ml demonstrated anti-inflammatory activity through the inhibition of NO (Fig 1a and 1b), TNF-α and IL-6 (Fig 2a and 2b) expression and promoted the expression of IL-10 (Fig 3a, 3b) in a concentration dependant manner. Zymographic analysis also showed a significant decrease in MMP activity in treated groups in a concentration dependent manner. Pre-treatment with AGE and TCE exerted blocking effect on LPS induced expression of JAK2 as well as the downstream elements of the pathway including STAT-3 and p-STAT3 analysed using western blotting (Fig 4). The anti-inflammatory action of AGE and TCE can be attributed to its role in JAK-STAT pathway modulation since most of the proinflammatory mediators (IL-6 and MC

Inflammatory signaling in cardiomyocytes usually occurs as an early response to myocardial injury and entails cytosolic and mainly mitochondrial reactive oxygen species overproduction. Apoptosis of cardiomyocytes is one of the important outcomes of hyperglycemia-induced inflammation and oxidative stress in the heart. Diabetic hyperglycemia is accompanied by the increased expression of cytokines in local cardiac myocytes. Activation of Toll-like receptors (TLRs) and the inflammasome complex has recently been proposed to be central in cardiac inflammation and likely in the pathogenesis of DCM. The following steps mainly involve increased activation of the proinflammatory nuclear transcription factor-κB (NF-κB), and the related expression of cytokines like tumour necrosis factor-α (TNFα). TLRs elicit conserved inflammatory pathways culminate in the activation of NF-κB and activating protein-1 (AP-1). TLR2 and TLR4 have a central role in the pathogenesis of diverse heart disorders. Both are strongly upregulated in chronic dilated cardiomyopathy and heart failure, serving as upstream inducers of a large variety of proinflammatory molecules including ICAM-1, chemokines, TNFα, interleukins, HSPs, interferon

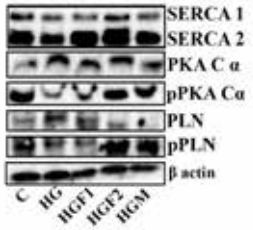
γ (IFNγ), and inducible nitric oxide synthase (iNOS). The inflammasome is a group of multimeric protein complexes composed of a cytoplasmic receptor of the Nod-Like Receptor (NLR) family, an adaptor protein termed ASC (Apoptosis-associated Speck-like protein containing an N-terminal caspase recruitment domain CARD), and procaspase-1. The best characterized complex is the NLRP3 inflammasome, which has been identified in a wide range of cells including macrophages, cardiofibroblasts, and cardiomyocytes. The cJun-N-terminal kinases JNKs are members of the mitogen-activated protein kinases (MAPK) family which are activated under conditions of stress. Likewise, under diabetic conditions, oxidative stress is induced and the JNK pathway is activated.



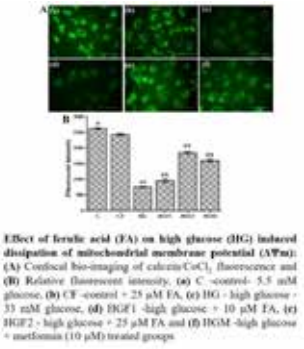
Elucidation of TLR4 and MyD88 levels in high glucose treated H9c2 cells and amelioration with cinnamic acid H9c2 cells were treated with high glucose (33 mM) for 48 h in the presence or absence of various concentrations of cinnamic acid, metformin.A) Representative immunoblot of TLR4 and MyD88. B & C. Densitometric quantification of western blot of protein level normalized to beta actin. C - control, HG - high glucose treated group, Met - HG + metformin, CiA1 - HG + cinnamic acid (100 nM), CiA2 - HG + cinnamic acid (500 nM). Values are expressed as mean ± SEM where n = 6. *p ≤ 0.05 significantly different from the control group. # p ≤ 0.05 significantly different from HG treated group.

Ferulic acid, a common bioactive from fruits ameliorates hyperglycemia induced alteration in H9c2 cells via SERCA/PLN pathway

Oxidative stress and associated complications are the major pathological concerns of diabetic cardiomyopathy (DC). We aim to elucidate the mechanisms by which high glucose (HG) induced alteration in calcium homeostasis and evaluation of the beneficial effect of two concentrations (10 and 25 µM) of ferulic acid (FA). HG was induced in H9c2 cardiomyoblast by treating with glucose (33 mM) for 48 h, and FA was co-treated. $[Ca^{2+}]i$ overload was found increased significantly with HG. For elucidation of mechanism, the SERCA pathway and mitochondrial integrity (transmembrane potential and permeability transition pore) were explored. Then oxidative stress, and cell injury with brain natriuretic peptide (BNP), atrial natriuretic peptide (ANP) and lactate dehydrogenase (LDH) release were assessed. HG caused significant $[Ca^{2+}]i$ overload through down regulation of SERCA2/1, pPLN and pPKA C-α; and upregulation of PLN and PKA C-α and alteration in the integrity of mitochondria with HG. The $[Ca^{2+}]i$ overload in turn caused oxidative stress via generation of reactive oxygen species, lipid peroxidation and protein carbonylation. This resulted in cell injury which was evident with significant release of BNP, ANP and LDH. FA co-treatment was effective to mitigate all pathological changes caused by HG. From the overall results, it is concluded that $[Ca^{2+}]i$ overload via SERCA pathway and altered mitochondrial integrity are the main causes for oxidative stress during HG. Based on the results it is reported that FA could be an attractive nutraceutical for DC.



Effect of ferulic acid (FA) and high glucose (HG) on SERCA/PLN pathway : C-control (5.5 mM glucose) *(lane 1)*, **HG**- high glucose (33 mM glucose) *(lane 2)*, **HGF1**- high glucose + 10 µM FA *(lane 3)*, **HGF2**- high glucose + 25 µM FA *(lane 4)* and **HGM** - high glucose + 10 µM metformin *(lane 5)* treated groups.

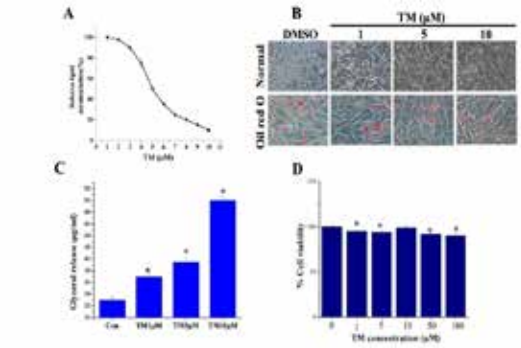


Effect of ferulic acid (FA) on high glucose (HG) induced dissipation of mitochondrial membrane potential (ΔΨm): **(A)** Confocal bio-imaging of calcein/CoCl$_2$ fluorescence and **(B)** Relative fluorescent intensity. **(a)** C -control- 5.5 mM glucose, **(b)** CF -control + 25 µM FA, **(c)** HG - high glucose + 33 mM glucose, **(d)** HGF1 -high glucose + 10 µM FA, **(e)** HGF2 - high glucose + 25 µM FA and **(f)** HGM -high glucose + metformin (10 µM) treated groups.

Anti-obesity effects of 7- methoxy-3-methyl-5-((E)-prop-1-enyl)-2(3,4, trimethoxyphenyl)-2,3-dihydrobenzofuran from Myristica fragrans

Myristica fragrans Houtt (*nutmeg*) is an aromatic evergreen tree of the family *Myristicaceae.* Nutmeg, the actual seed of the tree, is an important nutraceutical, used to treat cold, fever, catarrh, general respiratory ailments, digestion and skin diseases (Iyer et al., 2009). The anti-obesity effect of the bioactive compound, 7- methoxy-3-methyl-5-((E)-prop-1-enyl)-2-(3,4,5-trimethoxyphenyl)-2,3-dihydrobenzofuran (TM) was first identified in our screening of compounds isolated from the mace nutmeg against adipogenesis. To further characterize its anti-obesity activity in detail, a series of *in vitro* obesity-related assays were conducted. In adipogenesis assay, TM blocked the differentiation

of 3T3-L1 preadipocyte in a dose-dependent manner at concentrations 1, 5, and 10 µM. Treatment with TM reduced triglyceride content and enhanced glycerol secretion in a dose-dependent manner. Also, TM suppressed the expression of lipogenic genes, while increasing the expression of lipolytic genes *in vitro* with maximum effect at 10 µM concentration. The anti-adipogenic and anti-lipogenic effect of TM seems to be mediated by the inhibition of PPARγ and C/EBPα expression as shown in *in vitro*, and by the suppression of PPARγ transcription factor activity. Moreover, TM stimulated fatty acid oxidation in an AMPK-dependent manner. Treatment of TM also greatly improved levels of obesity-related biomarkers such as glucose uptake in the differentiated adipocytes, and secretion of adipocytokines such as adiponectin, and resistin. Altogether, these results showed anti-obesity effects of TM on adipogenesis and lipid metabolism *in vitro* and opened the possibility of developing TM as anti-obesity agent.



Effect of TM on lipid accumulation and lipolytic activity in 3T3-L1 adipocytes (A) (The lipid accumulation was measured by Oil red O staining (B) Representative microscopic images of oil red O stained differentiated 3T3 L1 cells was presented (C) The lipolytic activity of TM was determined by measuring glycerol levels secreted in medium (D) Cell viability was checked by MTT assay. * represents significant difference from control groups at P≥ 0.05.

Hyperinsulinemia induced alterations in redox status, bioenergetics and glucose metabolism in HepG2 cells and amelioration with vanillic acid

Insulin resistance (IR) is a crucial factor in the development of type 2 diabetes mellitus (T2DM) and associated complications. The role of hyperinsulinemia on insulin-sensitive target tissues like skeletal muscle, fat, liver explain why IR has this much importance in the pathogenesis of many metabolic disorders. Hyperinsulinemia (HI) is known to be a risk factor for IR. Increased insulin induces glycation and creates IR in HepG2 cells. These effects were paralleled by an increase in oxidative stress and mitochondrial dysfunctions. Vanillic acid (VA) was selected to check its potential against HI induced complications due to its acceptance as a food additive and its biological safety. HepG2 cells were incubated with 1µM insulin for 24 hrs for developing a model of HI. The test material was incubated simultaneously. The effect of VA against high insulin induced glycation, oxidative stress, mitochondrial dysfunctions and impaired redox status in HepG2 cells were studied. VA prevented glycation through decreased Receptor for Advanced Glycation End-products (RAGE) expression and increased dolichyl-diphosphooligosaccharide (DDOST) levels. Further, VA significantly decreased the Reactive Oxygen Species (ROS), Malondialdehyde (MDA) and protein carbonyls level. High insulin also

Figure 1: Immunoblot analysis of proteins involved in glycation pathway. (a) Control cells; (b) Insulin resistant cells; (c) IR+5 µM Vanillic acid; (d) IR+ 10 µM Vanillic acid; (e) IR+ Metformin (1mM).

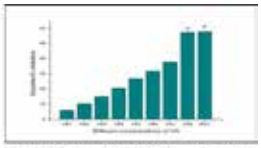


Figure 2. Evaluation of antiglycation effect of vanillic acid in cell free system. VA1-VA8 (Vanillic acid of different concentrations from 5 µM to 500 µM); AG1 (Aminoguanidine (500 µM)

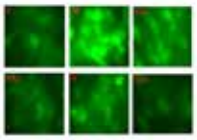


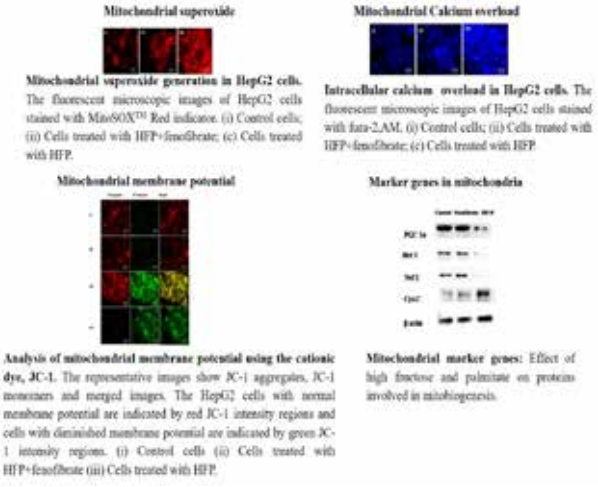
Figure 3: Intracellular reactive oxygen species analysis using DCFDA. (A) Fluorescent microscopic images of HepG2 cells stained with DCFDA. (C) control cells; (IR) insulin resistant cells; (VA1) IR+5 µM vanillic acid; (VA2) IR+ 10 µM vanillic acid; (M) IR+ Metformin (1mM); (NAC) IR+ N-acetyl cysteine (100 nM). Values are expressed as mean+/-SD. * indicates that the mean value was significantly different from control cells (P≤0.05). # indicates mean value was significantly different from IR cells (P≤0.05).

affected the mitochondrial membrane potential and its metabolism through reduced oxygen consumption rates and up-regulation of the energy status of the cells and these effects were reverted by the VA. The role of VA on up-regulation of MFN1 protein and activation of AMPK-sirt1- PGC1-α axis revealed its mitochondrial protection ability during abnormal insulin behaviour. Overall results reveal that HI in insulin sensitive cell alters basic biology and VA is effective against complications arising from HI.

High fructose and palmitate induced surplus TG accumulation leads to mitochondrial dysfunction reveals the possible significance of bioenergetics in the genesis of liver diseases

Non-alcoholic fatty liver disease (NAFLD) is one of the most common chronic liver diseases. Liver plays a pivotal role in metabolic homeostasis and both metabolic inflexibility and insulin resistance are the major factors behind the development of NAFLD, so most of the patients typically have obesity, insulin resistance and diabetes. Genetics, lifestyle and diet are the major driving forces behind the progression. NAFLD is characterized by increased lipid accumulation in hepatocytes and alteration in bioenergetics. The aim of the study was to validate the potential role of high fructose and palmitate, similar to the modern dietary pattern and validate whether the consumption of high fat and carbohydrate could contribute hepatic steatosis, and the molecular mechanism behind the alteration in bioenergetics that leads to the progression of NAFLD.

The findings of the study suggested that the presence



Mitochondrial superoxide generation in HepG2 cells. The fluorescent microscopic images of HepG2 cells stained with MitoSOX™ Red indicator. (i) Control cells; (ii) Cells treated with HFP+fenofibrate; (c) Cells treated with HFP.

Intracellular calcium overload in HepG2 cells. The fluorescent microscopic images of HepG2 cells stained with fura-2,AM. (i) Control cells; (ii) Cells treated with HFP+fenofibrate; (c) Cells treated with HFP.

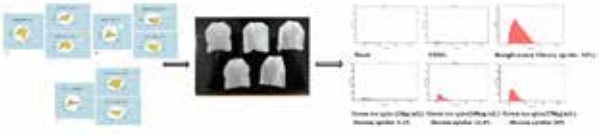
Analysis of mitochondrial membrane potential using the cationic dye, JC-1. The representative images show JC-1 aggregates, JC-1 monomers and merged images. The HepG2 cells with normal membrane potential are indicated by red JC-1 intensity regions and cells with diminished membrane potential are indicated by green JC-1 intensity regions. (i) Control cells (ii) Cells treated with HFP+fenofibrate (iii) Cells treated with HFP.

Mitochondrial marker genes: Effect of high fructose and palmitate on proteins involved in mitobiogenesis.

of high fructose and palmitate caused a significant rise in intracellular triglyceride accumulation and expression of lipogenic proteins in HepG2 cells. Detailed investigation on vital parameters of mitochondria revealed that the production of mitochondrial superoxide was increased significantly together with increased calcium overload and caspase 3 activities. The protein expression of Cyt.C and mitochondrial fission proteins like Drp1 and Fis1 also elevated markedly. The mitochondrial membrane potential deviates from its normal drastically with the down regulation of mitochondrial complex activities, expression of fusion proteins like Mfn2 and Opa1 and marker genes involved in mitobiogenesis. This reveals the significance of bioenergetics in the genesis of NAFLD.

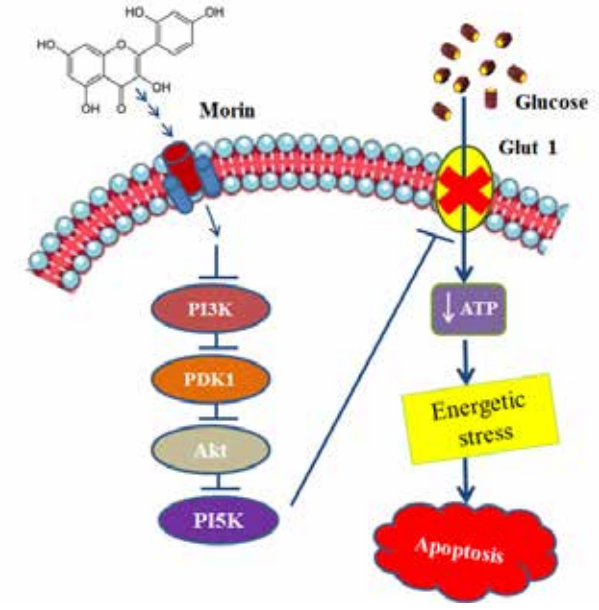
Development and optimization of tea bags based on spices with antidiabetic properties

As a part of the project 'development of spice based functional foods' supported by Spices Board, spice based tea bags were developed by blending green tea with spices and the process was optimized using resonance surface methodology (RSM) for prevention and management of diabetes. The spices that are reported for antidiabetic activity were chosen for the study, and the activity was affirmed by *in vitro* antidiabetic studies. The spices that demonstrated promising activity were blended with green tea after size reduction in different proportions and combination based on RSM and packed in tea bags. The products were analyzed for its phytochemical and antioxidant potential using total phenolic and flavonoid content (TPC & TFC) and DPPH radical scavenging activity. Tea decoction was prepared and was analysed for sensory properties and antidiabetic activity in terms of inhibition of intestinal α-glucosidase, pancreatic α-amylase and anti-glycation properties. Further to this, cytotoxicity of the extracts and its ability to enhance the uptake of glucose by the cells were studied by glucose uptake assay in L6 muscle cells. It was found that the spice based green tea-mix infusions possess good antidiabetic potential in terms of inhibition of amylase, glucosidase and glycation with inhibition of 45 µg/mL, 72 µg/mL and 121 µg/mL, and enhanced glucose uptake in cells from 3.1% (control cells) to 24%.



Effect of morin, a flavonoid, on Warburg effect (SW480 colorectal cancer cells)

The potential of morin, a flavonoid found mainly in members of the Moraceae family was investigated for its nutraceutical potential in prevention and management of life style associated diseases, as a part of the ongoing activity on functional foods and nutraceuticals. Studies suggest that diet play a major role in the onset of colorectal cancer. Preliminary studies indicated that morin possess excellent anticancer potential against colorectal cancer (CRC) and inhibit Warburg effect (the high rates of glucose uptake and lactate production, even in the presence of oxygen, rather than metabolizing pyruvate through the TCA cycle) in cancer cells. Warburg effect happens at a faster rate resulting in quicker rate of ATP production, which in turn helps in the rapid proliferation of cancer cells and greater dependency on glycolysis by cancer cells offers a number of potential therapeutic targets for eliminating cancer cells, very selectively and effectively. Therefore, further studies were carried out to understand the mechanism by which morin interfere with Warburg effect. The treatment of SW480 colon cancer cells with morin could limit the entry of glucose into the cells by decreasing GLUT 1 expression, resulting in a decline in cellular ATP level. The inhibition of GLUT 1 expression represents an effective way of preventing cancer progression by blocking its major nutrient supply, resulting in reduction of the glycolytic flux that further sensitizes cells to undergo mitochondria dependent apoptosis. Further studies by western blotting as well as docking suggested that alteration of Warburg effect in SW480 colorectal cancer cells by morin is mediated through blocking PI3K/Akt signaling pathway. The study suggests that morin may be a promising nutraceutical agent against colorectal cancer. Further *in vitro* and *in vivo* studies are ongoing to confirm the results and to understand the other mechanisms by which morin exhibits anticancer properties.

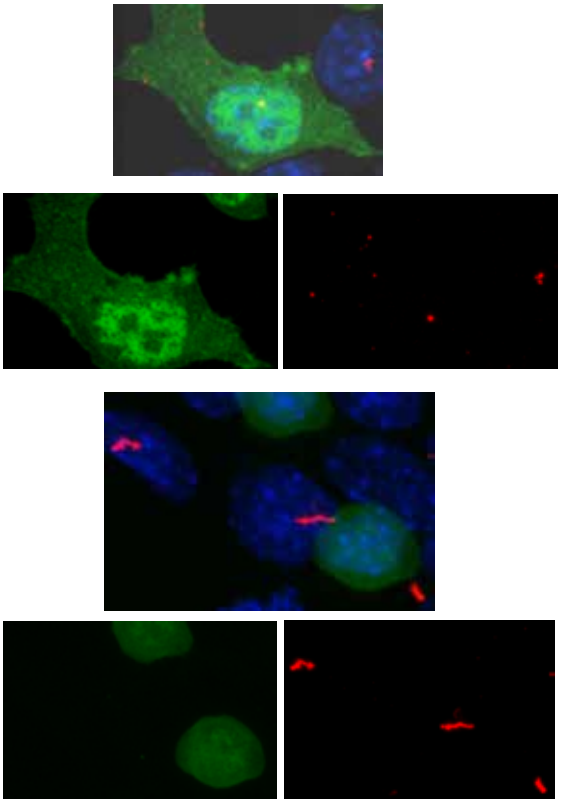


Molecular characterization of functional domain in CC2D2A associated with ciliopathy

Cilia are microtubule-based hair-like organelles that extend from the surface of almost all cell types of the human body. They are involved in numerous physiological and developmental processes. Many proteins are involved in biogenesis of cilia. Mutations in genes encoding these proteins cause multi system disorders called ciliopathies. CC2D2A is a gene localized in basal body. It is required for the cilia assembly. CC2D2A contains 2 coiled coil domains and a C2 domain. Mutations in the gene encoding CC2D2A cause ciliopathies like Meckel and Joubert syndromes. Null mutations in CC2D2A result in lack of protein, thereby lack of cilia, as in Meckel Gruber syndrome (MKS), a lethal ciliopathy. Missense mutations in CC2D2A result in abnormal cilia and are associated with Joubert syndrome (JBS).The patients with JBS survive with blindness and mental retardation. Most of the mutations in C2 domain of CC2D2A are known to affect the function of photoreceptors and brain. However, the role of C2 domain of CC2D2A is not clear. So, the present study analysed the role of C2 domain in CC2D2A in cilia forming cells IMCD-3. Mutations in human are simulated by gene knockdown, using custom made shRNA, in cilia forming IMCD3cells. The effect of gene knockdown is analysed by immunofluorescence and western

blot using antibodies specific to cilia and CC2D2A. The preliminary research indicates that C2 domain is necessary for cilia function. Further, molecular studies to elucidate the role of C2 domain is under progress.

KNOCKDOWN OF C2 DOMAIN SHOWS ABNORMAL CILIA



C2 Domain knockdown cells (Absence of cilia in C2 domain knockdown cells)

MICROBIAL BASED PLANT TONIC

Endophytic bacterial strains mediated plant growth promotion and disease management in rice plants

Rice *(Oryza sativa)* is a major food crop for the people of the world in general and Asians in particular; nearly 90% of the world's rice is produced and consumed in this region. Even though food habits of the people of Kerala had remarkedly changed over the last few decades, but still rice continues to be their staple food. Kuttanad 'The rice bowl of Kerala' is one of the most fertile regions of the world where rice is cultivated below sea level (about 4 to 10 feet). Several microbes associate inside rice plant parts such as root, stem and leaves, known as endophytes that are confirmed as biomass and yield enhancers. In the present study, endophytic bacterial strains were isolated from rice plants of Kuttanad region and screened for plant growth promotion and disease control against sheath blight disease caused by *Rhizoctonia solani*. The strains were selected based on the *in vitro* antagonism against *R.solani* (Fig 1). Among the strains isolated, *Bacillus subtilis* NIIST B616, *Bacillus subtilis* NIIST B627 in individual and their combination exhibited best plant growth promotion (Fig 2) and yield. The strains also exhibited management of sheath blight disease and induction of systemic resistance against this disease individually and in combination is in progress.

As on 28th day, treatment with NIIST B 627 recorded maximum increment of 46.54, 124.49, 196.67 and 283.33 times respectively for shoot length, root length, fresh weight and dry weight over control followed by combination NIIST B 616 + NIIST B 627 (37.42, 105.54, 115.56 and 225 percentage).

Fig 1: *In vitro* antagonism of the test bacterial strains against *Rhizoctonia solani*

Fig 2: Plant growth promotion of different treatments in rice plants after 28DAT

CHEMICAL SCIENCES AND TECHNOLOGY DIVISION

Expertise

Energy: Materials and devices for Photovoltaics, Thermoelectric and piezoelectric generators, Electroluminescent devices, Storage materials, chromogenic materials and smart windows, nanomaterial synthesis and applications, Photoprocesses: Ultrafast spectroscopy, photo-catalysis, computational chemistry, Synthetic Organic Chemistry: Phytopharmaceuticals, active pharma intermediates, Sensors: Anti-counterfeiting, diagnostics, nano-bio sensors, Raman spectroscopy, chemical sensors

Scientist	:	18
Technical staff	:	5
Students	:	134

Facilities

HRTEM (High resolution transmission Electron Microscopy), NMR (Nuclear Magnetic Resonance), AFM (Atomic force Microscopy), MALDI-ToF, Confocal Raman Spectroscopy, Femtosecond Pump-Probe Spectroscopy, Device Fabrication Facility

Ongoing projects (Grant-in-aid, Sponsored, Consultancy and Technical Services, In-house)	:	42
Publications (SCI+non SCI)	:	123
Ph. D. awarded		30

रसायन विज्ञान तथा प्रौद्योगिकी प्रभाग

रासायनिक विज्ञान और प्रौद्योगिकी प्रभाग अणुओं और कार्यात्मक सामग्रियों के विकास और विभिन्न डिवाइस प्लेटफार्मों में उनके अनुप्रयोग पर ध्यान केंद्रित कर रहा है। संस्थान के तीन प्राथमिकता वाले क्षेत्रों का नेतृत्व डिवीजन द्वारा किया जाता है - (1) ऑर्गेनिक और हाइब्रिड इलेक्ट्रॉनिक्स (ऊर्जा उत्पादन और भंडारण, क्रोमोजेनिक कोटिंग्स, ठोस राज्य प्रकाश व्यवस्था, कम्प्यूटेशनल रसायन विज्ञान); (2) फ्लोरोसेंट सामग्री (सुरक्षा अनुप्रयोगों, निदान और इमेजिंग जांच और अल्ट्राफास्ट कैनेटीक्स); (3) फाइटोफार्मास्युटिकल्स एंड ड्रग इंटरमीडिएट (औषधीय पौधों और उन्नत दवा मध्यवर्ती का जैव मूल्यांकन)। डिवीजन संस्थान स्तर पर सीएसआईआर की विभिन्न विषयगत गतिविधियों का समन्वय करता है, जिसका नाम ऊर्जा (पारंपरिक और गैर-पारंपरिक) सामग्री और ऊर्जा उपकरण, हेल्थकेयर और रसायन हैं। इसके अलावा, डिवीजन दो सीएसआईआर मिशन मोड परियोजनाओं में एक प्रमुख भूमिका निभाता है - (1) स्वास्थ्य देखभाल अनुप्रयोगों और (2) न्यूट्रास्युटिकल्स मिशन के लिए नैनोबायोसेंसर्स और माइक्रोफ्लुइडिक्स। यह प्रभाग विभिन्न सरकारी एजेंसियों और उद्योगों द्वारा वित्त पोषित महत्वपूर्ण परियोजनाओं का संचालन भी करता है। उच्च प्रभाव कारक वाले अंतरराष्ट्रीय स्तर पर प्रतिष्ठित पीयर-रिव्यू पत्रिकाओं में 2018-19 में डिवीजन से 100 से अधिक प्रकाशन हुए हैं। वर्ष 2018-19 के दौरान प्रभाग की गतिविधियों और उपलब्धियों पर प्रकाश डाला गया है, साथ ही साथ महत्वपूर्ण घटनाक्रमों के संक्षिप्त सार नीचे दिए गए हैं।

हाइलाइट्स

- डी एस डी एन ए के लेबल-मुक्त पता लगाने के लिए डी एन ए की सहायता की स्व-एक्सफ़ोलीएटेड आयनिक सहसंयोजक कार्बनिक नैनो शीट्स की पुन: असेंबली।
- कैंसर कोशिकाओं में एकीकृत इमेजिंग और चिकित्सा के लिए एक लाइसोसोम-लक्षित फोटोडायनामिक चिकित्सीय एजेंट के रूप में चक्रवाती इरेटा परिसर।
- सेल्फ-रिकवरिंग मेकोनोक्रोम चिरल जैलेटर्स।
- डायकेटोपीरोलोपिरोले-आधारित कम बैंड गैप अर्धचालक में चार्ज वाहक ध्रुवीयता मॉड्यूलेशन।
- सुपरमॉलेक्युलर जेल चरण नियंत्रित [4+2] इलेक्ट्रोप्लेक्स की श्वेत इलेक्ट्रोल्यूमिनेंस की मध्यस्थता के लिए डायल्स-एल्डर फोटोकैक्लोडडिशन।
- समाधान प्रक्रिया योग्य, ZnO पतली फिल्मों पर आधारित दृष्टिहीन यूवी डिटेक्टर।
- ऑप्टोइलेक्ट्रोनिक अनुप्रयोगों के लिए परोव्सकीट उपन्यास लीड-फ्री हाइब्रिड पेरोसाइट सामग्री।
- थियोफिन ऑलिगोमर्स का डिजाइन और संश्लेषण और उनके आत्म-विधानसभा गुणों का अध्ययन।
- विलायक की ध्रुवीयता द्वारा शासित इंट्रामोल्युलर चार्ज और ऊर्जा हस्तांतरण प्रक्रियाएं।
- हाइब्रिड पेरोसाइट नैनोसेक्रिस्टल असेंबली में फोटोल्यूमिनेशन वृद्धि।
- कार्बन आधारित हाइब्रिड नैनोकंपोजिट्स का उपयोग करके सुपरकैपेसिटर के लिए इलेक्ट्रोड सामग्री।
- विषम हाइड्रोथर्मल / सॉल्वोथर्मल संश्लेषण द्वारा 3 डी सब्सट्रेट पर नैनोसंरचित ऑक्साइड।
- MoS2 और MnO_2 का उपयोग कर उच्च गुरुत्वाकर्षण ऊर्जा और शक्ति घनत्व के साथ सिक्का सेल कैपेसिटर नेनो सामग्री।
- डाई-सेंसिटिव सोलर सेल (DSCs) के लिए कॉपर (Cu) आधारित इलेक्ट्रोलाइट्स, कम प्रकाश तीव्रता (CFL / LED) में उच्च वोल्टेज प्राप्त करने में सक्षम।
- स्वदेशी डाई सौर मॉड्यूल निर्माण सुविधा और 30 सेमी × 30 सेमी आकार के प्रोटोटाइप मॉड्यूल।
- पोर्टेबल रामन स्पेक्ट्रोमीटर का विकास
- प्रकाश प्रेरित स्पिन-स्टेट स्विचिंग एंजाइम में जैसे आयरन (III)।
- इलेक्ट्रोक्रोमिक डिवाइस अनुप्रयोगों के लिए ट्राइफेनिलमाइन आधारित जैविक सामग्री।
- सीटी-डीएनए टेम्प्लेट पर फुलरीन समूहों के चिरल स्व-संयोजन।
- एंटीकैंसर, एंटीडायबिटिक और एंटीबायोटिक लीड के रूप में प्रासंगिक रूप से प्रासंगिक अणु।
- प्रचुर मात्रा में प्राकृतिक संसाधनों का चेमोप्रोफाइलिंग और स्थायी उपयोग: औषधीय पौधों से रासायनिक रूप से विविध मचानों के लिए अलगाव और अर्धसूत्रीविभाजन संशोधन।
- जीवन शैली से संबंधित विकारों जैसे मधुमेह, कैंसर और हृदय संबंधी विकारों के लिए फाइटोमोलेक्यूलर की जैविक जांच।
- कैंसर स्क्रीनिंग के लिए- SERS-प्रतिदीप्ति आधारित डायग्नोस्टिक नैनो-कॉकटेल।
- लक्षित दवा वितरण प्रणाली (टीडीडीएस) और चिकित्सीय नैनोप्रोब विकास।

The Chemical Sciences and Technology Division has been focusing on the development of molecules and functional materials and their application in various device platforms. The three priority areas of the Institute are led by the Division – (1) Organic and Hybrid Electronics (Energy generation and storage, chromogenic coatings, solid state lighting, computational chemistry); (2) Fluorescent Materials (Security applications, diagnostics and imaging probes and ultrafast kinetics); (3) Phytopharmaceuticals and Drug Intermediates (Bio-evaluation of medicinal plants and advanced pharmaceutical intermediates).

The Division coordinates various thematic activities of CSIR at the institute level, namely Energy (conventional and non-conventional) Materials and Energy Devices, Healthcare and Chemicals. In addition, the division plays a major role in two CSIR Mission Mode projects – (1) Nanobiosensors and microfluidics for healthcare applications and (2) Nutraceuticals Mission. The Division also undertakes a large number of important projects funded by various government agencies and industries. There have been more than 100 publications from the division in 2018-19 in internationally reputed peer-reviewed journals with high impact factor. The highlights of the activities and achievements of the Division during the year 2018-19 along with brief abstracts of important developments are given below.

HIGHLIGHTS

- DNA assisted re-assembly of self-exfoliated ionic covalent organic nano sheets for label-free detection of dsDNA.
- Cyclometalated IrIII complex as a lysosome-targeted photodynamic therapeutic agent for integrated imaging and therapy in cancer cells.
- Self-recovering mechanochromic chiral π-gelators.
- Charge carrier polarity modulation in diketopyrrolopyrrole-based low band gap semiconductors by terminal functionalization.
- Supramolecular gel phase controlled [4+2] Diels-Alder photocycloaddition for Electroplex mediated white electroluminescence.
- Solution processable, visible blind UV detector based on ZnO thin films.
- Novel lead-free hybrid perovskite materials for optoelectronic applications.
- Design and synthesis of Thiophene oligomers and study of their self-assembly properties.
- Photoinduced intramolecular charge and energy transfer processes governed by polarity of the solvent.
- Photoluminescence enhancement in hybrid perovskite nanocrystal assemblies.
- Electrode materials for supercapacitors using Carbon based hybrid nanocomposites.
- Nanostructured oxides over 3D substrates by heterogeneous hydrothermal/solvothermal synthesis.
- Coin-cell capacitors with high gravimetric energy and power densities using MoS2 and MnO2 nanomaterials.

- Copper (Cu) based electrolytes for dye-sensitized solar cell (DSCs), capable of achieving higher voltages in low light intensities (CFL/LED).
- Indigenous dye solar module fabrication facility and prototype modules of size up to 30 cm × 30 cm.
- Development of a portable Raman spectrometer
- Light induced spin-state switching in an enzyme like iron (III) complex.
- Triphenylamine based organic materials for electrochromic device applications.
- Chiral self-assembly of fullerene clusters on CT-DNA templates.
- Pharmaceutically relevant molecules as anticancer, antidiabetic and antibiotic leads.
- Chemoprofiling and sustainable utilization of abundant natural resources: Isolation and semisynthetic modifications for chemically diverse scaffolds from medicinal plants.
- Biological screening of phytomolecules for life style related disorders such as diabetes, cancer and cardiovascular disorders.
- SERS-Fluorescence based Diagnostic Nano-cocktail for cancer screening.
- Targeted drug delivery system (TDDS) and theranostic nanoprobe development.

ORGANIC AND HYBRID ELECTRONICS

Photovoltaics & Lighting

Indigenous Development of Semi-Automatic Equipment for Dye-Sensitized Solar Module Fabrication

CSIR-NIIST succeeded in indigenizing dye-sensitized solar cell (DSSC) module fabrication equipment for the first time in the country through industry collaboration achieving a cost reduction of 60-70% with respect to the imported ones. CSIR-NIIST, leveraging this expertise, can now transfer intellectual properties related to the fabrication processes to other CSIR-Labs, R&D institutions and industries who are interested in upcoming areas of solar photovoltaics. By contributing towards smart agriculture, energy, urban and water management in a more environment friendly way, we strongly believe our initiative will lead to the improvement in quality of life along with economic and industrial growth in line with the GOI missions such as "Make in India", "Innovate in India", "Clean & Renewable Energy", "Skill India" and "Smart Cities & Villages".

Status of the Development

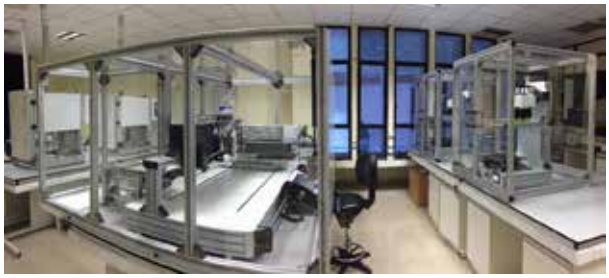
a) Indigenously built an entire DSSC module fabrication line for the first time in the country.

b) Installed and commissioned at CSIR-NIIST in November 2018.

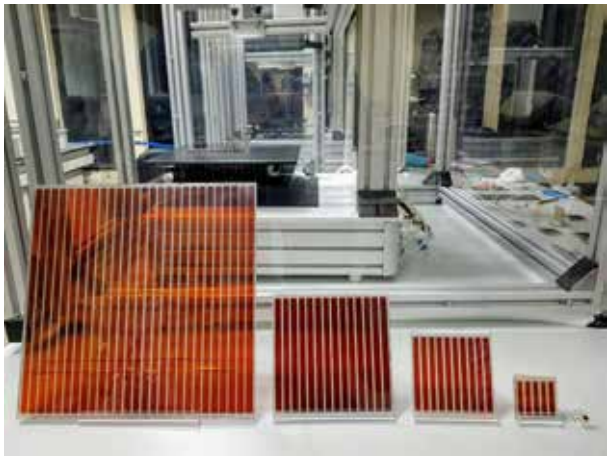
c) More than 60-70 % cost reduction was successfully achieved through indigenization.

d) Successfully demonstrated the production of 5 cm × 5 cm, 10 cm × 10 cm, 15 cm × 15 cm and 30 cm × 30 cm DSC modules.

e) Project funded by DST-SERI initiative included in PMOs high priority implementation category.



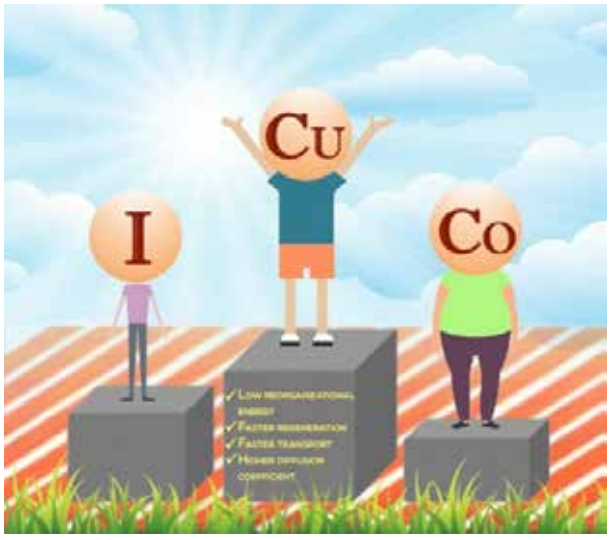
Indigenous DSSC Module Fabrication Facility at CSIR-NIIST



Modules of various sizes fabricated using the system

Resurgence of DSCs with Copper Electrolyte: A Detailed Investigation of Interfacial Charge Dynamics with Cobalt and Iodine Based Electrolytes

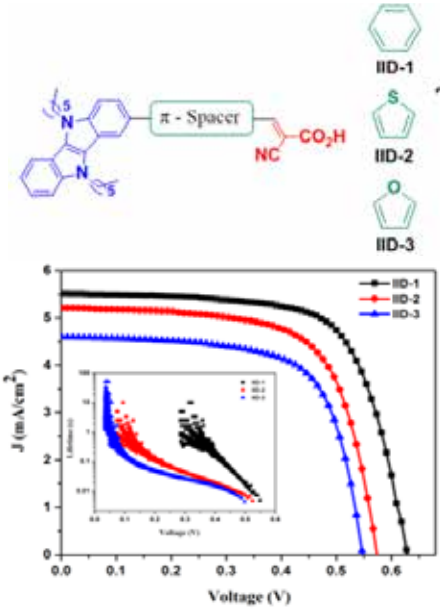
Deploying earth abundant copper as redox mediators in DSCs is found to be a very promising strategy to achieve higher photovoltage and power conversion efficiencies in full sun (100 mW cm^{-2}) and in low/diffused light conditions. Achieving higher photovoltage without compromising the photocurrent helped copper electrolyte to attract much attention among the alternate electrolytes currently employed in DSC. With a very small reorganization energy between Cu(I) and Cu(II) and small molecular size helped copper in achieving unit regeneration efficiency with a driving force as low as 100 mV and a high diffusion coefficient (D_n) leading to a better diffusion length (L_n) and charge collection efficiency (η_{cc}). The mass transport issues were also found to be better in comparison with the cobalt electrolytes. Being inert to silver (Ag) and other electrical contacts used in DSCs, with higher mobilities even in solid state make copper based electrolyte a promising candidate to spearhead the commercialization of dye solar technology. In this regard, a detailed evaluation of the internal electron transfer dynamics is highly essential to understand the limiting processes in these devices. We carried out a one-on-one comparison between copper, cobalt and iodine electrolyte using same dye (LEG4), semiconductor (TiO_2) and electrolyte with



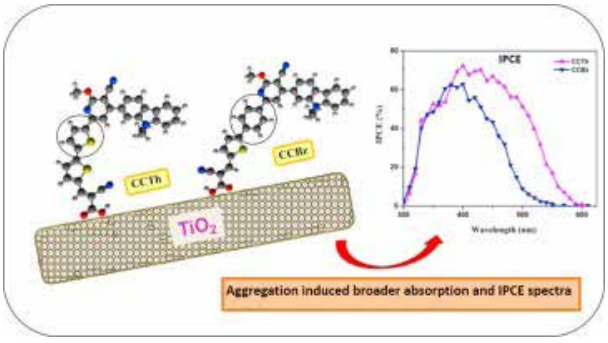
similar additive concentrations in a way to understand the in-depth charge transfer process leading to higher photoconversion efficiencies and also to probe the various deleterious processes taking place in copper devices which gives an opportunity to further improve its performance in future (*Journal of Materials Chemistry A,6*, 22204-22214, 2018).

Indolo[3,2-b]indole Donor-Based D-π-A Dyes for DSCs: Investigating the Role of π-Spacers Towards Recombination

Fused conjugated metal-free organic dyes have become a prominent class of dyes to be used in DSC in recent times by virtue of its better backbone rigidity, efficient charge transport properties, and the opportunity for further structural modifications. We have reported the synthesis and characterization of three metal free D-π-A organic dyes employing indolo[3,2-b]indole as the donor unit. The optical, electrochemical and photovoltaic properties were analyzed in detail as a function of π-spacers employing benzene (IID-1), thiophene (IID-2) and furan (IID-3). Eventually, the best performance was demonstrated by the dye bearing benzene as π-spacer. The role of recombination in determining the photovoltaic performance as a function of the nature of π-spacer was explored in detail using various perturbation techniques carried out on the fabricated devices and its comparison with the results obtained from molecular orbital calculations (*New J. Chem., 43*, 862-873, 2019)



Aggregation Induced Light Harvesting of Molecularly Engineered D-A-π-A Carbazole Dyes for DSCs



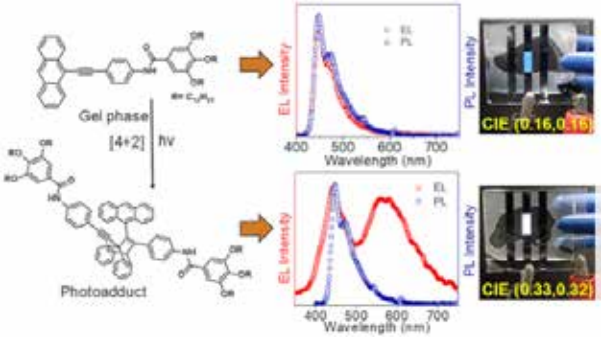
A novel class of metal free organic dyes (CCTh and CCBz) with D-A-π-A configuration, having carbazole as the donor unit and 3-cyanopyridine as auxiliary acceptor replacing conventional benzannulated heterocycles along with variable π-linkers, were synthesized and used in DSC. Both the dyes are having cyanoacrylic acid as the anchoring group with thiophene (CCTh) and phenylene (CCBz) as π-linkers. The photophysical, electrochemical, theoretical and photovoltaic properties of both the dyes were investigated in detail. The absorption spectra of both the dyes on TiO_2 showed

broader absorption bands compared to the solution spectra indicating aggregation in solid state. The aggregation induced emission (AIE) studies indicates J-aggregation for both the dyes. CCTh with thiophene linker showed more broader absorption compared to CCBz, and the photovoltaic performance recorded for CCTh directly indicates better light harvesting ability corresponding to the red shifted J-aggregated states. Hence, solar cells fabricated with CCTh gave a power conversion efficiency of 3.39% and CCBz delivered an efficiency of 2.03% under full sun condition. A detailed investigation of device dynamics has been carried out by employing charge extraction (CE), intensity-modulated photovoltage spectroscopy (IMVS) and open-circuit voltage decay (OCVD) measurements (*Solar Energy,174*, 1085-1096, 2018).

Organic Light Emitting Diodes

Supramolecular Gel Phase Controlled [4+2] Diels–Alder Photocycloaddition for Electroplex Mediated White Electroluminescence

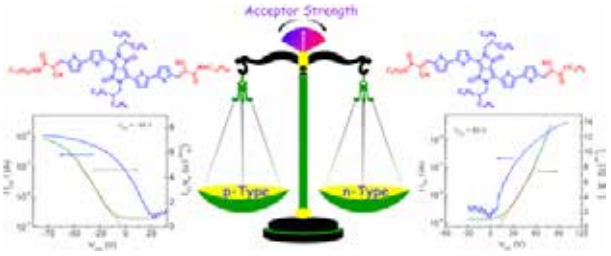
Diels–Alder photocycloaddition of 9-phenylethynylanthracene results in multiple [4+2] and [4+4] cycloaddition products in solution, which can be controlled to form specific products under a restricted environment. We have exploited the gel phase of a 9-phenylethynylanthracence derivative as a confined medium to specifically yield the [4 + 2] cycloadduct in >90% yield. The photocycloadduct (anti-form) exhibited a blue emission with CIE chromaticity of x = 0.16/y = 0.16. Construction of an organic light emitting device with the photocycloadduct, using a carbazole-based hole transporting host, resulted in white light emission with a CIE chromaticity of x = 0.33, y = 0.32. This observation not only highlights the use of gel chemistry to achieve the otherwise difficult to obtain photoproducts but also underlines their potential in optoelectronic device fabrication (*J.Am.Chem.Soc.141*, 5635–5639, 2019).



Organic Field-Effect Transistors (OFETs)

Charge Carrier Polarity Modulation in Diketopyrrolo- Pyrrole-Based Low Band Gap Semiconductors by Terminal Functionalization

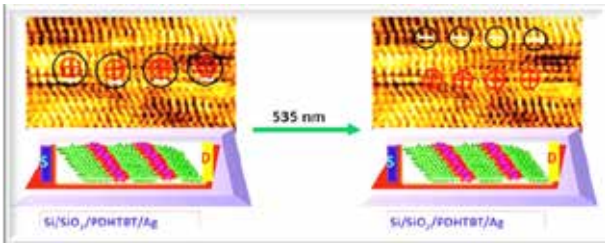
Organic semiconductors with variable charge carrier polarity are required for optoelectronic applications. Synthesis of three novel diketopyrrolopyrrole (DPP)-based D–A molecules having three different terminal groups (amide, ester, and dicyano) and study of their electronic properties have been done. An increase in electron acceptor strength from amide to dicyano leads to a bathochromic shift in absorption. Photoconductivity and FET measurements confirmed that a small increase in acceptor strength can result in a large change in the charge transport properties from p-type to n-type. The molecule with an amide group, DPP–amide, exhibited a moderate p-type mobility (1.3×10^{-2} $cm^2 V^{-1} s^{-1}$), whereas good n-type mobilities were observed for molecules with an ester moiety, DPP–



ester (1.5×10^{-2} $cm^2 V^{-1} s^{-1}$), and with a dicyano group, DPP–DCV (1×10^{-2} $cm^2 V^{-1} s^{-1}$). The terminal functional group modification approach presented here is a simple and efficient method to alter the charge carrier polarity of organic semiconductors (*ACS Appl. Mater. Interfaces 11*, 1088–1095, 2019).

Stimuli Responsive Donor-Acceptor Poly (Dithienyl-Benzothiadiazole) for Efficient Charge Transport Applications

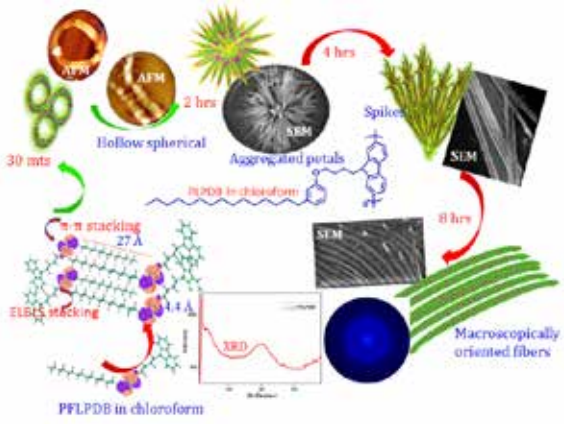
Preparation of D-A copolymers with alternate donor and acceptor fragments as active layer receives special



interest since the intra-molecular charge transfer interaction between the donor and acceptor units can be readily tailored to modulate their electronic band-structures suitable for various device applications. Solution processed conjugated polymer OFETs gathered wide attention in flexible electronics recently due to their low cost and ease of fabrication. Quality of polymer circuits is mainly judged by the mobility of charge carriers through the channel of constituent transistors. Albeit OFETs, fabricated with polymeric active layer, are more flexible and processable than their inorganic counterparts, realize high carrier mobility, require specially designed substrates, and utilize sophisticated working conditions. Furthermore, most of the OFETs derived from ICPs have high threshold voltages (V_{th}) to set the devices ON which apparently raises the power consumption and may ultimately lead to the device breakdown via internal heating. We have reported a facile strategy for the macroscopic ordering of a D-A semiconducting copolymer on the active layer of OFET by varying the combinations of solvents and the concomitant improvement of its OFET performance. Further, photo-responsive switching of the transfer characteristics has been monitored which seems exquisitely useful for the future organic electronic applications. The investigation of a donor-acceptor copolymer of 3-hexylthiophene and benzothiadiazole (PDHTBT) to generate macroscopically oriented nanofibers by self-assembly approach to be used as an active layer for OFET is reported. Aligned polymeric nanofibers with long range order has been confirmed by various microscopic techniques and XRD analyses. OFET containing aligned nanofibers (Si/SiO_2/PDHTBT/Ag) exhibits an impressive field effect mobility of 2.29 ± 0.85 $cm^2 V^{-1} s^{-1}$ with an ON/OFF ratio of ~105 and a low threshold voltage of -0.47±0.05 V at room temperature which relies on the texture and domains generated in the film. Light induced enhancement in charge transport owing to the formation of photo-induced charge carriers postures a facile strategy for the fabrication of high performing plastic electronic devices (*Materials Chemistry and Physics*, 222,52-65, 2018).

Macroscopically Oriented (3-Pentadecyl Phenol) Dangled Fluorene Based Conductive Polymer Through Side Chain Engineering for Microelectronics

Design and development of processable macroscopically ordered intrinsically conducting polymers (ICPs) are receiving overwhelming interest in the academia and industry owing to the emergence of versatile flexible microelectronic devices. These flexible, portable and implantable electronic devices globally are inevitable constituents in every walks of our life style. ICPs are endowed with unique opto-electronic properties, excellent thermo-mechanical stability, low band gap, excellent charge carrier mobility, solution processability, flexible, and light weight. They are portable in nature compared to their inorganic counterparts. Solution processability is one of the most attractive features of organic semiconductors, enabling low-cost, low-temperature, and large-area device fabrication. A solution processable conjugated polymer generally contains two parts - π-conjugated polymer backbone and peripheral solubilizing side chains. The π-conjugated backbone determines the optical, electrochemical and electronic behaviour of

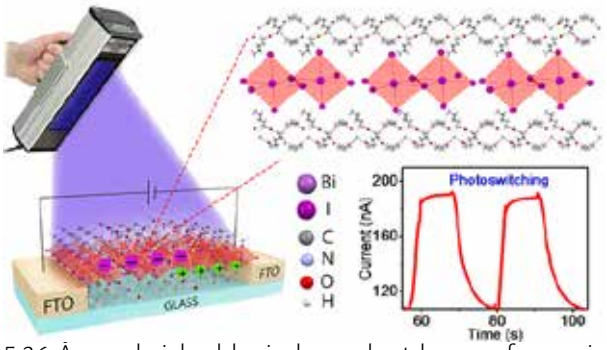


that material. Enhancement in processability and formation of ordered films are projected through side chain engineering. Side chain can enhance the self-assembly process through electrostatic layer by layer assembling (ELBLS) and the back bone can contribute through π-π stacking and hydrogen bonding. In this work, we have designed a solution processable macroscopically oriented conductive polymer of fluorene dangled 3-pentadecylphenol (3-PDP) through side chain engineering and self-assembly approach. Initially, fluorene was coupled with 3-PDP, and then, further subjected to oxidative polymerisation in presence of anhydrous $FeCl_3$. Polarity of the solvent and time on self-assembly process were studied using various microscopic techniques which suggested the formation of macroscopically oriented fibres having 20-30 nm diameter in chloroform with electrical conductivity of (2.1×10^{-2} S cm^{-1}). Optical and electrochemical band gaps were calculated from the studies made from UV-Vis spectroscopy and cyclic voltammetry. Further, we studied its field effect transfer characteristics by fabricating the OFET device having configuration (Si/SiO_2/PFLPDB/Ag) and measured its field effect mobility (1.076 cm^2 V^{-1} s^{-1}) at 1 V and ON/OFF ratio of the device calculated as 1.82×10^3 suggests its application as an excellent active material for organic microelectronics (*Express Polymer Letters, accepted, 2019*).

PHOTODETECTORS

Zero-Dimensional Lead-free Hybrid Perovskite-like Material with a Quantum-well Structure

Low-dimensional perovskites are an emerging class of materials with high stability and excellent optoelectronic properties. Herein, we introduce a novel, lead-free, zero-dimensional perovskite-like material, (1,3-propanediammonium)^{2}Bi2I10·2H2O, for optoelectronic applications. This material exhibited good moisture and thermal stability under ambient conditions. Single-crystal X-ray diffraction analysis revealed a quantum-well structure having the inorganic Bi2I10^4- clusters periodically arranged in the crystallographic "c" axis separated by a distance of



5.36 Å, sandwiched by independent layers of organic cations. The density functional theory calculations showed that the oxygen in water molecules has a significant contribution to the band edges of the material. The photodetector device fabricated using this material showed an efficient charge separation at low voltage (1 V) due to the good electronic conduction between the Bi^{2}I10^4- dimer units (*Chem. Mater.,31*, 1941–1945, 2019).

Low Temperature-processed Zinc Oxide (ZnO) Thin Films for P–N Junction-based Visible-Blind Ultraviolet Photodetectors

Ultraviolet (UV) photodetectors have drawn extensive attention due to their numerous applications in both civilian and military areas including flame detection, UV sterilization, aerospace UV monitoring, missile early warning, and ultraviolet imaging. ZnO-based UV detectors exhibit remarkable performance; however, many of them are not visible-blind, and the fabrication techniques involve a high-temperature annealing step. We fabricated a p–n junction photodiode based on annealing-free ZnO thin films prepared from ZnO nanoparticles (NPs) and N,N′-di(1-naphthyl)-N,N′-diphenyl-(1,1′-biphenyl)-4,4′-diamine (NPB). NPB was chosen due to its transparent nature in the visible region and high hole mobility. The device exhibited responsivity of 0.037 A W^{-1} and an external quantum efficiency (EQE) of 12.86% at 5 V bias under 360 nm illumination. In addition, with no biasing, the device exhibited an on–off ratio of more than 103 and a linear dynamic range (LDR) of 63 dB. A high built-in potential at the ZnO/NPB interface could be the reason for this performance at zero bias (*RSC Adv.,8*, 37365-37374, 2018).

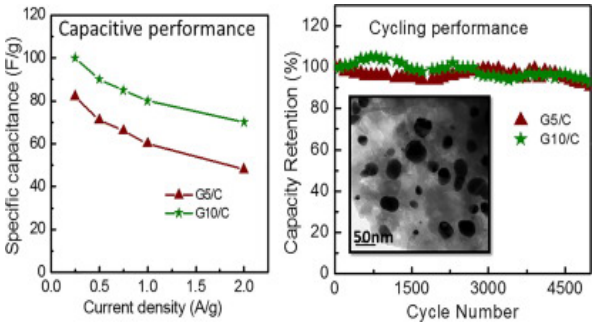
ENERGY STORAGE

Green Synthesized Gold (Au) Nanoparticles Dispersed Porous Carbon Composites for Electrochemical Energy Storage

Gold nanoparticles were prepared successfully by Green synthesis method using the reducing agent extracted from *Solanumnigrum*leaf (SNL). Gold nanoparticles dispersed porous carbon (G5/c and G10/C) composites have been prepared via the pyrolysis of the colloidal gold. The presence of antioxidant compounds in SNL extract is responsible for reducing the gold nanoparticles. The synthesized nanocomposite contained small-sized spherical nanoparticles and porous carbon. Electrochemical energy storage performance of the porous carbon/ gold nanoparticles composite is evaluated in symmetric two electrode configuration. An aqueous symmetric supercapacitor based on G10/C composite electrode exhibited a gravimetric specific capacitance of 80 F g^{-1} at 1 A g^{-1} and retains a cycling stability of 93% even after 5000 charge-discharge cycles (*Materials Science for Energy Technologies*, 2, 389-395, 2019).

Titania Nanotubes Dispersed Graphitic Carbon Nitride Nanosheets as Efficient Electrode Materials for Supercapacitors

The synthesis of a hybrid nanocomposite containing one dimensional (1D) TiO_2 nanotubes supported over a two dimensional (2D) network of conducting graphitic carbon nitride (g-C_3N_4) nanosheets by a facile hydrothermal strategy was carried out. Symmetric supercapacitors based on the hybrid composite electrodes were fabricated and their electrochemical energy storage performances were evaluated and the results were compared with individual component based supercapacitors. The symmetric supercapacitor based on the composite with 1:4 weight ratio of TiO_2 and g-C_3N_4 exhibited a remarkable increase in the specific capacitance in comparison with the individual components. The improvement in electrochemical behavior of the composite sample was attributed to the increase in surface area of the composite due to the spacer effect of titania nanotubes in the 2D g-C_3N_4

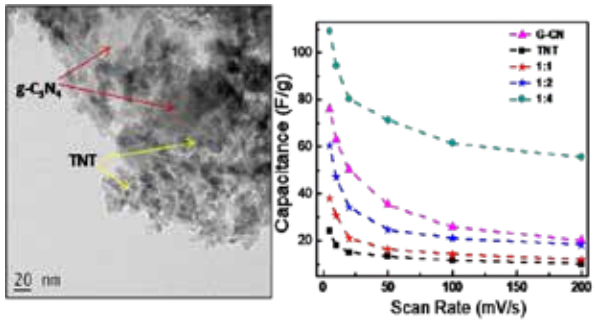


nanosheets (*Journal of Materials Science: Materials in Electronics*, *29 (19)*, 16598-16608, 2018).

One-pot Synthesis of G-C3N4/MnO_2, G-C_3N_4/SnO_2 Hybrid Nanocomposites for Supercapacitor Applications

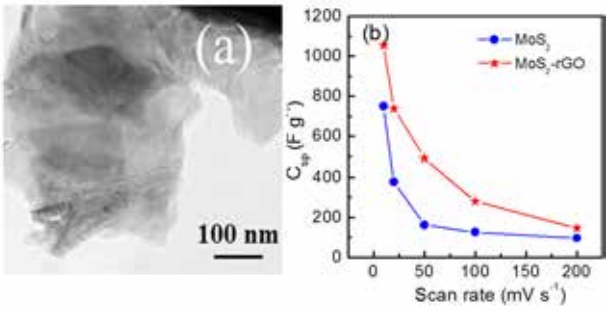
The rapid agglomeration of layered materials during electrochemical process reduces their shelf life and specific capacitance, which can be prevented by the introduction of suitable spacers between the layers. Herein, we report the electrochemical performance of MnO_2 and SnO_2 metal oxides spacers incorporated layered graphitic carbon nitride g-C_3N_4 in symmetric two electrode configuration.

The as-prepared g-C_3N_4/MnO_2 and g-C_3N_4/SnO_2 hybrid nanocomposites act as efficient electrode materials for symmetric supercapacitors. The performance of the electrode materials is compared with that of the bare g-C_3N_4. A remarkable increase in specific capacitance was obtained for the g-C_3N_4/MnO_2 composite electrode (174 F g^{-1}) when compared to the bare g-C_3N_4 electrode (50 F g-1) and g-C_3N_4/SnO_2 electrode (64 F g^{-1}). At a constant power density of 1 kW kg^{-1}, the symmetric supercapacitors based on g-C_3N_4, g-C_3N_4/SnO_2, and g-C_3N_4/MnO_2 electrodes exhibited energy densities of 6.9, 8.8 and 24.1 Wh kg^{-1} respectively (*Sustainable Energy and Fuels*, 2, 2244-2251, 2018).



Organic-inorganic Hybrid Composite Material As a High Performance Supercapacitor Electrode

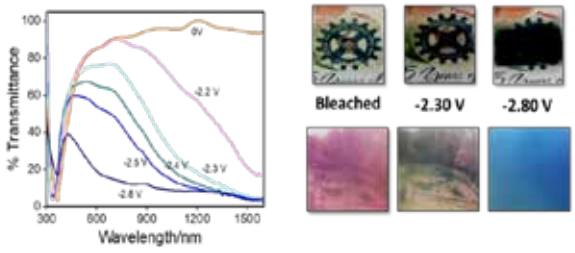
The preparation of few-layered MoS2 nanosheets via exfoliation from bulk for electrochemical application was carried out. A nanocomposite containing MoS2 and reduced graphene oxide (rGO) has been prepared by simple physical mixing. The electrochemical properties of the MoS2 nanosheets and MoS2-rGO nanocomposite have been analyzed in 3-electrode configuration. At a scan rate of 10 mV s^{-1}, the MoS_2 nanosheets and the $MoS_{2-r}GO$ nanocomposite exhibit



specific capacitance values of 375 F g^{-1}, and 739 F g-1 respectively. MoS_2-rGO nanocomposite electrode retains a stability of 96% even after 5000 cycles of continuous charge-discharge at a current density of 6 A g^{-1} (*Vacuum*, 3 *(11)*, 3234-3240, 2018).

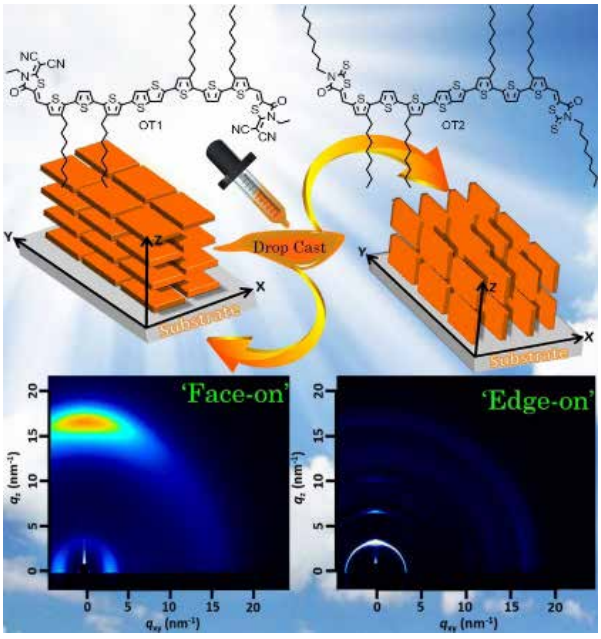
Multifunctional Chromogenic Devices

We developed multifunctional EC glasses where smart function of optical modulation can be combined with energy storage. Recently, we developed technology for voltage dependent spectrally selective modulation with integrated energy storage smart glasses. This technology would enable "smarter" control over the optical/energy throughput. Significant NIR blocking without compromising visible transmission could be achieved with a voltage up ±2.3 V. Complete Vis-NIR blocking is achieved at -2.8 V (Patent application under process).



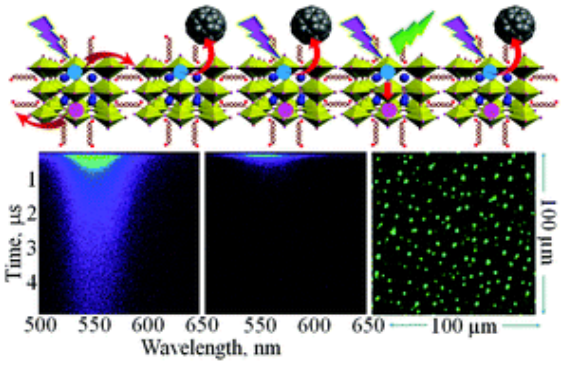
Preferential Face-on and Edge-on Orientation of Thiophene Oligomers by Rational Molecular Design

Precise control over the supramolecular organization of organic semiconducting materials guiding to exclusive face-on or edge-on orientation is a challenging task. In the present work, we study the preferential packing of thiophene oligomers induced through rational molecular designing and self-assembly. The acceptor-donor-acceptor type oligomers having 2-(1,1-dicyano-methylene) rhodanine as acceptor favored a face-on packing, while that of functionalized with N-octylrhodanine preferred an edge-on packing as evident from 2D-grazing incidence angle X-ray diffraction, tapping-mode atomic force microscopy (AFM) and Raman spectroscopy analyses. As an outcome of the preferred orientation, the oligomers exhibited anisotropic conductivity in the self-assembled state, revealed by the conducting AFM experiment (*Chem. Asian J.*, *14*, 963 – 967, 2019).



Photoinduced Photoluminescence Enhancement in Self-Assembled Clusters of Formamidinium Leadbromide Perovskite Nanocrystals

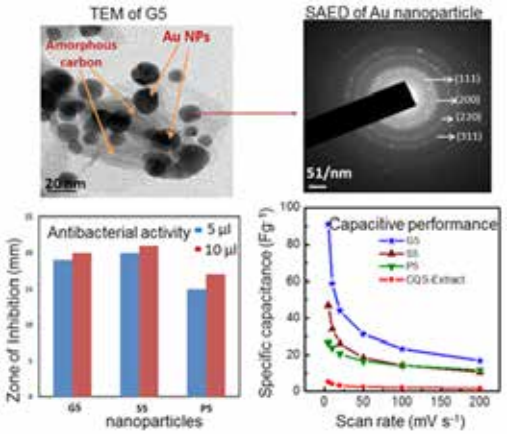
Nanocrystals of formamidinium lead bromide perovskite (FAPbBr3), self-assembled into clusters in powder and film samples, provide a prolonged photoluminescence lifetime which is attributed to the diffusion of charge carriers through interparticle states formed among nanocrystals. Interestingly, the photoluminescence lifetime decreases and the emission intensity increases for the clusters with the increase in the intensity of excitation light. By doping the nanocrystal clusters with C60, we successfully harvested the photogenerated charge carriers.



Nonetheless, at high intensities of excitation, the rate of radiative recombination becomes comparable to that of the electron transfer to C60. Thus, the optimum rate of electron transfer to C60 is accomplished by minimally exciting the self-assembled nanocrystals (*Nanoscale*, *11*, 9335-9340 2019).

Antibacterial and Electrochemical Activities of Silver, Gold, and Palladium Nanoparticles Dispersed Amorphous Carbon Composites

Gold, silver, and palladium (Pd) nanoparticles dispersed amorphous carbon composites have been prepared successfully via Green synthesis method using the reducing agent extracted from *Cissusquadrangularis* stem (CQS). The presence of antioxidant compounds in *CQS* extract is responsible for reducing and capping metal nanoparticles. The

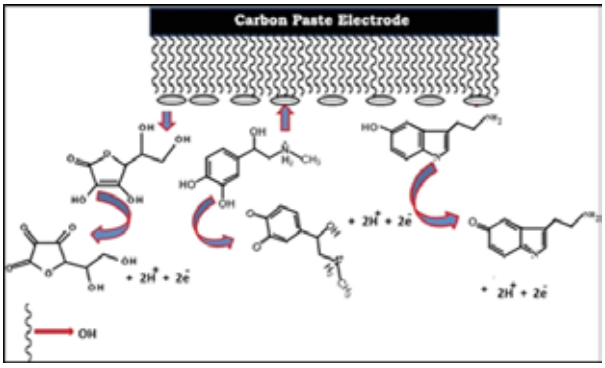


synthesized nanocomposites exhibited excellent antibacterial activity against gram-negative bacterial strains. Electrochemical performance of the composites is evaluated in symmetric two-electrode configuration. At a power density of 1 kW kg^{-1}, the symmetric supercapacitor based on Au nanoparticles dispersed carbon electrodes exhibits an energy density of 7.1 Wh kg^{-1} (*Applied Surface Science*, *479*, 96-104, 2019)

ELECTROCHEMICAL SENSORS

Carbon Quantum Dots Modified Carbon Paste Electrode based Sensor for Selective and Sensitive Determination of Adrenaline

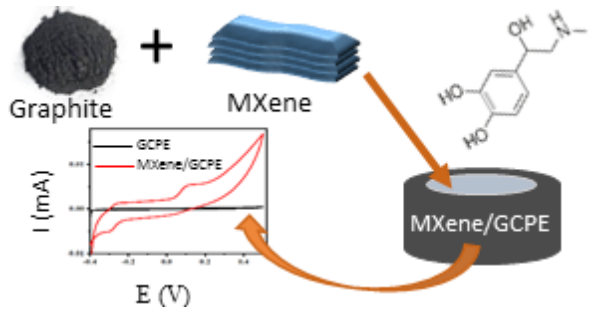
A Carbon quantum dots based carbon paste electrode (CQDs/CPE) was fabricated and used for the determination of Adrenaline (AD) at nanomolar level. This fabricated electrode exhibited very high electrocatalytic activity to the oxidation of Adrenaline in supporting electrolyte (PBS pH 7.4). The scan rate variation studies with the modified electrode revealed that the overall electrode process was controlled by diffusion process. A lower detection



via chronoamperometry. Interference by biological molecules such asserotonin (5-HT) and ascorbic acid (AA) to the electrochemical oxidation of AD on the fabricated electrode were tested. It was observed that with the modified electrode the selective determination of AD was possible. Further, with the fabricated electrode, simultaneous analysis of AA, AD and 6-HT was performed and observed that the overlapped peaks of these analytes on naked electrode were well resolved into 3 peaks with the modified electrode. Along with a decent sensitivity and selectivity, the electrode also showed a higher stability and antifouling nature. The real time application of the projected scheme was proved by employing the said electrode for adrenaline in adrenaline bitartrate injections (*ACS Omega, 4 (4)*, 7903-7910, 2019).

Electrochemical Determination of Adrenaline Using Mxene/Graphite Composite Paste Electrodes

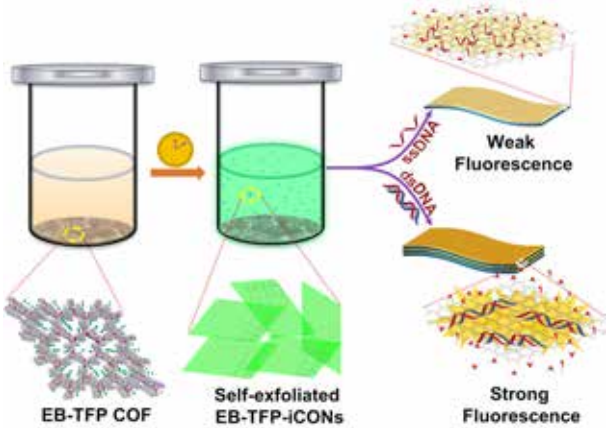
An efficient electrochemical sensor for the detection of adrenaline was fabricated using MXene/Graphite composite paste electrode (MXene/GCPE). The fabricated electrode exhibited a sensitive electrochemical response to adrenaline in phosphate buffer solution of pH 7.4, and its catalytic activity is much higher than that of the bare graphite paste electrode. The electron transfer reaction of MXene/GCPE is a diffusion controlled process. The graph of concentration of adrenaline with the peak current exhibited two linearity, one in the lower and other in the higher concentration range with a detection limit of 9.5 nM. The simultaneous analysis of adrenaline, ascorbic acid and serotonin revealed that the fabricated electrode could separate the overlapped cyclic voltammetric peaks of these ternary mixtures. The electrode was further applied to the determination adrenaline in pharmaceutical samples with percentage recoveries of 99.2%–100.8% (*ACS Applied Materials and Interfaces, 10 (50)*, 43343–43351, 2018).



FLUORESCENT SENSORS

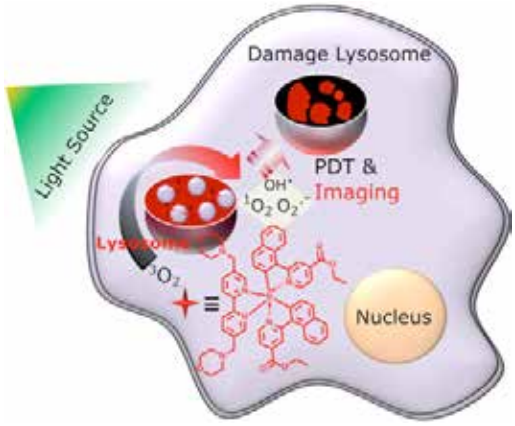
Supramolecular Reassembly of Self-Exfoliated Ionic Covalent Organic Nanosheets for Label-Free Detection of Double-Stranded DNA

Ionic covalentorganic nanosheets (iCONs), a member of the two-dimensional (2D) nanomaterials family, offer a unique functional platform for a wide range of applications. We explored the potential of an ethidium bromide (EB)-based covalent organic framework (EB-TFP) that self-exfoliates in water resulting in 2D ionic covalent organic nanosheets (EB-TFP-iCONs) for the selective detection of double-stranded DNA (dsDNA). In an aqueous medium, the self-exfoliated EB-TFP-iCONs reassemble in the presence of dsDNA resulting in hybrid EB-TFP-iCONs-DNA crystalline nanosheets with enhanced fluorescence at 600 nm. Steady-state and time-resolved emission studies revealed that the reassembly phenomenon was highly selective for dsDNA when compared to single-stranded DNA (ssDNA), which allowed to use the EB-TFP-iCONs as a 2D fluorescent platform for the label-free detection of complementary DNA strands (*Angew. Chem., Int. Ed.,57*, 8443–8447, 2018 *(VIP Article)*.



A Cyclometalated IrIII Complex As a Lysosome-targeted Photodynamic Therapeutic Agent for Integrated Imaging and Therapy in Cancer Cells

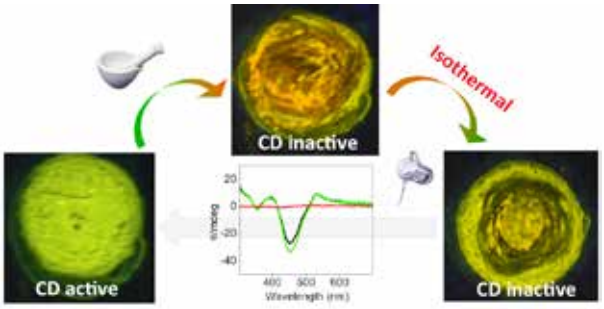
Organelle-targeted photosensitizers having luminescence properties are potential theranostic agents for simultaneous luminecence imaging and photodynamic therapy (PDT). In this work, we report a water-soluble luminescent cyclometalated IrIII complex, Ir-Bp-Ly, as a lysosome-targeted theranostic probe. Ir-Bp-Ly exhibits exceptional photophysical properties, with good triplet-state quantum yield (0.90), singlet oxygen generation quantum yield (0.71 at pH 4), and long lifetime (1.47 ms). Interestingly, Ir-



Bp-Ly localizes mostlyin lysosomes due to the presence of morpholine units, suggesting its potential use as a lyso-tracker. Ir-Bp-Ly displays a notable PDT effect in C6glioma cells, efficiently generating reactive oxygen species owing to close proximity between the energy levels of its triplet state and those of molecular oxygen ($^3O_2$). The mechanism of cell death has been studied through caspase-3/7 and flow cytometry analyses which clearly established the apoptotic pathway (*Chem. –Eur. J.* 24, 10999–11007, 2018, *Hot Article, highlighted with a Frontispiece*).

A Self-recovering Mechanochromic Chiral π-Gelator

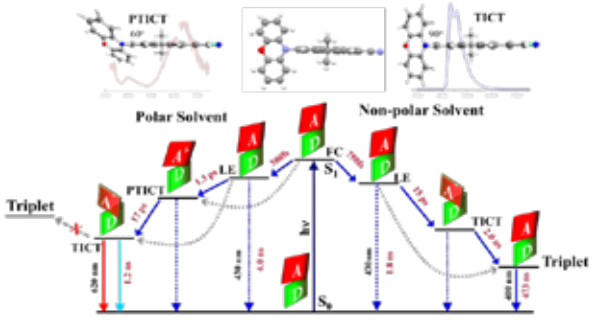
Mechanochromism is a stress-induced perturbation of electronic property in molecular materials. In this work, we demonstrated that the presence of a branched chiral chain facilitates mechanochromic response in a molecular assembly as illustrated with a chiral



oligo(*p*-phenylenevinylene) derived π-gelator (OPVC). OPVC exhibits a reversible mechanochromism; while, the analogous achiral derivative (OPVA) having a linear side chain does not, as established from the fluorescence and circular dichroism studies. The helically twisted chromophore packing in OPVC allows mechanical reorganization of the self-assembly and the associated fluorescence intensity variation at different wavelength positions, in the broad emission spectrum, resulting in a perturbation in the color ratio leading to the observed mechanochromic emission color change. This exciting new finding may have wide ranging implications in the design of stimuli responsive molecular materials with reversible optical properties (*J. Mater. Chem. C*, 7, 1292–1297, 2019).

Direct Evidence of Solvent Polarity Governing the Intramolecular Charge and Energy Transfer: Ultrafast Relaxation Dynamics of Push-pull Fluorene Derivative

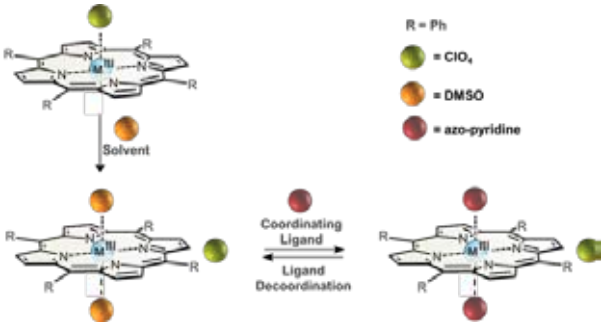
Photoinduced charge and energy transfer are significant photophysical processes controlling the efficiency of the photosynthesis and molecular electronics. Here, the influence of solvent polarity and excitation wavelength on the dynamics of excited state relaxation pathways of push–pull chromophore (PXFCN), where phenoxazine and cyanofluoreneacted



as donor and acceptor respectively, are investigated in detail by using steady state spectroscopy, nanosecond and femtosecond transient absorption spectroscopy and picosecond emission spectroscopy. In acetonitrile (ACN), the steady state emission spectra of PXFCN exhibited three maxima at around 330, 405 and 620 nm covering the complete continuum range (CIE coordinates of 0.32, 0.40) with absolute quantum yield of ≈ 0.12. The aggregation induced emission with an increase quantum yield of ≈ 0.32 was observed in tetrahydrofuran and water mixture due to the formation of ano-aggregates. Interestingly, the steady state and time resolved emission spectra of PXFCN in ACN obtained by exciting at different wavelengths exhibited the occurrence of both the intramolecular charge and energy transfer processes, whereas in cyclohexane (CHX) the emission originated mainly from the local excited state revealing an efficient intramolecular energy transfer. The femtosecond transient absorption spectra in the polar solvent, ACN shows that the excited state relaxation pathway is controlled by solvent stabilized twisted intramolecular charge transfer dynamics limiting the formation of triplet state. However, in the case of CHX, the charge transfer state formed upon photoexcitation decayed to the triplet state by geminate charge recombination. The nanosecond transient absorption spectra manifest the dominant feature of triplet state and the charge transfer state in CHX and ACN respectively and their complete dynamics were obtained. Thus, based on the transient absorption and emission spectra, it is inferred that the intramolecular charge transfer occurring along with the energy transfer is controlled by the polarity of the solvent through conformational changes leading to favourable position yielding the charge and energy transfer between the donor and acceptor moieties (*Phys. chem.chem.Phys.*,*21*, 11087-11102, 2019).

Light Controlled Switching of Spin State of Iron(III)

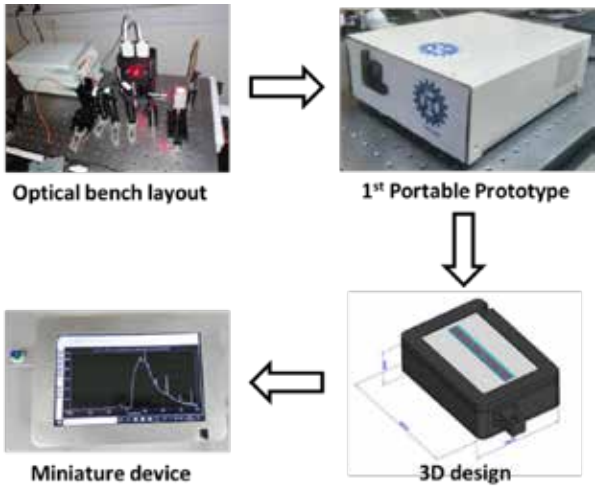
Controlled switching of the spin state of transition metal ions, particularly of FeII and FeIII, is a prerequisite



to achieve selectivity, efficiency, and catalysis in a number of metalloenzymes. An iron(III) porphyrin with a photochromic axial ligand which upon irradiation with two different wavelengths reversibly switches its spin state between low-spin ($S=1/2$) and high-spin ($S=5/2$). The switching efficiency is 76% at room temperature. The system is neither oxygen nor water sensitive, and no fatigue was observed after more than 1000 switching cycles. This system serves as a simple model for the first step of the cytochrome P450 catalytic cycle (*Nature Commun. 9*, Article Number 4750, 2018).

Low Cost Portable Raman Spectrometer

Raman spectroscopy is a versatile spectroscopic technique that probes the characteristic vibrational and rotational transitions of the materials; and thus, provide their fingerprint information. As a result, recently Raman spectroscopy has emerged as a valuable tool for material identification and is impacting many field of basic science and technology. Some of the examples include their utilization for bio-

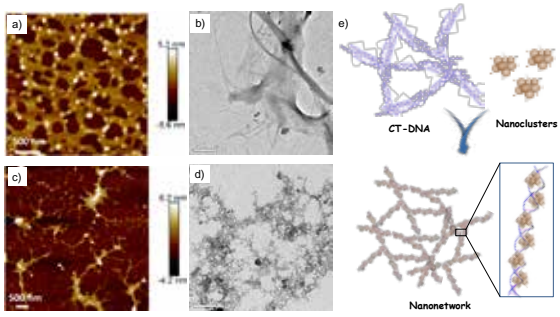


medical fields, ingredient identification in chemical and pharmaceutical industry, quality and monitoring control, detection of food adulterant, counterfeits, drugs / narcotics, explosives, and forensicetc. Though the basic concept of the technique was invented in this country by Sir C. V. Raman in 1928 and got Nobel prize, it is still hard to find any Indian manufacturers and we rely on foreign companies for this technology. To unravel the usefulness of this technology to the problems faced in our society, it is necessary to master this technology. Presently, the institute is having two major programs focusing on the applications of Raman Spectroscopy: (i) a CSIR mission mode project on "Nano-biosensors and Microfluidics for health care" and (ii) an industry collaborated Ph.D. program, (KSCSTE-VINVISH-CSIR-NIIST PAIR (Partnering Academic Industrial Research)) initiated by the Government of Kerala (KSCSTE). In first program, it is targeted to develop methodologies for cancer diagnosis using Raman spectroscopy; whereas in latter, the industry's interest is to establish proof of concept device for fake pill identification. The basic hardware part in both the cases is a portable Raman spectrometer; and to start with, the institute has initiated acquiring the skill and knowledge required for fabricating it. Initially, we tested the feasibility of the drawn optical layout on an optical bench configuration using low cost components which later transferred into the first prototype of portable device. Later, with the support from industry, the design was successfully translated into a robust miniature device.

PHOTOBIOLOGY

Chiral Self-assembly of Fullerene Clusters on CT-DNA Templates

The differential interactions of three mono-substituted fullerene derivatives having pyridinium, aniline or phenothiazine end groups (F-Py, F-An and F-PTz, respectively) with calf thymus DNA (CT-DNA) are explored *via* spectroscopic and imaging techniques. The pyridinium derivative, F-Py gets molecularly dissolved in 10% DMSO-PBS and interact with CT-DNA via groove binding and electrostatic interactions leading to initial condensation of CT-DNA



into micrometer sized aggregates and subsequent precipitation. On the other hand, the aniline derivative F-An, which is reported to form nanoclusters of 3-5 nm size, interact with DNA through ordered, chiral assemblies on CT-DNA template perturbing the highly networked structure of CT-DNA to form nanonetworks, which eventually transform to condensed aggregates. The binding interactions between CT-DNA and F-An nanoclusters were established via UV-Vis, AFM and TEM analyses and the chiral nature of the fullerene nanocluster assemblies on CT-DNA was confirmed through the induced circular dichroism exhibited around 250-370 nm region, corresponding to the F-An nanocluster absorption. In contrast, the phenothiazine derivative, F-PTz, which forms larger nanoclusters of ~70 nm in 10% DMSO-PBS showed only weak interactions with CT-DNA without affecting its network structure. These results demonstrate the role of the hydrophobic-hydrophilic balance in the design of DNA interacting fullerene derivatives in controlling their cluster size and interactions with CT-DNA and have significance in applications such as DNA condensation, gene delivery and dimension controlled nanomaterial fabrication *(Faraday Discuss., 207, 459-469, 2018)*.

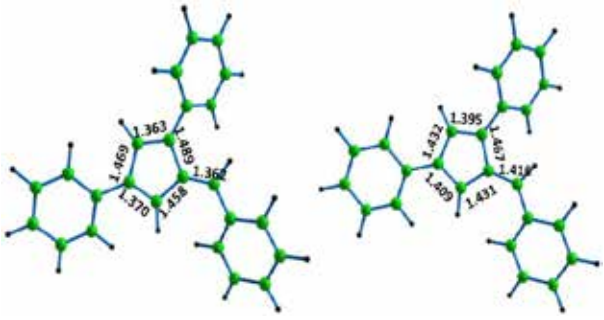
COMPUTATIONAL CHEMISTRY RESEARCH

Computational Chemistry is a branch of theoretical chemistry in which computer assisted simulations of molecules and molecular behaviour are done using mathematical calculations based on fundamental laws. In Computational Chemistry various models, functions and approximations are used for understanding the concepts of molecular binding,

solving chemical problems such as predicting the reaction feasibility and reaction mechanism pathways. CSIR-NIIST activities in this area apply the state-of-the-art computational quantum chemistry methods to study structure and reactivity of molecular systems and made significant original contributions to the electronic structure theory related to structure, bonding and reactivity of organic, organometallic and inorganic systems.

Prediction of Reduction Potential

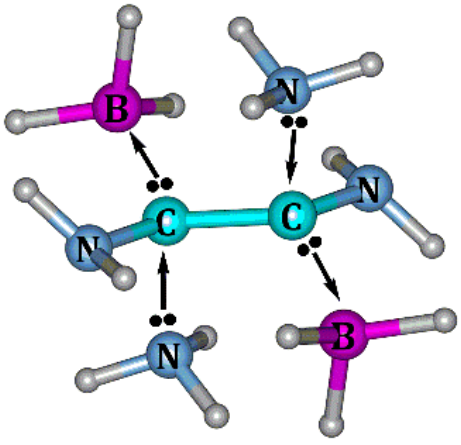
The influence of mono- and multiple substituent effect on the reduction potential (E_0) of 1,3,6-triphenyl fulvenes is investigated using B3LYP-SMD/6-3111G(d,p) level density functional theory. The molecular electrostatic potential (MESP) minimum at the fulvene π-system (V_{min}) and the change in MESP at any of the fulvene carbon atoms (DVC) for both neutral and reduced forms are used as excellent measures of substituent effect from the para and meta positions of the 1,3 and 6-phenyl moieties. Substitution at 6-phenyl para position has led to significant change in E_0 than any other positions. By applying the additivity rule of



substituent effects, an equation in DVC is derived to predict E_0 for multiply substituted fulvenes. Further, E_0 is predicted for a set of 2000 hexa-substituted fulvene derivatives where the substituents and their positions in the system are chosen in a random way. The calculated E_0 agreed very well with the experimental E_0 reported by Godman *et al*. Predicting E_0 solely by substituent effect offers a simple and powerful way to select suitable combinations of substituents on fulvene system for light harvesting applications *(Journal of Computational Chemistry 39.15*, 881-888, 2018*)*.

Hidden Dicarbene Nature of Acetylene

DFT derived molecular electrostatic potential (MESP), 13C), bond order and coordination reactions show δ NMR chemical shift (that alkynes (RCCR) attain 1,2-dicarbene nature during CCR angle bending. Alkyne carbon atoms of bent structures exhibit MESP around 200 ppm typicalδfeatures unique to lone-pair bearing atoms, for carbene centers and large reduction in CC triple bond character. Lone pair bearing atoms of R substituents enhance the carbene character. The bent alkynes can be trapped with Lewis acids (BH_3, BF_3, AlF_3 and $AlCl_3$) as the lone pairs developed on carbon

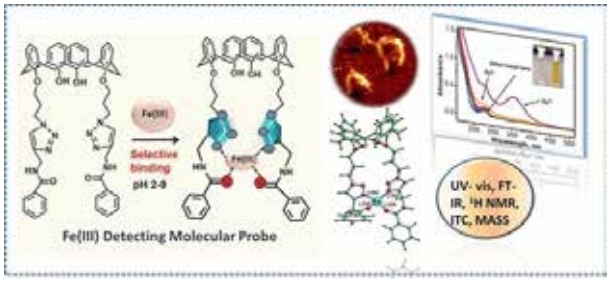


centers provide strong donor type dative bonding. The dative bond gives a formal valence electron count six on carbon and suggests the formation of acceptor type dative bonding to carbon from Lewis base Lewis base) systems (←) (NH_3). Reaction of alkynes with (Lewis acid Lewis base)$_2$ complexes which are (←)Alkyne(←yield (Lewis acid)$_2$ exothermic and exergonic for many cases. These complexes are examples of capto-dative carbon(II) compounds *(ChemPhysChem 19:23* 3266-3272, 2018*)*.

DIAGNOSTICS

Calix[4]arene Based Redox Sensitive Molecular Probe for SERS Guided Recognition of Labile Iron Pool in Tumor Cells

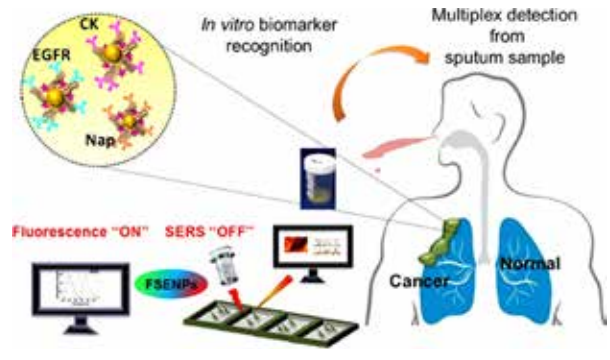
Targeting the intracellular 'labile' iron pool has emerged as a key modulator for cancer progression since the former is responsible for several pathological processes in tumor cells. Herein, we have initiated



a non-fluorescent calix[4]arene based triazole appended molecular probe (PTBC) for redox-specific detection of Fe^{3+} under physiological condition by UV-vis, FT-IR, 1H NMR, HR-MS spectroscopies, ITC and the binding strategy between Calix[4]arene and Fe^{3+} was modelled by DFT calculations. As a new insight, PTBC probe showed significant Raman fingerprint through surface enhanced Raman scattering (SERS) modality revealing the ultrasensitive detection of Fe^{3+} with a LOD of 2 nM. Interestingly, intracellular "iron pool" has been recognized in human lung adenocarcinoma cells (A549) by the PTBC illustrating the distinct Raman mapping. Finally, PTBC imparted cytotoxicity *via* Reactive Oxygen Species (ROS) generation in cellular milieu signifies its capability as a theranostic molecular probe. *(Anal. Chem., 90,* 7148–7153, 2018).

Enzyme-driven Switchable Fluorescence-SERS Diagnostic Nanococktail for Multiplex Detection of Lung Cancer Biomarkers

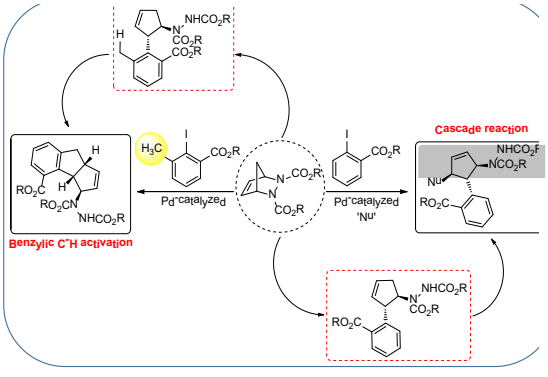
Comprehensive profiling of multiple protein targets plays a critical role in deeper understanding of specific disease conditions associated with high heterogeneity and complexity. In view of this fact, we have developed smart programmable nano architectures, which could integrate clinically relevant diagnostic modalities for the multiplexed detection of most prevalent panel of disease biomarkers present in lung cancer. The multiplex nanoprobes were prepared by attaching dual-functional Raman-active fluorogens onto spherical gold nanoparticles through a peptide linker, Phe-Lys-Cys (FKC), which is engineered with a cathepsin B (cathB) enzyme cleavage site. The enzyme-triggered switchable nanoprobes were utilized for the simultaneous detection of pathologically relevant lung cancer targets by tethering with specific antibody units. The multiplex-targeted multicolor coded detection capability of the antitags was successfully developed as a valid protein screening methodology, which can address the unmet challenges in the conventional clinical scenario for the precise and early diagnosis of lung cancer. *(ACS Appl. Mater. Interfaces 10,* 38807–38818, 2018).



CATALYSIS

Accessing Highly Functionalized Cyclopentanoids via A Cascade Palladation Approach: Unprecedented Benzylic C–H Activation Towards Cyclopentenoindanes

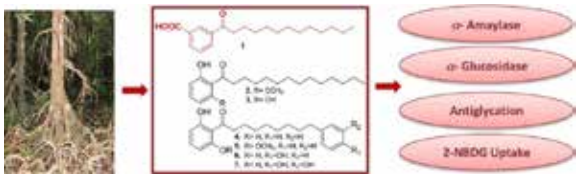
For an organic chemist, the one-step synthesis of molecules with multiple stereocentres at adjacent positions is a laborious task. This objective was realized in part by the use of both organo- and metal-catalysed cascade reactions. Here in, we describe our efforts on the development of a Pd-catalysed tandem reaction for the synthesis of trisubstituted cyclopentanoids from simple and easily available starting materials. A Pd-catalyzed synthesis of 3,4,5-trisubstituted cyclopentenes from diazabicyclic olefins and o-iodobenzoates has been developed.



The hitherto unknown cascade process involves three stages: carbopalladation, oxypalladation and a Tsuji–Trost reaction. We have also developed a facile route involving a novel benzylic C–H activation towards cyclopentenoindane moieties *(Chemical Communications 54(24)* 2982-2985, 2018*)*.

PHYTOCHEMISTRY

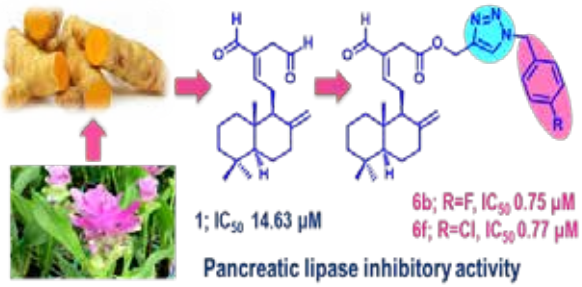
Antidiabetic Potential of Phytochemicals Isolated from Stem Bark of Myristica Fatua Houtt. Var. Magnifica (Bedd.) Sinclair



Phytochemical investigation of the stem bark of Myristica fatua Houtt. led to the isolation of a new compound 1 (3-tridecanoylbenzoic acid), along with six known acylphenols (2–7). All the compounds displayed moderate inhibitory activity on α-amylase and significant activity on α-glucosidase; however, malabaricone B (6) and C (7) were identified as potent α-glucosidase inhibitors with IC50 values of 63.70 ± 0.546, and 43.61 ± 0.620 µM respectively. Acylphenols (compounds 3–7) also showed significant antiglycation property. The molecular docking and dynamics simulation studies confirmed the efficient binding of malabaricone C with *C*-terminus of human maltase-glucoamylase (2QMJ). Malabaricone B also enhanced the 2-NBDG [2-(N-(7-nitrobenz-2-oxa-1,3-diazol-4-yl)amino)-2-deoxy glucose] uptake in L6 myotubes. These findings demonstrate that acylphenols isolated from *Myristica fatua* Houtt. can be considered as a lead scaffold for the treatment of type II diabetes mellitus *(Bioorganic and Medicinal Chemistry 26 (12)*; 3461-3467, 2018*)*.

Discovery of Natural Product Derived Pancreaticlipase Inhibitors: Ligand based Molecular Hybridization Approach

Obesity contributes to the genesis of many metabolic disorders including dyslipidemia, coronary heart

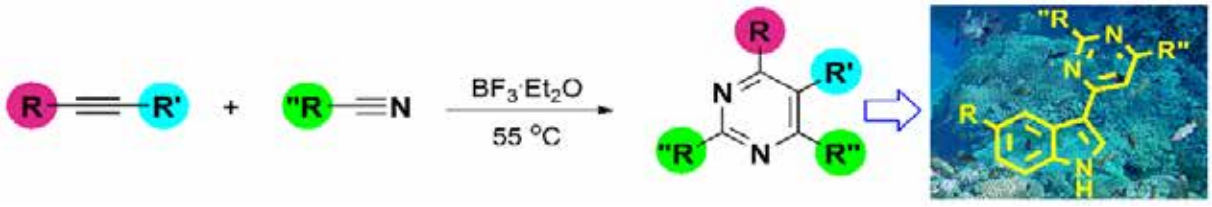


disease (CHD), nonalcoholic fatty liver, type 2 diabetes etc. Pancreatic lipase plays a vital role in food fat digestion and absorption. Therefore, in order to control obesity, inhibition of pancreatic lipase enzyme is the active therapy. In recent times, natural/herbal products also considered as alternative medicine for the treatment of obesity and related disorders. Many plant-based extracts reported for the treatment of obesity and associated diseases.

Based on the traditional applications and its large medicinal properties in a long history of Ayurvedic medicine, we have selected Curcuma amadaRoxb. for the exploration of its inhibition properties against the pancreatic lipase. The rhizomes of *C. amada* are a rich source of essential oils; and more than 130 phytochemicals are isolated which possess various biological properties. Herein, we have isolated the major compound (E)-Labda-8(17),12-diene-15,16-dial. This was synthetically trans-formed to rationally designed triazole appended analogues and evaluated for their pancreatic lipase inhibitory potential. Among the semi-synthetic derivatives, two are identified as most active candidates of the series with excellent PL inhibitory activity slightly higher than that of the positive control Orlistat. This is the first report on the PL inhibitory activity of labdane dial and its semi synthetic triazole appendages *(ACS Med. Chem. Lett., 9 (7)*, 662–666, 2018*)*.

Functionalized Pyrimidines from Alkynes and Nitriles: Application towards Synthesis of Marine Natural Product Meridianin Analogs

Fully substituted pyrimidine synthesis accomplished from alkynes and nitriles via $BF_3.Et_2O$ mediated [2+2+2]



cycloaddition. The substrate scope of the reaction was broad to include terminal alkynes to internal alkynes and aromatic nitriles to aliphatic nitriles. The highlights of our protocol are solvent free-reaction conditions, 100% atom economy and good to acceptable chemical yields. The marine alkaloid, meridianin mimics were synthesized successfully by utilizing this protocol. In general, the developed protocol significantly broadens the scope of diversity of pyrimidines in a simple and convenient process. The pyrimidine analogues were also screened for their broad spectrum of antibacterial property against ten bacteria. Among the derivatives, three compounds have displayed diverse activity on various gram positive and gram-negative bacteria. In particular, 2,4-dimethyl-6-p-tolylpyrimidine has shown excellent inhibition potential against most of the tested organisms with a range of 9 to 21 mm zone of inhibition *(ChemistrySelect, 3,* 6394 – 6398, 2018).

ENVIRONMENTAL TECHNOLOGY DIVISION

Expertise

Environmental Impact Assessment, Water & Wastewater treatment technologies, Solid & Hazardous Waste management, Environmental Biotechnology, Environmental Analytical Chemistry, Persistent Organic Pollutant Monitoring & Mitigation, Dioxin Research, Pollution abatement, Process development & Optimization, Geographic information system applications, Computer-Aided Casting Design by simulation and optimization, Application of Soft Computing Methodologies, Modeling & Simulation.

NABET & MoEF&CC accredited consultant Organisation , NABL Accredited Laboratory
MoEF recognized centre for dioxin analysis

Scientist	:	8
Technical staff	:	3
Students	:	16

Facilities

Dioxin Research, ICP-MS (Inductively coupled plasma mass spectrometry), Wastewater testing and analysis,

Ongoing projects(Grant-in-aid, Sponsored, Consultancy and Technical Services, In-house)	:	16
Publications (SCI+non SCI)	:	4
Ph. D. awarded	:	2

पर्यावरण प्रौद्योगिकी प्रभाग

पर्यावरण प्रौद्योगिकी प्रभाग क्षेत्र के प्राकृतिक संसाधनों के प्रदूषण नियंत्रण और मूल्य संवर्धन के लिए स्वदेशी प्रौद्योगिकियां बनाने में सक्रिय रूप से लगा हुआ है। पर्यावरण प्रौद्योगिकी प्रभाग की संपूर्ण गतिविधियों को इन दो विषयों के अंतर्गत रखा जा सकता है।

इसके अलावा, प्रभागीय गतिविधियाँ अपशिष्ट प्रबंधन, डाइऑक्सिन अनुसंधान और पर्यावरण प्रभाव आकलन (ईआईए) के क्षेत्रों में परिवर्तित होती हैं। अपशिष्ट प्रबंधन के समाधान, अपशिष्ट उपचार, मिट्टी के शोधन आदि में विकसित विशेषज्ञता से, विभाजन ने अत्याधुनिक तकनीकी समाधान और शमन उपायों की स्थिति में एक जगह बनाई है। सीएसआईआर-एनआईआईएसटी एक एनएबीईटी मान्यता प्राप्त है, केरल में एक परामर्शदाता संगठन है, जो दो क्षेत्रों में खनन और बंदरगाहों और हार्बर में मान्यता प्राप्त है। भारत की सरकारी और निजी क्षेत्र द्वारा ईआईए सेवाओं का उपयोग परियोजनाओं की वैधानिक मंजूरी के लिए किया जाता है। सीएसटीडीएच (कॉमन रिसर्च एंड टेक्नोलॉजी डेवलपमेंट हब) DSIR, सरकार द्वारा वित्त पोषित एक परियोजना है। । सीआरटीडीएच अनुसंधान एवं विकास और परामर्श सेवाओं के लिए MSMEs के लिए पर्यावरणीय हस्तक्षेप को सक्षम करने के लिए सुविधाएं प्रदान करता है। एमएसएमई से जुड़े पर्यावरणीय मुद्दों को विकास, हस्तक्षेप और तकनीकी समाधान के लिए लिया जाता है। विनियमों के साथ-साथ संसाधन की खपत को कम करने और संचालन की दक्षता में सुधार करने के लिए तकनीकी सहायता प्रदान की जाती है। सीआरटीडीएच परियोजना के तहत अत्याधुनिक डाइऑक्सिन विश्लेषण सुविधा की स्थापना की गई है। पर्यावरण प्रौद्योगिकी प्रभाग के परीक्षण और विश्लेषण प्रयोगशाला को आईएसओ/आईईसी 17025: 2005 के अनुसार जल, अपशिष्ट जल, डाइअ ऑक्सिन, फुरान और पॉली क्लोरीनयुक्त बिपिनिल्स (पीसीबी) के विश्लेषण के लिए एनएबीएल द्वारा मान्यता प्राप्त है। इसके अलावा, पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय (एमओईएफ़सीसी), सरकार द्वारा सीएसआईआर-एनआईआईएसटी की सिफारिश की गई है। भारत की पर्यावरणीय मंजूरी के लिए डाइऑक्सिन विश्लेषण के लिए एक रेफरल प्रयोगशाला के रूप में। प्रभाग के अधिकांश आरएंडडी परिणाम सफल, नवीन और लागत प्रभावी प्रौद्योगिकियों के रूप में हैं, जो "विनाश के बिना विकास" का एक पारिस्थितिकी तंत्र बनाने के लिए प्रयासरत हैं।

हाइलाइट्स

- 500 किलोग्राम/दिन क्षमता एनआईआईएसटी कॉम्पैक्ट फूड वेस्ट बायोगैस प्लांट त्रिवेंद्रम इंटरनेशनल एयरपोर्ट पर स्थापित।
- एनआईआईएसटी कैंटीन से 2000 लीटर ग्रेवेटर के उपचार के लिए एक पायलट प्लांट स्थापित किया गया था।
- पायलट संयंत्र इकाई (670 किलोग्राम/बैच) के लिए पर्क्लोरेटेट दूषित मिट्टी हटाने का प्रदर्शन किया गया था।
- मिश्रित मिश्रित नगरपालिका ठोस अपशिष्ट के उपचार के लिए बायोडायरीकरण प्रक्रिया को अनुकूलित किया गया।
- गुजरात में झींगा फ़ीड कारखाने के लिए गंध नियंत्रण प्रणाली का डिजाइन
- एनएबीएल मान्यता प्राप्त प्रयोगशाला जल, अपशिष्ट जल, डाइऑक्सिन, फुरान और पॉली क्लोरीनयुक्त बाइफिनाइल (पीसीबी) के विश्लेषण के लिए स्थापित की गई है।
- केरल में नगरपालिका ठोस कचरे के खुले जल से डाइऑक्सिन के उत्सर्जन कारकों का निर्धारण किया गया।
- 22 फरवरी - 25 फरवरी 2019 के दौरान अपशिष्ट उपचार संयंत्र, ब्रह्मपुरम, कोच्चि के ठोस अपशिष्ट डंप यार्ड में आग लगने के दौरान परिवेशी वायु नमूना और अवशिष्ट राख का नमूना लिया गया। ““
- उन्नत ”भारत पर 2019 में एक व्यापक तीन कार्यशालाओं का आयोजन किया गया। नमूनाकरण, नमूना तैयार करने और डाइऑक्सिन और पीसीबी के परिमाणीकरण में प्रशिक्षण आयोजित किया गया था।
- भारतीय दुर्लभ पृथ्वी, कोल्लम, केरल द्वारा ब्लॉकों II और IIEE में समुद्र तट रेत खनिजों के खनन के लिए पर्यावरण प्रभाव आकलन (EIA) अध्ययन किया गया।
- केरल खनिज और धातु लिमिटेड (KMML), चवारा, केरल द्वारा ब्लॉक IV और IVEE में खनन समुद्र तट खनिजों के लिए EIA अध्ययन।

The Environmental Technology Division is actively engaged in creating indigenous technologies for pollution control and value addition to the region's natural resources.

The entire activities of Environmental Technology Division (ETD) can be put under these two topics.

Further, the divisional activities converge into the areas of waste management, dioxin research and Environmental Impact Assessment (EIA). From the expertise developed in waste management solutions, effluent treatment, soil remediation etc., the division has made a niche in state of the art technological solutions and mitigation measures.

CSIR-NIIST is a NABET accredited, Category A consultant organisation in Kerala with accreditation in two areas i.e Mining and Ports & Harbour. The EIA services are used by government and private sector for statutory clearance of projects.

CRTDH (Common Research & Technology Development Hub) is a project funded by DSIR, Govt. of India. CRTDH provides facilities for R&D and consultancy services enabling environmental interventions for MSMEs. Environmental issues associated with MSMEs are taken up for development, interventions and technological solutions. Technical support is provided to meet regulations as well as to reduce resource consumption and improve efficiency of operation. The state of the art Dioxin analysis facility has been established under the CRTDH project.

The Testing and Analysis Laboratory of ETD is accredited by NABL as per ISO/IEC 17025: 2005 for analysis of Water, Waste water, Dioxins, Furans and Poly Chlorinated Biphenyls (PCBs). In addition, CSIR-NIIST has been recommended by Ministry of Environment, Forest and Climate Change (MoEFCC), Govt. of India as a referral laboratory for Dioxin analysis for environmental clearances. Most of the R&D outcomes of the division are in the form of successful, innovative and cost-effective technologies striving to create an ecosystem of "development without destruction".

Highlights

Major activities of the division during 2018-19:

- 500 kg/day capacity NIIST compact food waste biogas plant installed at Trivandrum International Airport.
- A pilot plant for treating 2000 litres of greywater from NIIST canteen was set up.
- Pilot plant unit (670 kg/batch) for demonstrating perchlorate contaminated soil remediation was set up.
- Biodrying process for treatment of mixed unsorted Municipal Solid Waste was optimized.
- Design of odour control system for shrimp feed factory in Gujarat
- NABL accredited laboratory has been set up for the analysis of Water, Waste water, Dioxins, Furans and Poly Chlorinated Biphenyls (PCBs).
- Determination of emission factors of dioxins from open burning of municipal solid wastes in Kerala was carried out.
- Ambient air sampling and residual ash sampling were carried out during the fire broke out at solid waste dump yard of Waste Treatment Plant, Brahmapuram, Kochi during 22nd – 25th February 2019.
- A comprehensive three day workshop "DIOXIN India 2019" on "Advanced training in sampling, sample preparation and quantification of dioxins and PCBs" was conducted.
- Environmental Impact Assessment (EIA) studies carried out for mining beach sand minerals in blocks II and IIEE by Indian Rare Earths, Kollam, Kerala.
- EIA studies for mining beach sand minerals in blocks IV and IVEE by Kerala Minerals and Metals Ltd. (KMML), Chavara, Kerala.

Scale up and field installation of NIIST compact food waste biogas plant

The compact food waste biogas plant developed by CSIR-NIIST was scaled up to 500 kg/day capacity from the existing 50 kg/day level. In a joint project with Airport Authority of India (AAI) and a private industry, Swatch Future Energy Solution (the NIIST technology licensee) a 500 kg food waste-biogas-power unit was installed at Trivandrum International Airport. The project was fully funded by AAI, the scale-up design was provided by NIIST, while the fabrication and installation was done by the industry. The plant is expected to generate around 90-100 cubic meter biogas every day, that will be converted into ~110-120 kWh of electricity. The installation of the plant was completed in Dec 2018 and trial runs are currently in progress. The reactor was designed to treat ~5 kg VS/m3 of the reactor working volume. Around 90 % volatile solid degradation was observed in the reactor. The operation and maintenance of the system for the first one year will be done jointly by CSIR-NIIST and the industry partner.

Large capacity (500 kg/day) food waste biogas plant installed at Trivandrum International airport.

Onsite greywater treatment/recycle system

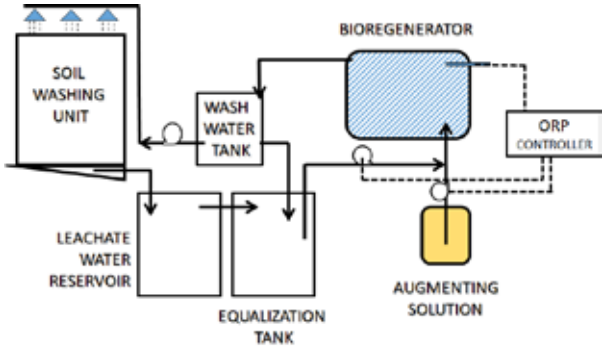
In a new initiative, as part of CSIR FTT project, the development of modular onsite greywater treatment cum recycle system is in progress. This is a combined anaerobic-aerobic system, that will be suitable for treating greywater from canteens, small restaurants, hotels etc. which will find wide application in fast growing cities where sewerage network is limited. Presently at NIIST, as a pilot plant, around 2000 litres greywater from NIIST canteen is treated in this system daily. The entire treatment system consists of an initial equalization tank followed by anaerobic treatment in a baffled anaerobic reactor with biofilm support medium. Around 70% COD reduction happens at this stage. Subsequently, there is a suspended growth aerobic treatment unit, where the residual COD is consumed to discharge limits. The total COD from its initial 1500±30 mg/L level was reduced to ~30 mg/L. The biogas produced from the anaerobic treatment unit can be used as biofuel. The entire treatment system will be consolidated into a single modular unit.

Clear water from canteen wastewater after treatment

Ex-situ-soil bioremediation system for perchlorate

The environmental monitoring and bioremediation of perchlorate, an endocrine disrupting ground water contaminant, is one of the areas of research in the environmental technology division in CSIR-NIIST. In the continuing efforts an ex-situ bioprocess was developed for decontaminating perchlorate contaminated soil in a comparatively short period. In this process the contaminated soil will be flushed with water and the wash water containing perchlorate will be completely treated with a bio-regenerator. The perchlorate free water will be again used for washing fresh lot of soil, and the cycle can be continued. The bio-regenerator (Patent filed) is a fixed film bioreactor inoculated with NIIST developed bacterial consortium (cultures submitted with IMTECH) expressing specific enzymes capable of reducing perchlorate into

chloride and oxygen. Compared with the existing practices for remediating perchlorate contaminated soil, this approach is comparatively fast without any environmental impacts. We have demonstrated the process up to 670 kg soil per batch. Our previous studies have revealed soil contamination of perchlorate at bulk handling sites like perchlorate production units and space R&D labs as one of the sources of ground water contamination. The present process will find application for remediating perchlorate contaminated soil in such places.



Process flow sheet for bioremediation of soil contaminated with perchlorate

Pilot plant unit (670 kg/batch) for demonstrating perchlorate contaminated soil remediation.

A Comprehensive Municipal Waste Management Scheme for Kerala

This project, sanctioned by the Department of Environment and Climate Change, Government of Kerala, in 2016 with a budget of Rs. 1 crore, was completed and report submitted.

This year, experiments to enable scale-up of the biodrying reactor were conducted. The airflow pressure drop is a key parameter that determines the biodrying pile height. Laboratory measurement of pressure drop as a function of air velocity in small diameter vessels containing MSW is not accurate because of air short-circuiting along walls. This effect cannot be avoided except by having large vessels. But filling large vessels to the required pile heights is not feasible in the laboratory. Hence, a new large diameter apparatus with a short pile height was compressed with deadweight was constructed. This apparatus is able to simulate the load because of the pile self-weight above a layer.

The air pressure (mm.wg), P, in terms of air velocity (m/min), v, and specific pile weight kg MSW / m^2, (w) fits the following relation:

$$P = \left(\frac{w^2}{92}\right)(0.2v^2 + 0.26v - 0.00071)$$

Drying and pressure drop determination in 1 m diameter pile with dead weight for compression

The municipal waste management scheme examined various options for waste collection, transport, treatment process and final disposal.

The following collection systems were analyzed and costs (capex and opex) were estimated:

i. Door-to-door collection, wet and dry segregated household and commercial waste
ii. Door-to-door collection, mixed household waste and wet commercial waste;

Bin collection – dry commercial waste;

Option ii. was optimal. Segregated collection was sub-optimal because of the high cost of quality control required to maintain segregation efficiency. Quality control requires the waste collector to inspect waste before collection at each household. This requires time along with corresponding increase in wages. Without adequate control over quality of waste, downstream processing operation that assume segregation, will fail.

Taking Thiruvananthapuram as a model, the waste transport requirements were estimated. The number of garbage trucks and collection auto-rickshaws, the fuel and maintenance costs were calculated.

The optimal treatment process has the following components:

i. BMT plant for biodrying mixed waste and dry waste with recovery of RDF
ii. Anaerobic digestion of waste with power generation, dewatering and drying of digestate

The following options for utilization of RDF were examined.

i. RDF fired thermal power plant
ii. Coal fired thermal power with 10% RDF substitution
ii. Cement kiln with 25% RDF substitution

Option I. is uneconomical since the power plant sizes are small (less than 15 MW) and capital investment is high.

Option II. is far more economical as plant sizes are larger 250MW and generation of toxic dioxins is negligible. RDF produced from across the state can be transported to a single power plant.

Option III. Cement kiln is most economical and environmentally preferred option. Kerala has one cement factory which is a State Government Enterprise. The RDF produced across the state can be used in just one factory. Suitable kiln burner and waste handling system is required for utilization of RDF in cement factory. The capital investment for cement kiln burner replacement is lower than that required for establishing a co-firing thermal power station. There is no residual ash for disposal as ash is incorporated into cement clinker. There is no need for exhaust gas treatment because combustion temperature and gas retention time in cement kiln is sufficient to prevent formation of dioxins.

Biodrying uses self-generated heat to dry unsegregated 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. Process parameters required for design of a biodrying plant for mixed waste were determined in a series of biodrying experiments. Various waste compositions were tested.

Based on experiments conducted, the biodrying process design is formulated as :

a. Waste composition: At least 60% organic waste with 55% to 60% moisture is suitable for biodrying, with moist air. Wastes with lower organic matter and moisture need to be dried physically with unsaturated air.
b. Air to be supplied in upflow mode. Downflow mode causes bottom layers to compact by wetness, causing high back pressure.
c. Air flow required 2 m^3/kg waste/d
d. Saturated air by air recirculation required for wastes with greater than 55% organic content.
e. Drying time 10 d
f. Mixing: Breakup agglomerates without mixing along depth on 4^{th} day.
g. Bed height: 2 to 3 m. Lower bed height when waste moisture content is higher.
h. Air pressure: Varies from 150mm w.g. to 20 mm w.g.
i. Exhaust air odour destruction: Gas biofilter
j. Bed temperature maximum to be limited to 65°C. Mixing breakup of pile agglomerates required if temperature exceeds 65°C. Channels in pile through which dominant air flows occur should be not more than 45°C.

k. Temperature to be held above 50°C for 24h within 4 days of loading for destruction of fly larvae as they hatch.

The Government of Kerala has decided to set-up Waste-to-Energy (WtE) plants at 8 locations in Kerala, although our analysis concludes that it is a not a cost-effective option. One 11.8 MW Waste-to-Energy plant at Brahmapuram in Kochi is in the advanced stage of project approvals. The plant has Biodrying BMT to produce RDF, followed by Air-fed gasification type power generation. The waste handling capacity is 500 tpd. The power costs from the plant are in the range of Rs.15 per kWh. The cost of treatment is Rs.3.27 per tonne MSW. Purchase of power at higher cost subsidizes waste treatment cost. The implied subsidy for the Kochi WtE plant is Rs.9.3/kWh and Rs.6.2/kg RDF. In comparison, the option of utilization of RDF produced in cement factory has implied subsidy of Rs.2.0/kg RDF. We recommend BMT (Biodrying) Plants at all census towns as the key technology for Kerala.

Odour Control Systems Design and Technology Transfer

M/s. Avanti Feeds Ltd., is the largest manufacturer of shrimp/prawn feed in the country. The company's factory at Valsad, Gujarat has production line of 83 tpd established in 2011, and another 83 tpd production line established in 2014. The raw materials used in feed production are fishmeal, soyameal, fish oil, isopropyl alcohol and other ingredients. The Valsad factory is located in a tight space, with private residential areas around, and hence faces odour complaints. The measurement of odour in some of the exhaust air streams was carried out by NIIST licensee, Elixir Envirosystems Pvt. Ltd. The odour control system designed for the plant comprises

1. Ventilation system for capture of odour emissions
2. Odour destruction system using gas biofilter

- The gas biofilter technology was transferred to M/s AP Engineers Pvt. Ltd. Erode. The company supplies fishmeal manufacturing equipment.
- Preliminary design and investigations were carried out for Elgi Rubber Ltd., for reclaim rubber factory odour control.

NABL accredited Testing and Analysis facility

NABL accredited laboratory for testing and analysis of water/waste water samples ranging from surface water to industrial effluents and for the analysis of Dioxins, Furans and Poly Chlorinated Biphenyls (PCBs) has been set up at CSIR-NIIST. Beneficiaries include industries, hospitals, Govt. Departments & Ministries, regulatory agencies like pollution control boards, hotels, resorts, healthcare units etc.

NABL accredited laboratory for testing and analysis

Setting up of Major Analytical Facility –

Inductively Coupled Plasma Mass Spectrometry for Elemental Analysis

Inductively coupled plasma mass spectrometry ((ICP-MS) is routinely used in many diverse research fields such as earth, environmental, pharmaceuticals, Ayurveda drugs/ formulations, life and forensic sciences and in food, material, chemical, semiconductor and nuclear industries. The high ion density and the high temperature in a plasma provide an ideal atomizer and element ionizer for all types of samples and matrices introduced

by a variety of specialized devices. Outstanding properties such as high sensitivity (ppt–ppq), relative salt tolerance, compound-independent element response and highest quantitation accuracy lead to the unchallenged performance of ICP-MS in efficiently detecting, identifying and reliably quantifying trace elements. The increasing availability of relevant reference compounds and high separation selectivity extend the molecular identification capability of ICP MS hyphenated to species-specific separation techniques. Coupling of Ion chromatograph with ICP - MS enable speciative separation and quantification of As (III), As (V), arsenobetaine, Hg (II), methyl- Hg, Cr (III), Cr (VI) etc. The instrument is serving the ongoing R & D activities of the institute as well as the clients from industries, regulatory bodies etc.

Inductively Coupled Plasma Mass Spectrometer (ICP-MS)

Dioxin Research & Monitoring

CSIR-NIIST has been recommended by MoEFCC as a referral laboratory for dioxin analysis for environmental clearances. We have submitted the report on "Determination of emission factors of dioxins from open burning of municipal solid wastes in Kerala" to Kerala State Pollution Control Board in December 2018. It is the first such study conducted in India. A "Burn Hut" was constructed in the campus and simulated waste combustion studies were carried out using known compositions of municipal solid wastes. Emission factor is the total TEQ of dioxin generated during the combustion of unit quantity of material under consideration. The annual emission inventories can be calculated by multiplying emission factor and activity rate (total quantity of material processed). Copies of report have been provided to MoEFCC, MoHUA and CPCB for necessary policy decision making in scientific solid waste management in the country.

The major findings of the study are

- The average emission factor of dioxins to air and land is **5.1 & 34.71 µg PCDD-F TEQ_{WHO}/ ton of waste** burned based on the emission studies conducted in wet waste (original weight basis) samples.
- A large decrease of dioxin levels in residual ash of dry waste combustion compared to wet waste was observed. It indicates that moisture levels and poor combustion conditions play a major role in enhancing dioxin formation. Further studies are ongoing to understand this phenomenon.
- It is found that 87 % of the total dioxin emitted is present in the residual ash of wet waste and only 13 % is emitted to air.
- The dioxin emission in ambient air in the vicinity of open burning site in Thiruvananthapuram city was found to be 13.04 pg TEQPCDD/F per m^3 of air, whereas it was found to be 0.2 pg TEQPCDD/F per m^3 of air in control samples. The ambient air data is in line with the simulated open burning studies where the stack emission concentration is 18.05 pg TEQPCDD/F per Nm^3 of air.

Simulated waste combustion experiments & isokinetic sampling

CSIR-NIIST conducted ambient air and residual ash sampling during the solid waste dumpyard fire break out at Brahmapuram Plant, Kochi during 22nd – 25th February 2019. The study was taken up suo moto by CSIR- NIIST in view of serious societal implications. The analysis showed higher levels of dioxin emission from dump-yard fire and is in tune with our study report submitted to KSPCB.

The important findings of the study are

- Dioxins were detected and quantified in ambient air, residual ash and sediment samples collected from the premises of waste dumpyard during fire break out.
- The average dioxin levels observed in **ambient air** was found to be **10.3 pg TEQ/m³.** The observed levels are **50 and 10 times higher than reference and field blank data.**
- The average dioxin concentration observed in **residual ash samples** collected from different locations in the fire covered area is **158.5 ng TEQ/kg of ash.**
- The observed dioxin levels in **sediment samples** collected from nearby marsh fields is **6.8 ng TEQ/kg.**
- The total estimated dioxin emitted **= 72 milligram Toxicity equivalence (TEQ).**
- The WHO /FAO maximum tolerable monthly intake of dioxins for humans is 70 picogram TEQ/kg body weight (annual tolerable annual intake for a 65 kg person is 54.6 nanogram TEQ). While only a very small fraction of the dioxins generated reaches humans via the food chain, the total dioxin generated is sufficient to exceed tolerable annual intake of $72 \times 10^{-3} / 54.6 \times 10^{-9} = 1.3$ million persons.

Air and Residual ash sampling at Brahmapuram waste dumpyard

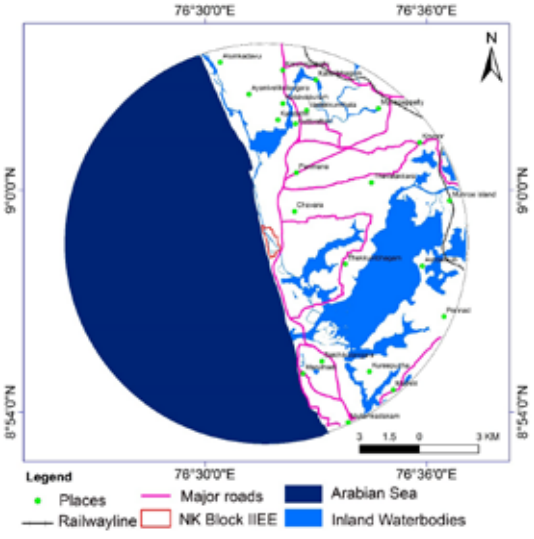
Brahmapuram waste treatment plant (Google Inc.) as on 23/02/2019 and the boundary demarked in red is the fire covered area

VIII. Environmental Impact Assessment (EIA)

Environmental Impact Assessment (EIA) is the systematic identification and evaluation of the potential impacts (effects) of proposed projects, plans, programs, or legislative actions, relative to the physical–chemical, biological, cultural, and socioeconomic components of the environment. It is a mandatory process for obtaining Environmental Clearance (EC) for various developmental projects. EIA promotes sustainable development by identifying environmentally sound practice and mitigation measures for development.

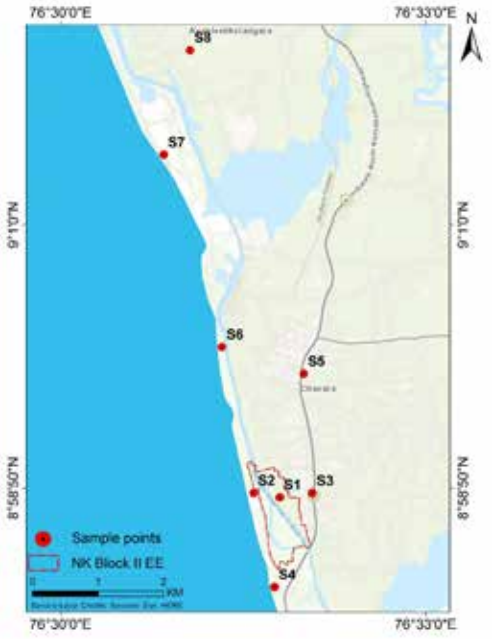
Our major clients, Indian Rare Earths Ltd and Kerala Minerals & Metals Ltd are public sector companies situated in Neendakara Kayamkulam (NK) block of Kollam district, Kerala stretching 22.5 km having beach sand heavy mineral deposits rich in ilmenite, rutile, zircon, monazite, sillimanite etc. EIA studies are mandatory to sustain these industries and these companies rely on us for carrying out these studies. Through our EIA studies, our commitment towards environment protection and monitoring is adhered to while ensuring our customer's meeting the mandatory EIA requirement.

Indian Rare Earths Ltd (IREL) has appointed CSIR-NIIST, to evaluate the environmental impacts that due to the proposed heavy mineral sand mining operations and to work out an environmental management and monitoring programme to prevent, control, minimize or eliminate the adverse environmental impacts envisaged from the mining activity. A purely physical process separates the heavies and no chemicals are used. The mined out heavies are transported to mineral separation plant and the mined voids are refilled simultaneously making space for re-vegetation / resettlement. The mineral concentrate can be transported by trucks or by waterway using NWAI developed TS canal (Figure 1).

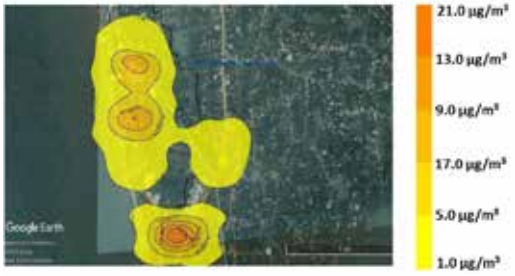


Base map of NK Block IIEE

Fugitive Dust Model (FDM) is used to predict dispersion of particulate matter in the study area and shows incremental increase in pollution due to truck traffic. However, the values are within the CPCB limit prescribed for PM10, which is 100µg/m^3 for 24 hours. The maximum value of PM^{10} for an average of 24 hours was 63 µg/m^3 observed in the buffer zone and minimum value for PM^{10} for an average of 24 hours was 45 µg/m^3. Similarly, SO_2, NO_2 values showed less than 10 µg/m^3 for all stations. The permissible limits for this area as per NAAQ standards for PM^{10} is 100 µg/m^3 and for SO_2 and NO_2 the limits are 80µg/m^3. Thus the observed values for air quality taken over the study period in core and buffer zone is within the permissible limits.



Ambient air quality sampling locations for NK Block IIEE



Dispersion Model for PM_{10} in NK Block IIEE

The mitigation measure includes the feasibility of using floating barges/country boats and pumping through pipes as a means of transporting heavy minerals to IREL plant. The TS canal, a part of national waterway-3 runs through the mine lease of IREL Block II EE (Eastern Extension). The mine lease does not have access to well-developed roads where TS canal can be utilized for the transportation of heavies to MSP. The consultant recommends the transportation of the heavies using floating/towing barges with mechanical articulated connectivity. This will also provide employment to the Project affected people (PAPs). Another option for transportation of heavies is by pumping. A two stage pumping can be used to transport heavy mineral slurry to mineral separation plant. Advantages of barge transport which is eco-friendly as compared to road transport are covered in the report. The EIA study also includes marine ecological survey, socio-economic survey, hydrogeological survey, assessment of impacts and its mitigation measures etc.

During this period NIIST has completed the field studies and submitted the draft final report for carrying out the public hearing which was successfully completed for these two blocks and the final report is submitted online to State Environmental Impact Assessment Authority (SEIAA) for according Environmental Clearance. EIA of NK Block IV of Indian Rare Earths Ltd and submitted final report and this project has accorded Environmental Clearance from SEIAA.

COMPUTATIONAL MODELLING AND SIMULATION

The Computational Modeling and Simulation Group is engaged in interdisciplinary, collaborative research. We develop computational techniques for a wide range of phenomena and processes like metal casting and welding, multiphase hydrodynamics including reaction kinetics of various chemical reactors like rotary kilns, stirred and fluidized bed reactors. Further this group is also involved in development of commercial technical software and providing computational support to other groups within the Institute.

Commercialization of the Virtual Casting Solver Technology

Virtual Casting is a software package for the simulation of solidification process of industrial castings and was developed by CSIR-NIIST which can predict shrinkage defects in a given casting design. 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. This company maintains and markets AutoCAST which uses an integrated easy-to-use environment for casting method design, solid modeling, and simulation. During 2012-13, Virtual Casting Solver was fully integrated with their casting design software AutoCAST, giving birth to FLOW+ module in AutoCAST X1 software. During 2013-19, AutoCAST X1 with FLOW+ has been showcased at various Indian Foundry Exhibitions. Till date, more than 175 licenses of AutoCAST-X1 have been sold to various ferrous, non-ferrous foundries and academic institutes in India by 3D Foundry Tech Pvt. Ltd. CSIR-NIIST is a lead technical partner for this product.

The focus this year has been on the benchmarking and beta testing of the modified mold filling algorithm which includes the pressure head and inertia effects by testing the software code on industrial casting parts. This innovative, realistic & quick mold filling software module has been released in the new version of ***AutoCAST X1-*** **Release 11.10.1.** In addition, network flow based hydraulics model is developed to predict the velocity, flow rate and pressure at the in-gate locations. This code was benchmarked for simple two-ingate casting geometry and the results were presented as a poster at the Seventh International Conference on Solidification Science and Processing (ICSSP – 2018), which was held during November 19-22, 2018 at Thiruvananthapuram.

AutoCAST X1-FLOW+ is available from Shri. Babaprasad Lanka, CEO, 3D Foundry Tech Pvt. Ltd. 507-C, Ecstasy Business Park City of Joy, JSD Road, Mulund (W) Mumbai – 400 080, India. Phone: +91 98921 00072 E-Mail: babaprasad@autocast.co.in

SMART FOUNDRY 2020

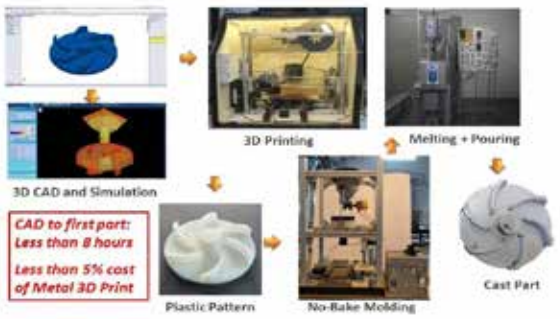
This project was sanctioned during August 2016 for Rs. 8.25 crores from DST under Technology Systems Development Program and with a contribution of RS. 1.25 crores from five private industrial partners and CSIR-NIIST is the overall project coordinator for this project and the amount sanctioned for CSIR-NIIST is Rs. 3.32 crores for a period of three years.

The objective of this project is to develop and demonstrate an ultra-compact SMART Foundry with unique and novel features for economic production of small intricate metal parts of high quality with the following modules by a collaborative initiative by a national network of researchers and entrepreneurs from all over India

- Casting Design and Simulation (for high yield and quality),
- Mold Fabrication (for speed and consistency),
- Efficient Melting and Direct Casting (for energy efficiency),
- Metal Matrix Composite Processing (for advanced applications),
- Data Sensing and Analytics (for optimization and reliability)

The starting point is a 3D model of the cast part which can be created using a solid modeling software or can be given as a STL file from the customer. This is imported into the casting design & simulation software for methods design. The as-cast model is sent to the 3D plastic printer which is a 3D FDM printer with novel features. The plastic pattern is then placed in an adjustable mold box in a semi-automatic mold making set-up into which silica sand mixed with resin and a cross linking agent is poured. After ramming, the mold box is removed and is placed under the bottom pouring melting unit. The melting and pouring unit has add-on facilities for making vacuum induced casting and MMC castings with particle addition and stirring. After shakeout and cleaning, the casting is subjected to quality checking by radiography. In addition, sensors are used in the hardware units for collecting data which is used for on-line and off-line data analytics.

Version 1 of the modular set-up of SMART FOUNDRY was demonstrated at VNIT, Nagpur on 1st September 2018. A SMART Foundry workshop was also conducted during 31st August - 2nd September 2018 at VNIT which was attended by 32 local college teachers, who greatly appreciated the collaborative technology development, and showed interest in joining the SF initiative.



The entire facility can be set up in a 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 replacement parts of costly equipment, metal busts, household appliances and other innovative applications. The new process aims to change the perception of metal casting from "dirty, difficult, and dangerous" to "sustainable, smart, and safe."

MATERIALS SCIENCE & TECHNOLOGY DIVISION

Expertise

Minerals & Metallic Materials, lectronics & Energy Materials, Polymers & Composites, Ceramics, Computational Modeling & Simulation

Scientist	:	19
Technical staff	:	6
Students	:	73

Facilities

XRD (X-ray diffraction), XPS (X-ray photo electron spectroscopy), EM (Scanning electron microscopy), PMS (Physical property measurement system), D XRD (X-ray diffraction), BET (Brunauer, Emmett and teller)

Ongoing projects (Grant-in-aid, Sponsored, Consultancy and Technical Services, In-house)	:	46
Publications (SCI+non SCI)	:	72
Ph. D. awarded	:	11

पदार्थ विज्ञान तथा प्रौद्योगिकी प्रभाग

पदार्थ विज्ञान तथा प्रौद्योगिकी प्रभाग सक्रिय रूप से धातु, चीनी मिट्टी की चीज़ें, पॉलिमर, इलेक्ट्रॉनिक और चुंबकीय सामग्री के क्षेत्रों में उच्च विज्ञान और प्रासंगिक प्रौद्योगिकियों के लिए अग्रणी आर एंड डी गतिविधियों को काटने में शामिल है। इसके अलावा, इस प्रभाग के वैज्ञानिकों द्वारा उच्च गुणवत्ता वाले प्रकाशनों और पेटेंट के लिए अंतःविषय प्रकृति के मौलिक शोध किए जा रहे हैं। इस प्रभाग ने एससीआई पत्रिकाओं में 72 पत्र प्रकाशित किए हैं, जिनमें औसत प्रभाव कारक 3.235 है, जिसमें प्रति वैज्ञानिक प्रभाव कारक 2.904 है और विभाजन को इस वर्ष 3 अमेरिकी पेटेंट प्राप्त हुए हैं।

हाइलाइट्स

- बायोडिग्रेडेबल पॉलीएलैक्टिक एसिड और कॉयर कंपोजिट।
- स्पोक्ट्रोनिक्स और मैग्नेटो-ऑप्टिकल अनुप्रयोगों के लिए डोपेड TiO_2 क्रिस्टल।
- कोण-निर्भर रंग बदलते कोलाइडल फोटोनिक क्रिस्टल सरणियों ।
- डोनर-स्वीकर्ता चार्ज ट्रांसफर स्टैक्स का उपयोग करते हुए सुपरमॉलेक्यूलर ब्लॉक कॉपोलिमर।
- ग्राफीन आधारित झिल्ली के लिए झिल्ली।
- एंजाइम मुक्त, जैव-डीजल में प्रयुक्त खाना पकाने के तेल के रूपांतरण के लिए सिरेमिक उत्प्रेरक प्रक्रिया।
- सिलिका आधारित कार्बनिक-अकार्बनिक संकर फ्लोरोसेंट स्याही।
- कार्बनिक डाई हटाने के आवेदन के लिए आयन-एक्सचेंज संसाधित चुंबकीय नैनो-कंपोजिट-कार्बनिक-अकार्बनिक संकर फ्लोरोसेंट स्याही प्रिंट करने योग्य पदानुक्रमित। निकल नैनोवायर आधारित सेंसर-स्व-चिकनाई द्विदिश कार्बन फाइबर प्रबलित स्मार्ट एल्यूमीनियम कंपोजिट-Ni-B-CeO_2 केंपोसिट कोटिंग्स।
- मैग्नीशियम मिश्र धातुओं पर लंतानम फॉस्फेट कोटिंग्स ।
- धातु कार्बनिक जेल इंटरप्रिट्रेटिंग बहुलक नेटवर्क व्युत्पन्न आंतरिक Fe-N- डोपेड झरझरा ग्रेफाइट कार्बन डी।
- माइक्रो / अल्ट्रा निस्पंदन के लिए सिरेमिक झिल्ली।

MSTD of CSIR-NIIST is actively involved in cutting edge R&D activities leading to high science and relevant technologies in the areas of Metals, Ceramics, Polymers, Electronic and Magnetic materials. In addition, fundamental research of interdisciplinary nature is being carried out by the scientists of this division leading to high quality publications and patents. This division has published 72 papers in SCI journals with an average impact factor of 3.235 with impact factor per scientist being 2.904 and the division has got 3 US patents granted this year.

Highlights

- Biodegradable polylactic acid and coir composites
- Doped TiO_2 crystals for spintronics and magneto-optical applications
- Angle-dependent color changing colloidal photonic crystal arrays
- Donor-acceptor charge transfer stacks using supramolecular block copolymers
- Graphene based membranes for desalination
- Enzyme free, ceramic catalytic process for the conversion of used cooking oil into bio-diesel
- Silica based organic-inorganic hybrid fluorescent ink
- Ion-exchange processed magnetic nano-composites for organic dye removal application
- Organic-inorganic hybrid fluorescent ink
- Printable hierarchical nickel nanowire based sensors
- Self-lubricating bidirectional carbon fiber reinforced smart aluminum composites
- Ni-B-CeO_2 composite coatings
- Lanthanum phosphate coatings on magnesium alloys
- Metal organic gel interpenetrating polymer network derived intrinsic Fe-N-doped porous graphitic carbon
- Multi-channeled ceramic membranes for micro/ultra filtration

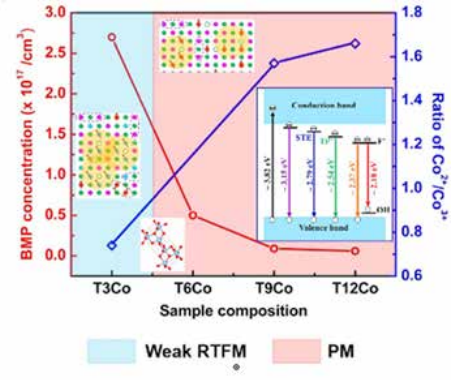
Coir and Coir Composites

Natural fiber-reinforced composites offer high specific strength and good mechanical properties being light weight and eco-friendly. The development of renewable and biodegradable materials has attracted significant attention in terms of meeting the growing demand for sustainable development, given the increase in environmental awareness. We have developed a process for the surface modification of coir fibers using a plasma treatment method. This method has many advantages in surface modification including its effective alteration of surface properties and reducing the usage of environmentally hazardous chemicals. We have also developed a process for the surface treatment of geotextiles with silylated natural phenolic exudates of plant species including cashew nut shell liquid, cardanol, or derivatives of pentadecenyl phenols to improve the longevity of the coir geotextiles. We have developed the process for the production of household articles/automobile parts/packaging materials based on Coir and Poly (lactic acid) composites.

Products developed using polylactic acid and coir composites

Magnetic behavior of TiO_2 and doped TiO_2 nanocrystals for spintronics and magneto-optical applications

TiO_2 is a known semiconductor and the defects present in the material is known to control its transport properties. Magnetic behavior of the semiconductor TiO_2 was modified by the substitution of Cr ions in the lattice. A simple low temperature sol-gel method is developed for the synthesis of low dimensional and highly efficient stable anatase TiO_2 nanocrystals and Co-doped TiO_2 nanocrystals. Co-doped TiO_2 shows a narrowing of bandgap due to Co incorporation in TiO_2 which can be useful for visible light photocatalysis in practical applications. X-ray photoelectron spectra show the presence of Co^{2+}, Co^{3+} and Ti^{3+} and certain amount of oxygen vacancies. Magnetic behavior shows weak ferromagnetic behavior in undopedand 3% Co-doped TiO_2 at room temperature whereas at higher concentration, Co-doped TiO_2 shows paramagnetic behavior which is explained well by taking into consideration the bound magnetic polaron (BMP) formation. The doping with magnetic impurities associated with oxygen vacancies could enable coupling between them to enhance BMP overlapping and ferromagnetic exchange interaction in the system apart from their potential optical properties. A significant reduction in bandgap associated with its interesting magnetic properties makes Co-doped TiO_2 a well-suited material for future spintronics and magneto-optical applications.

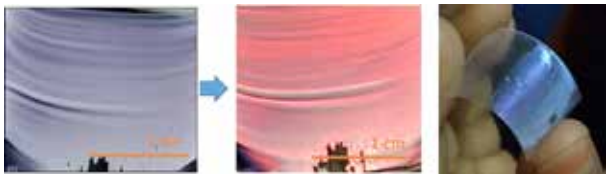


Variation of magnetic properties of TiO_2 with doping

Angle-dependent color changing colloidal photonic crystal arrays using polymer/inorganic microspheres on flexible surfaces

Sir C.V. Raman had discussed the origin of colors in the plumage of the bird, *CoraciasIndica* in one of his paper published in 1934. Apart from the contribution from chemical coloration, the unique brilliant angle-dependent color is mainly

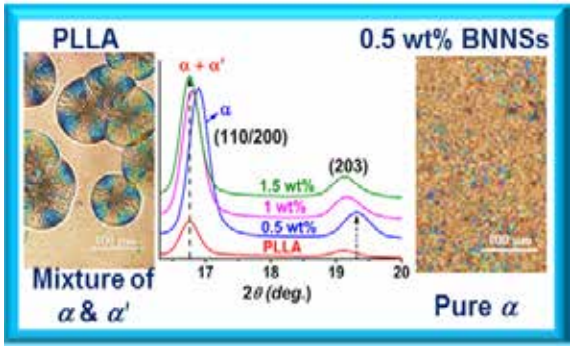
due to well-ordered hierarchal structures present in the feathers of peacock and butterflies as a result of the interaction of light with periodic structures on their surfaces. Mimicking these structures found in nature requires state-of-the-art nanofabrication facilities. Another approach would be self-assembled colloidal particles by employing colloidal crystallization methods for the fabrication of bio-inspired photonic crystal arrays. The color of ordered photonic crystals arrays changes when viewed at different angles and under different lighting conditions. These angle-dependent color changing photonic crystals can be used in combination with advanced fluorescent materials to create new generation authentication technologies. In the current global scenario, there is great demand for the development of color changing materials that can changes color in response to changes in pH, humidity, aging and analyte concentration. Here, we could successfully develop angle-dependent color changing photonic crystals on both solid and flexible surfaces over large area. Scale up of specialty colloidal particles and the fabrication processes are underway.



Angle-dependent color changing photonic crystals on solid and flexible surfaces

Influence of Boron Nitride Nanosheets on the Crystallization and Polymorphism of Poly(L-lactide)

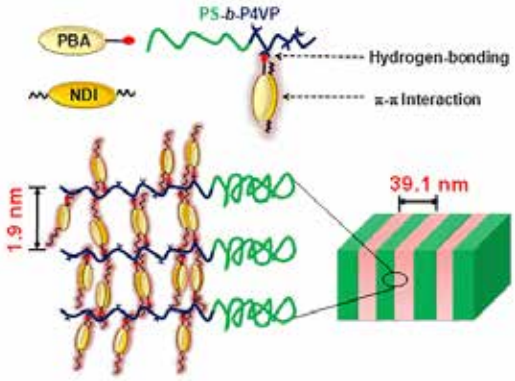
Impact of delaminated boron nitride nanosheets (BNNSs) on the crystallization behavior and crystalline structure of melt-crystallized poly-L-lactic acid (PLLA) was studied using wide-angle X-ray diffraction and scanning electron microscopy. Addition of lower loadings of BNNSs (~0.5 wt %) resulted in the highly dispersed PLLA nanocomposites, whereas the higher loading of BNNSs (≥1 wt %) leads to the agglomerated nanocomposites. Lower loadings of the BNNSs induces the formation of ordered α form (when crystallizing from the melt at a cooling rate of 10 °C/min) but the mixture of α' and α forms are formed in the presence of higher loading of BNNSs. It was observed that the crystallization of PLLA occurred rapidly with the narrow distribution of crystal size and degree of crystal perfection in highly dispersed nanocomposites and the thermal conductivity of PLLA/BNNSs nanocomposites was found to increase significantly with BNNSs loading (*J. Phys. Chem. B 2018, 122, 6442–6451,2018*)



Directed Assembly of Hierarchical Supramolecular Block Copolymers: A Strategy to Create Donor-Acceptor Charge Transfer Stacks

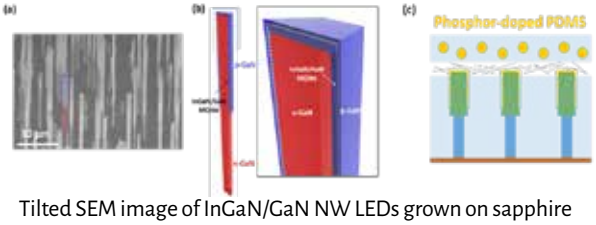
A three-component hierarchical self-assembly approach was developed to generate stable alternate donor-acceptor (D-A) assemblies within block copolymer microdomains by involving the supramolecular approach in self-assembly of block copolymers. Block copolymer supramolecules composed of two small molecules (donor and acceptor) and polystyrene-block-poly(4-vinylpyridine) (PS-b-P4VP). 1-Pyrenebutyric acid (PBA, donor) forms hydrogen bonding with P4VP and aromatic interactions with naphthalene diimide (NDI, acceptor) to generate charge transfer (CT) complexes within the block copolymer domains in the solid state. Formation of hierarchical structures and charge-transfer complexes between PBA and NDI were established by experimental techniques. Space charge limited current analysis showed the enhanced charge carrier mobility in PS-b-P4VP (PBA+NDI) supramolecules compared

to the physical blends of PBA+NDI. The organization of donor and acceptor molecules within the block copolymer microdomains open up new insight in the area of electronic devices because of its advantages such as solution processability, controlled formation of hierarchical assemblies and the CT interaction in the solid state *(Macromolecules , 52, 2889–2899, 2019)*



Phosphor-converted flexible nitride nanowire white light-emitting-diodes

Flexible optoelectronic devices are one of the most rapidly evolving fields. The nitride nanowires (NWs) provide the possibility to fabricate flexible devices as their footprint is small compared to the bending radii of the macroscopic devices. Dr. Maria and her research team from Centre de Nanosciences et de Nanotechnologies (C2N), France reported the first flexible white LED based on the InGaN/GaN NWs and yellow nanophosphors (*ACS Photonics,3(4),597-603, 2016*). However, this 1st-generation flexible white LED had a poor colour performance: it emitted a bluish cool white light with a high correlated colour temperature (CCT) of 6306 K and a low colour rendering index (CRI) of 54. Recently, Dr. Maria Tchernycheva and research team from NIIST collaboratively demonstratedflexible nanowire white light-emitting-diodes (LEDs) consist of flexible InGaN/GaN nanowire LED pumps capped with removable phosphor-doped PDMS membranes. Different phosphors with tens of microns grain size emitting from green to orange were investigated using a violet-blue pump and a blue-green pump. In addition, a flexible NW white LED with a warm white emission was demonstrated using two-layers of different phosphors. Compared to the previous realizations of flexible nanowire white LEDs, these novel LEDs improved the CRI from 54 to 86 and showed a colour tunable from bluish cool white colour to natural white and finally to warm white. The flexibility tests showed that the LEDs can be bent down to 1.5 cm curvature radius without degradation. Therefore, the replacement of the nano-phosphors used in the previous realization by relatively inexpensive micro-phosphors does not degrade the good mechanical flexibility of the nanowire white LEDs.

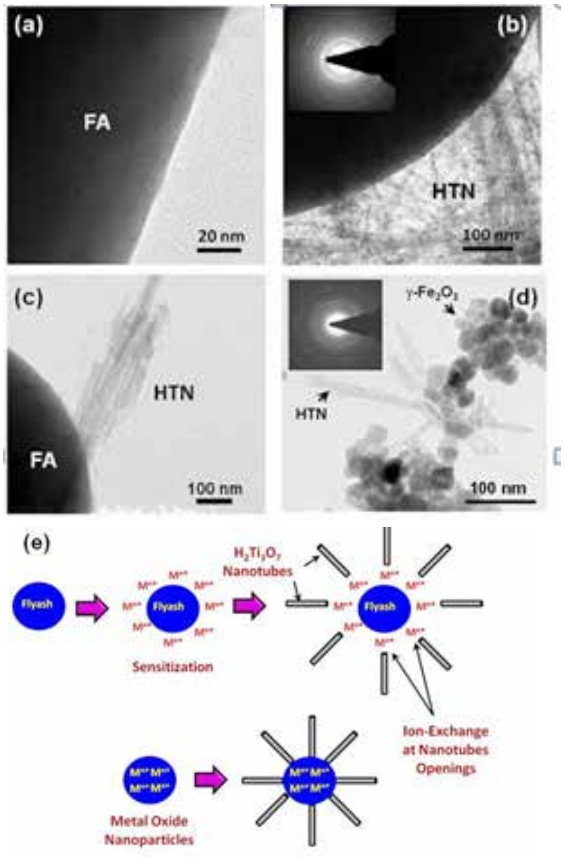


Tilted SEM image of InGaN/GaN NW LEDs grown on sapphire substrate. (b) Schematic illustrations of the NW LED structure in a cross-sectional view. (c) Schematic illustration of the fabrication processing of the 2nd-generation flexible white LED

Synthesis of semiconductor oxide nanotubes based composite particles via ion-exchange reactions and their application in removal of organic dyes from aqueous solutions

Hydrothermally synthesized hydrogen titanate ($H_2Ti_3O_7$) nanotubes (HTN) possess very high specific surface-area (300-400 $m^2 g^{-1}$) and high dye adsorption capacity (100-120 mg g^{-1}). However, due to their small size, the separation of $H_2Ti_3O_7$ nanotubes from the treated aqueous solution is a major problem. On the other hand, the spherical (diameter=1-100 µm) flyash particles, which are produced as by-product of coal combustion in the thermal power plants, have relatively low dye adsorption capacity; however they can be separated from the treated aqueous solution via gravity settling. It appears that the composite of flyash particles and HTN may be beneficial to obtain high dye adsorption capacity along with high separation efficiency. However, depositing HTN on the surface of flyash particles has been a challenge. In this context NIIST has developed a new technique to attach HTN on the surface of flyash particles. In this technique, the surface of flyash particle is first sensitized via the

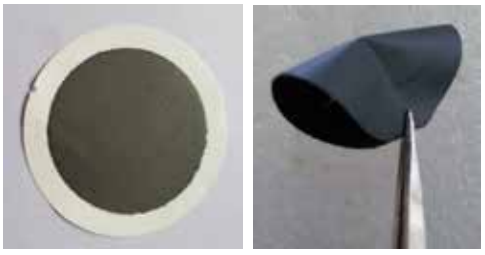
adsorption of metal-cations (M^{n+}such as Sn^{2+}/Sn^{4+}, Fe^{2+}/Fe^{3+}, Pb^{2+}, Zn^{2+}, Cu^{2+}, Mn^{2+}). When the surface-sensitized flyash particles are stirred with HTN in an aqueous solution at neutral solution pH, the nanotubes undergo ion-exchange reaction, typically at the tube opening, during which the intercalated H^+ are replaced with M^{n+} cations. Since the latter are anchored to the surface of flyash particles, HTN get permanently attached to the surface of flyash particles via ion-exchange bond formation at the tube opening. As a corollary, HTN can be directly attached to the surface of oxides of M^{n+} without any prior sensitization step. Using this principle, the magnetic nanocomposite of HTN and γ-Fe_2O_3 could be successfully synthesized which exhibits not only high dye adsorption capacity but also the ability to be separated from the treated aqueous solution by using an external magnetic field. A US patent has been granted for this process as *Shukla et al.,U.S. Patent Number 9,993,814, Granted on 12-June-2018*.



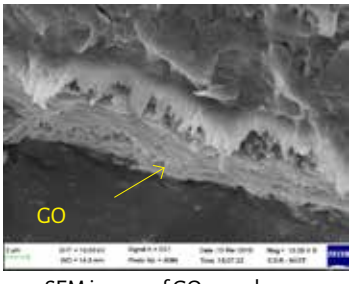
Semi conductor oxide nano tubes based composite particles

Development of graphene based membrane from graphite ore for desalination

The problem of fresh water scarcity has continued to intensify globally. One of the most powerful techniques to fully secure the availability of fresh water is desalination. In any desalination process, the role of a membrane is crucial. Membrane fouling, high energy demand and trade-offs between salt rejection and water flux remained as challenges of water desalination membranes. To meet the needs of advanced desalination required to address the water challenges of the twenty-first century, a breakthrough in RO membrane technology is a must. Recently graphene-based materials with their unique physicochemical properties have emerged as potential candidates with excellent desalination characteristics. Recently, graphene-based materials with their unique physicochemical properties have emerged as potential candidates with excellent desalination characteristics. Hence, in a preliminary study at NIIST, Graphene Oxide (GO) was synthesized via chemical exfoliation of graphite flakes (from beneficiated ore) by modified Hummer's method and characterized. GO membrane was developed by vacuum filtration of GO solution through mixed cellulose acetate membrane. Contact angle measurement confirmed the hydrophilicity of GO membrane. An attempt has been made for studying



GO membrane over porous support

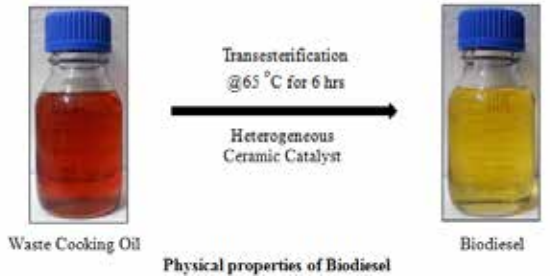


SEM image of GO membrane

the desalination performance of the membrane in terms of percentage salt rejection and conductivity measurement. Further studies are going on in the optimization of the parameters and also engineering the space between GO layers by incorporating cross-linkers during membrane fabrication.

Transesterification of waste cooking oil into biodiesel

The Food Safety and Standards Authority of India (FSSAI) has launched an initiative, repurpose used cooked oil, and recommended to use it for the production of biodiesel by the year 2022. India has the potential to recover 220 crore litres of used cooking oil from food industries and it is extremely essential to find an appropriate technology for the conversion of used cooking oil to biodiesel via industrially viable process. In this context, a new heterogeneous ceramic catalyst has been identified and validated for the transesterification of waste cooking oil to obtain methyl esters biodiesel. The catalytic loading, oil methanol ratio, reaction time, temperature, pH and milling conditions were optimized. More than 95% yield is seen at reaction temperature and time of 65 °C/6h. Presence of fatty acid methyl esters were established. The physico-chemical properties of biodiesel are mitigating well with the ASTM standards for biodiesel.

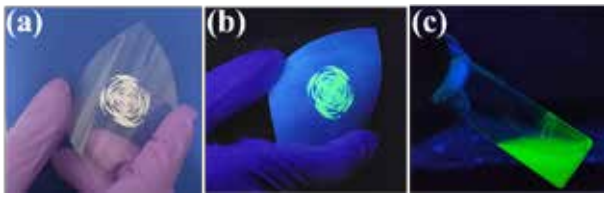


Physical properties of Biodiesel

Parameters	Waste Cooking Oil Feed	Biodiesel Methyl esters
Specific gravity @ 30 °C	0.926	0.893
Kinematic Viscosity @ 40 °C [cSt]	51.0	18.0
Acid value mg KOH/g	5.820	1.459
C (%)	18.93	21.02
H (%)	2.808	3.141
S (%)	6.7	0.127

Silica based organic-inorganic hybrid fluorescent ink

UV readable fluorescent inks have potential applications in optical reading systems, intelligence information and in automatic identification systems. However, sustaining the fluorescence at the printed level requires a extensive optimisation in the synthetic chemistry and ink formulation. With the aim of developing a fast-curing fluorescent ink, NIIST synthesised fluorescent silica nanoparticles through modified Stöber method. The rheostable viscous ink of fluorescent silica was formulated by choosing ethanol as solvent system. The developed ink provides promising applications in the fields of automatic identification, optical devices and information encryption.



Photographs of (a) fluorescent ink printed on flexible Mylar substrate, (b) under a hand-held UV lamp, showing bright green emission and (c) fluorescent ink under UV light.

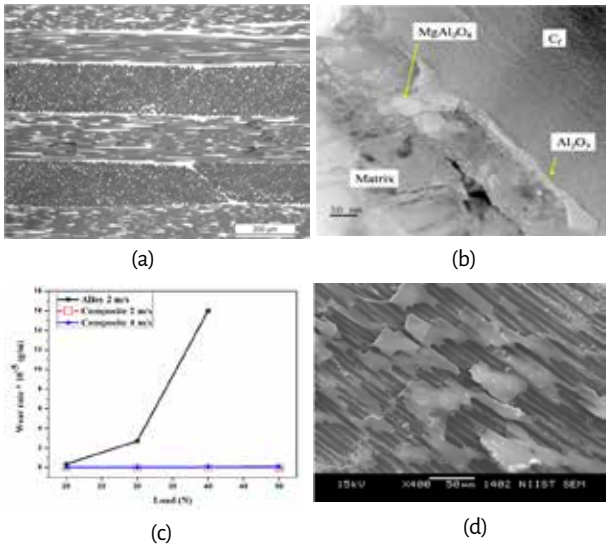
Printable hierarchical nickel nanowire based sensors

Unlike the traditional lithography that involves time-consuming and costly procedures, the printed electronics, requires simple printing steps for device fabrication. Hierarchical nickel nanostructures were synthesized using a simple reduction method employing ethylene glycol. The developed structures exhibited Ms of 51 emu/g, better electrical conductivity (2.19 $\times 10^6$ S/m), and an impressive thermal conductivity of 33 W/m.K even for a densification of about 40%. Even with high porosity in the compacted form, the promising properties of h-NiNWs are due to their effectively interconnected networks, similar to a foam structure. Hence, NiNWs proposed as good candidate for a soft magnetic sensor. NiNWs could be used for sensing magnetic microbeads for biological

applications and sensitivity could be optimized by tuning the electrical resistivity, the diameter, and aspect ratios of hierarchical structures. The novel formulation of the screen-printable ink using these nanostructures could make printing of magnetic devices for industrial applications. Low-cost flexible magnetic sensors would be a reality with this kind of magnetic printed structures replacing lithographically patterned expensive magnetic thin films.

Self-lubricating bidirectional carbon fiber reinforced smart aluminum composites by squeeze infiltration process

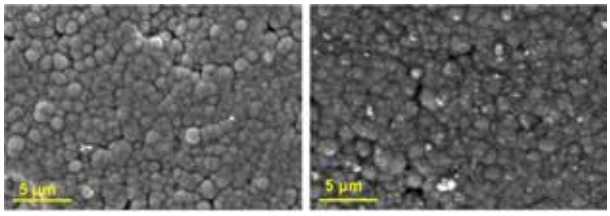
Self-lubrication is one of the smart material properties required for producing components with enhanced wear resistance and low coefficient of friction. Bidirectional (BD) satin weavepolyacrylonitrile (PAN) based carbon fiber (C_f) fabric preform was successfully infiltrated with aluminum alloy by squeeze infiltration process. The infiltrated composite shows the uniform distribution of carbon fibers in the matrix with the elimination of porosities, fiber damage and close control on the formation of deleterious aluminum carbide (Al_4C_3) phase. C_f/Al composite exhibits remarkable wear resistance compared to unreinforced alloy due to the formation of self-lubricating tribolayer on the pin surface, which intercepts the contact of matrix metal to counter surface. The BD carbon fiber enhanced the hardness and compressive strength of the composite by restraining the plastic flow behavior of matrix. HRTEM shows the presence of Al_2O_3 and $MgAl_2O_4$ spinel, confirmed by EDS and SAD pattern, at the composite interface. The composite shows a lower density of 2.16 g/cm^3 which is a major advantage for weight reduction compared to the monolithic alloy (2.7 g/cm^3)



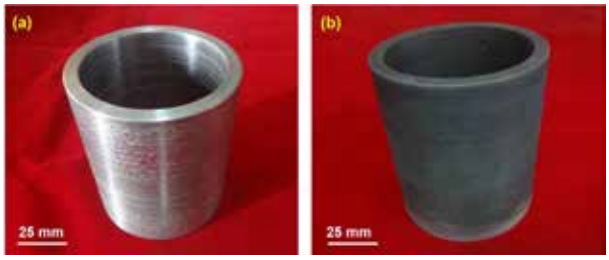
(a) Optical Micrograph of Aluminum infiltrated carbon fibre layers, (b) Carbon fibre- Matrix interface bonding, (c) Remarkable enhancement in wear behaviour of carbon fibre reinforced Al composite compared to the base alloy and (d) Self lubricating tribolayer formed in between the mating surfaces.

Ni-B-CeO_2 composite coating for enhanced wear and corrosion resistance of Aluminium alloy

Nickel-based coatings on aluminium with specific surface properties are of great interest for anti-corrosive, antiwearing,and self-lubricating applications. In the present study electroless Ni-B alloy and Ni-B-CeO_2 nanocomposite coatings were formed on 356 aluminium alloy surfaces. Ceria incorporation to Ni-B coating reducesthe average nodular grain size from 1150 nm to 650 nm and Ni crystallite size from 15 nm to 9.97 nm. Ni-B-CeO_2 nanocomposite shows remarkable improvement in microhardness of 684 VHN compared to pure Ni-B coating with 424 VHN. Enhanced wear resistance and reduction in friction coefficient are observed for the nanocomposite coatings compared to



SEM micrograph of the surface texture of electroless (a) Ni-B alloy and (b) Ni-B-CeO_2 composite coatings

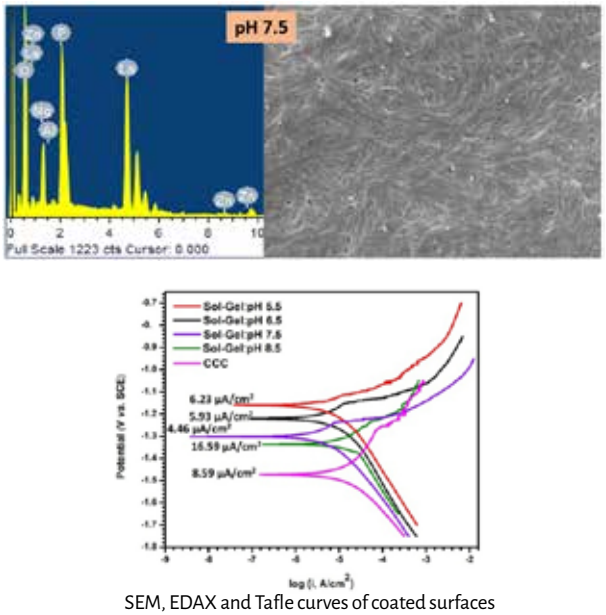


(a) Uncoated and (b) electroless NiB-CeO_2 coated A356 cylinder liners

356 Al alloy and Ni-B alloy coating. Potentiodynamic polarization measurements show a remarkable reduction in the corrosion current density for ceria added nanocomposite coating (2.48×10^{-6} A cm^{-2}) than that of the particle-free counterpart (11.18×10^{-6} A cm^{-2}). Uniform Ni-B-CeO_2 composite coating was obtained on centrifugally cast A356 aluminium alloy cylinder liners which have potential applications in automotive systems.

Sol-gel lanthanum phosphate coatings on magnesium (Mg) alloys for better corrosion resistance

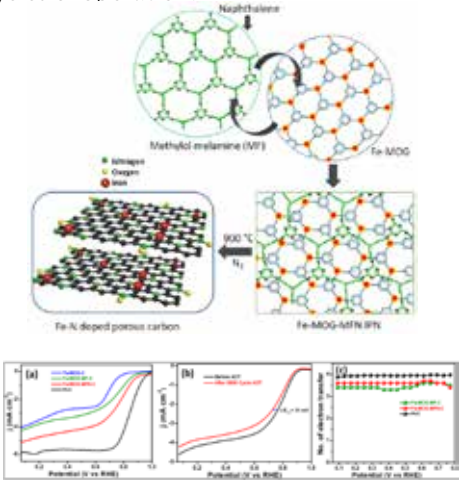
Lanthanum phosphate based sol-gel coating was developed on AZ31 magnesium alloy. 0.1 M concentrations of lanthanum nitrate [$La(NO_3)_3$] and ammonium bi phosphate [$NH_4H_2PO_4$] were used to prepare the lanthanum phosphate sol. Coatings were made at different pH ranges (5.5, 6.5, 7.5 and 8.5). Typical SEM micrograph for sample coated at pH 7.5 showed that substrate surface was completely covered with fiber like $LaPO_4$. EDS analysis confirmed the presence of high percentage of La and P ensuring the formation of $LaPO_4$ during coating. Corrosion performance of the developed coatings in 1 wt. % NaCl was evaluated using electrochemical polarization. $LaPO_4$ coating obtained through conversion coated was also analyzed for comparison. The least corrosion current (4.46 μA/cm^2) from Tafel plots was observed for samples coated at pH 7.5 in comparison to that obtained through chemical conversion method (8.59 μA/cm^2).



SEM, EDAX and Tafle curves of coated surfaces

Melamine formaldehyde–metal organic gel interpenetrating polymer network derived intrinsic Fe–N-doped porous graphitic carbon

Fe and N doped carbon for catalyst application in fuel cells to improve the kinetics of oxygen reduction reaction (ORR) was obtained by the pyrolysis of an interpenetrating polymer network comprised of an organic thermosetting polymer enriched with N (melamine-formaldehyde (MF)) and a metalorganic gel (Fe-MOG) network. During pyrolysis, the precursor undergo restructuring to generate highly porous graphitic sheets with firmly anchored Fe and N. The introduction of porogen like naphthalene in the MF polymer has been examined as a strategy to enhance the surface area. Pyrolysis of this precursor resulted in the formation of porous carbon with enhanced surface area of 950 m^2/g with hetero porous architecture. This is due to the sublimation of dissolved naphthalene. The atomic percentage of Fe and N was estimated to be 0.13 and 2.8 at% respectively. About 70 % of the N was found to be in the form of graphitic N, with high catalytic activity. The catalyst exhibited an onset potential of 0.91 V vs RHE with four electron reduction pathway. A better durability was achieved even after 5000 cycles of operation.



Potential (v)-current (i) curves for Fe-N doped porous graphitic carbon

Multi-channeled ceramic membranes for micro/ ultra filtration applications

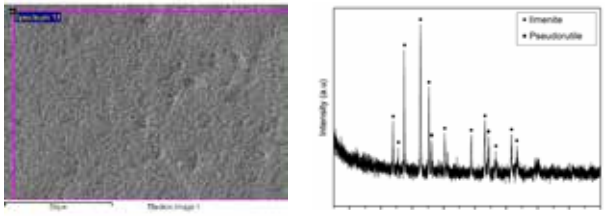
Asymmetric ceramic membranes are deposited over support materials like alumina, zirconia, silica and titania which make them cost effective, durable and resistant towards high temperature and chemical attack. Initially alumina based multi-channelled porous support tubes are developed followed by membrane layer depositions by sol / slurry coatings of nanosized metal oxide sols. This method has serious limitations such as reduced flux and high costs and there is a growing demand.

Lanthanum phosphate ($LaPO_4$) has been shown to possess unique properties compared to commonly used ceramics and is inherently hydrophobic aiding antifouling characteristics. Moreover, the nanorod morphology plays a vital role in increasing the flux rate. CSIR-NIIST developed a single layer $LaPO_4$ sol coating on alumina ceramic membranes that resulted in micro/ultrafiltration with enhanced flux values. Sugarcane juice clarification tests at IIT Guwahati indicated turbidity removal of 99.5 % .A pre-pilot plant is setup at HR Johnson, Mumbai under DST (Department of Science and Technology) funding. The technology was realised in collaboration with CSIR-CGCRI, Kolkata.

Multi-channelled ceramic membrane tubes (left) and sugarcane juice clarification through the developed membranes

Investigation on mineralogical, geochemical and morphological characterization of raw material and intermediate samples of KMML

Ilmenite from Chavara deposit was studied for structure and geochemical studies using ED-XRF, XRD and SEM-EDAX. By using advanced characterization techniques such as scanning electron microscope (SEM) with energy dispersive X-Ray (EDAX) we got the elemental values in weight % and atomic % for Carbon, Oxygen, Titanium and Iron in the sample. The XRF results of Chavara ilmenite show that the presence of major oxides of ilmenite as TiO_2 of about 59.53% which was followed by Fe_2O_3 (25.15%). The XRD analysis of ilmenite samples shows ilmenite as the major phase and other phases such as pseudobrookite and pseudorutile. Finally, SEM of surface and sub-surface sediments to describe the surface textures like, mechanical and chemical pits, etch-Vs, grooves and so on has documented micro-morphology of ilmenite grains. The mineral exhibits sub-rounded shape along with 'V" marks of impact and solution reactions. Further, the results were substantiated via EDAX analysis where it shows the weight percentages of minor impurities like Al, Si along with major components of Ti and Fe. The results of EDAX –analysis shows reduced ilmenite difficult to leachable TiO_2 content of 59.13% (Ti-35.49% and O-24.03%). Whereas, the reduced ilmenite easy to Leachable shows 59.99 percentage (Ti-36.01% and O-24.21%). Fe content for the reduced ilmenite difficult to leachable is 26.12% where as that of reduced ilmenite easy to leachable is 24.42%. Other than major elements, leached ilmenite and reduced ilmenite shows the presence of impurities like Al of about 0.59% and 0.83%. Raw ilmenite shows Ti and Fe content of 36.38% and 24.51%. SEM–EDAX enabled advanced chemical and morphological analysis of ilmenite mineral will impact on the efficiency for determining their grade and potential applications.



SEM and XRD patterns of Ilmenite deposits from Chavara

MICROBIAL PROCESSES AND TECHNOLOGY DIVISION

Expertise

Microbial based processes and microbial biotechnology

Scientist	:	8
Technical staff	:	1
Students	:	42

Facilities

Biofuel pilot plant, Solid-state fermentation pilot plant (Koji Room)

Ongoing projects (Grant-in-aid, Sponsored, Consultancy and Technical Services, In-house)	:	23
Publications (SCI+non SCI)	:	24
Ph. D. awarded	:	3

माइक्रोबियल प्रक्रिया तथा प्रौद्योगिकी प्रभाग

माइक्रोबियल प्रक्रिया तथा प्रौद्योगिकी प्रभाग (एमपीटीडी) का जनादेश जैव प्रौद्योगिकी के विशिष्ट अग्रणी क्षेत्रों में उच्च गुणवत्ता वाले अनुसंधान एवं विकास का संचालन करना है। पर्यावरणीय स्थिरता सुनिश्चित करते हुए क्षेत्रीय जैव स्रोतों की खोज और मूल्यवर्धन में महत्वपूर्ण जोर दिया जाता है। माइक्रोबियल संसाधनों की खोज और दोहन करके जैव प्रक्रियाओं और उत्पाद विकास के केंद्रित क्षेत्रों के अनुसंधान में प्रभाग सक्रिय रूप से शामिल है। अनुसंधान के वर्तमान ध्यान केंद्रित क्षेत्रों में शामिल हैं i) औद्योगिक एंजाइम और मूल्यवर्धित रसायनों (ii) जैव ईंधन और बायोरिफाइनरी (iii) जैव सक्रिय अणु (iv) स्वास्थ्य और जीनोमिक्स (v) पादप सूक्ष्मजीव इंटरैक्शन और (vi) प्रोबायोटिक और एल्गल न्यूट्रास्यूटिकल्स। दूसरी पीढ़ी बायोइथेनॉल पर विशेष अनुसंधान एवं विकास के लिए प्रभाग में एक समर्पित "जैव ईंधन केंद्र" है। लिग्नोसेल्युलोसिक बायोइथेनॉल के उत्पादन का पायलट संयंत्र, अब ओन-साइट ठोस-अवस्था किण्वन एंजाइम उत्पादन पायलट संयंत्र से समर्थित है, जो लागत प्रभावकता और हैंडलिंग के लिए बेहतर अवसर प्रदान करता है। प्रभाग के आर एंड डी में विभिन्न माइक्रोबियल बायोप्रोसेस के विकास शामिल हैं और किण्वन प्रौद्योगिकी पर तथा प्रोबायोटीक, जैव-कीटनाशकों और जैव उर्वरक आदि के लिए माइक्रोबियल फॉर्मूलेशन पर काम करने के लिए मजबूत उद्योग संबंध भी है।

हाइलाइट्स

- 2800 आईयू / जीडीएस की उपज के साथ सब्सट्रेट के रूप में चिकन पंख और गेहूं के चोकर का उपयोग करते हुए ट्रे स्तर पर प्रदर्शित केरातिनसे उत्पादन के लिए प्रक्रिया। कोडन अनुकूलित केरातिनसे जीन को पिचिया पास्टोरिस में सफलतापूर्वक क्लोन किया गया।
- मेटाबॉलिक रूप से इंजीनियर कोरिनेबैक्टीरियम ग्लूटामिकम उपभेदों को सफलतापूर्वक α,-अमीनो एसिड (गाबा (गामा-अमीनोब्यूट्रिक एसिड) और 5- अमिनोवालेरते (δ- अमिनोपंतानोट) और चीनी एसिड, डी- क्सीलोनिक एसिड के उत्पादन के संबंध में बनाया गया था। सिंथेटिक से उनके उत्पादन के साथ-साथ बायोमास हाइड्रोलाइजेट मीडिया के संबंध में अवधारणा का प्रदर्शन किया गया है।
- लैक्टोबैसिलस प्लांटारम द्वारा एक्सोपॉलीसेकेराइड उत्पादन के लिए सस्टेनेबल कार्बन स्रोत के रूप में कसावा स्टार्च हाइड्रोलाइजेट के उपयोग को प्रदर्शित किया गया
- दो औद्योगिक परियोजनाएं शुरू की गईं: (1) डेयरी उत्पादों में उपयोग के लिए स्वदेशी स्टार्टर कल्चर कंसोर्टिया (2) गिबेरेलिक एसिड (जीए 3) के विकास के लिए बायोप्रोसेस
- एन्टेरोबेक्टर एसपी से 2,3-ब्यूटेनियोल के उत्पादन के लिए बायोप्रोसेस को लैब स्केल के तहत अनुकूलित किया गया था
- 5- हयड्रोक्सीमेथील फुरफुरालडीहैड से 2,5-फुरिंडिकार्क्सिलिक एसिड का उत्पादन के लिए एक जैविक प्रक्रिया। सूक्ष्मजीवों का उपयोग करके कार्यकुशलता 67% रूपांतरण के साथ विकसित किया गया था।
- उपन्यास जीनस पोक्काली बैक्टीरिया से संबंधित एक संभावित नॉवेल प्लांट रहिजोबैक्टीरिया स्ट्रेन को पोकली चावल से पहली बार पहचाना गया और लवणता के तनाव को कम करने के लिए दिखाया गया।
- माइक्रोएल्गे द्वारा तेल संचय में तनाव की भूमिका पर शोध ने अवलोकन किया कि तनाव से जुड़े पौधों के हार्मोन के साथ उपचार तनाव तंत्रों और अंतर्जात विकास हार्मोन के मॉड्यूलेशन द्वारा (एम यू एफ ए) और पी यू एफ ए उत्पादन को बढ़ाता है
- सेलेनोपोप्रोटीन जीन की पहचान माइक्रोएल्गे स्केनडेसमस क्वाड्रिकोडा (सी ए एस ए) सी सी 202
- उपयोग किए जाने वाले कुकिंग ऑयल का उपयोग करके पॉलीहाइड्रोक्सी ब्युटीरेट का उत्पादन प्रयोगशाला पैमाने पर प्रदर्शन किया गया था, जिसमें 3.8g / L उत्पादन होती है।
- 2 जी इथेनॉल पर पैन सी एस आई आर कार्यक्रम के साथ 9 सी एस आई आर प्रयोगशालाओं की भागीदारी NIIST द्वारा समन्वित किया गया था। 2G इथेनॉल उत्पादन की लागत को कम करने (<रुपये 100 / एल) के लक्ष्य के साथ शुरू किया गया है। एकीकृत प्रक्रिया योजना को डिज़ाइन किया गया है और सभी यूनिट संचालन के लिए महत्वपूर्ण प्रक्रियाओं और रणनीतियों की लागत किया गया है।

The mandate of the Microbial processes and Technology Division (MPTD) division is to conduct high quality R & D in specific frontier areas of Biotechnology. Significant emphasis is put in exploration and value addition of regional bioresources while ensuring environmental sustainability. The division is actively involved in research in the focussed areas for bioprocesses and products development by exploring and exploiting the microbial resources. The current focus of research are in the areas of i) Industrial enzymes and value added chemicals ii) Biofuels and biorefinary (iii) bioactive molecules iv) Health and genomics (v) plant microbe interactions and (vi) probiotic and algal nutraceuticals. The Division has a dedicated "Centre for Biofuels" for exclusive R&D on 2nd generation bioethanol. The pilot plant for the production of lignocellulosic bioethanol is now supported by on-site solid-state fermentation enzymes production pilot plant, bringing better cost-effective and handling opportunities. The Division is involved in R & D on developing different microbial bioprocess and has strong industry linkages to work on fermentation technology, microbial formulation for probiotic, biopesticides and biofertilizers etc.

Highlights

- Process for keratinase production demonstrated at tray level using chicken feather and wheat bran as substrates with a yield of 2800 IU/gDS. Codon optimized keratinase gene successfully cloned in *Pichia pastoris*.
- Metabolically engineered *Corynebacterium glutamicum* strains were successfully made with respect to the production of α, ω-amino acids (GABA (gamma-aminobutyric acid) and 5-aminovalerate (δ-Aminopentanoate) and the sugar acid, D- xylonic acid. The proof of concept with respect to their production from synthetic as well as biomass hydrolysate media is demonstrated.
- Demonstrated the use of Cassava Starch Hydrolysate as Sustainable Carbon Source for Exopolysaccharide Production by *Lactobacillus plantarum*
- Two Industrial projects were initiated: (1) the development of a bioprocess for Gibberellic acid (GA3) and (ii) the development of indigenous starter culture consortia for using in dairy products
- A bioprocess for the production of 2,3-butanediol from *Enterobacter* sp. was optimized under lab scale
- A biological process for the production of 2,5-Furandicarboxylic acid (FDCA) from 5-hydroxymethylfurfuraldehyde (HMF) using microorganisms was developed with 67% conversion efficiency.
- A potential novel plant associated rhizobacteria strain belonging to the novel genus *Pokkalii bacter* were identified for the first time from Pokkali rice and shown to provide salinity stress alleviation.
- Research on the role of stress in oil accumulation by microalgae led to the observation that treatment with stress associated plant hormones significantly increases MUFA and PUFA production by modulation of stress mechanisms and endogenous growth hormone
- Selenoprotein gene identified from microalga *Scenedesmus quadricauda* CASA CC202
- Polyhydroxy butyrate production using used cooking oil was demonstrated at lab scale with a yield of 3.8g/L
- PANCSIR program on 2G ethanol with participation from 9 CSIR labs and coordinated by NIIST was kick started with a target of reducing the cost of 2G ethanol production to < Rs 100/L. Integrated process scheme is designed and costs worked out for all unit operations. Critical processes and strategies to reduce cost was derived.

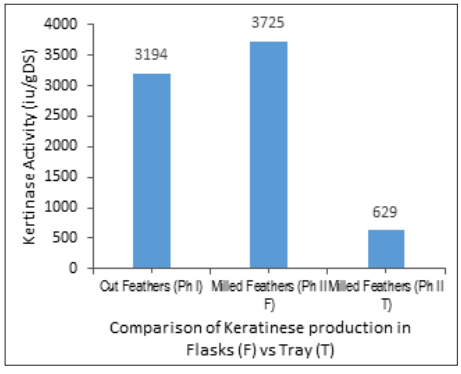
Brief report of the R &D activities

Bioprocesses and Products

Industrial Enzymes

Production of keratinase enzyme using *Streptomyces albidoflavus.*

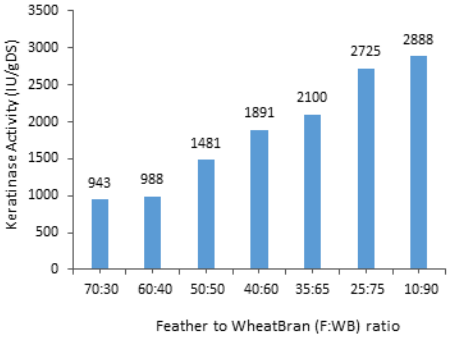
The actinomycete – *Streptomyces albidoflavus*, producing keratinase could yield upto 3000 IU/gDS under solid state fermentation in flask scale studies. For scale up purposes the substrate was changed to chicken feather from a poultry process factory, which was used in milled form. The original moisture content optimized for the trials were 90 % with the un-milled feather. Under tray fermentation in 50g capacity trays, 90% moisture resulted in a slurry and yield was reduced to 629 IU/gDS. Optimization of the moisture content resulted in improved yield upto 1481 IU/gDS at 75% moisture

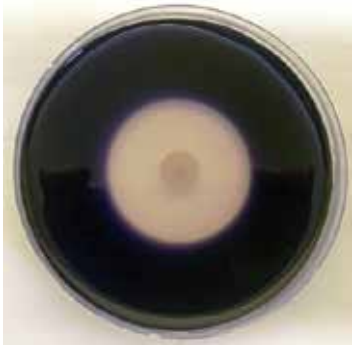


Slurry formation at 90% moisture
PhI – Phase I optimized conditions
Ph II F- Phase II (milled feather) in flasks
Ph II T- Phase II (milled feather) in trays

Keratinase production using chicken feather medium
A) Comparison of keratinase production in flasks vs trays
B) Slurry formation at higher moisture content

Since the particle size of feather has reduced considerably, it was speculated that a high feather to wheat bran ratio (F:WB) may not be necessary as the available surface area of keratin has increased. Different ratios of feather (in % wt/wt) – 10, 25, 35, 40, 50, 60 and 70% to wheat bran were tried and lower feather concentration yielded high activity, close to 3000 IU/gDS. Feather may be required only to act as an inducer for keratinase production and starch in WB may act as a carbon source. A plate assay for starch utilization by the organism confirmed presence of good amylase activity





Amylase production by *S.albidoflavus*

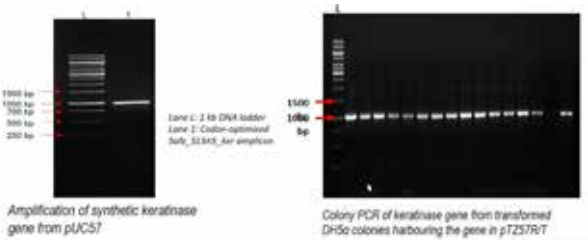
A) Optimization of feather to wheat bran ratio B) Amylase production by S.albidoflavus

Highest keratinase activity obtained was 2888 IU/gDS at the lowest F: WB ratio of 10:90. This was close to the enzyme activity obtained under optimized conditions of Phase I in flasks. Further optimization of parameters is expected to yield still higher activities.

Cloning of the keratinase gene in *Pichia pastoris* system

The gene for keratinase (Salb-S13A5_ker) from *S.albido flavus* which was cloned earlier in *E coli* had a lower expression. It was therefore decided to express the gene from the yeast system –*Pichia pastoris*. The gene sequence was codon optimized for yeast expression

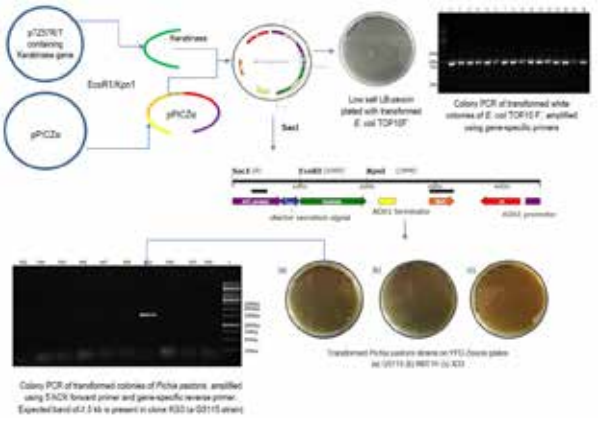
and was synthesized by outsourcing to "GeneScript". The codon optimized gene which was obtained as an insert in pUC57 was amplified using the primer pair SA_CO_F (5' AAGAATTCTCTGAACCCCAGTCAG 3') - SA_CO_R (5' AAGGTACCTTATCCTATCTCTACGCC 3') to give a 1000 bp long product. The gene was cloned into pTZ57R/T (Eco R1/Kpn1), Transformed DH5α and Confirmed by colony PCR



Amplification of synthetic keratinase gene from pUC57

Colony PCR of keratinase gene from transformed DH5α colonies harbouring the gene in pTZ57R/T

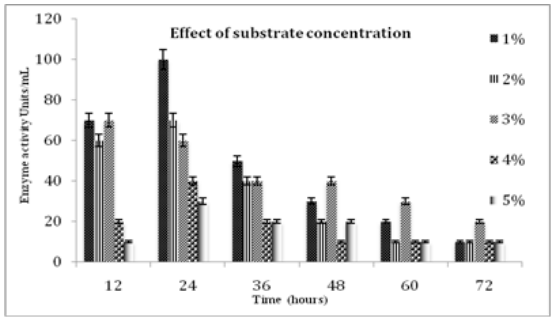
The pTZ57R/T vector containing insert was cut using Eco R1 and Kpn1 to release the gene and it was cloned into linearized pPICZα vector cut with the same enzymes. Ligated and transformed into *E coli* TOP10F and plated on low salt LB zeozin plates. Insert was confirmed by colony PCR. The plasmid was isolated and linearized using SacI and the linearized vector was transformed into *Pichia pastoris* strains GS115, KM71H and X33. Colony PCR of transformed colonies of *Pichia pastoris*, performed using 5'AOX forward primer and gene-specific reverse primer confirmed that one clone (KG3) in the GS115 strain carried the gene.



Cloning of codon optimized keratinase gene in *Ppastoris*

Microbial Lipase

A newly isolated culture, *Pseudomonas guariconesis*, is reported for the first time for lipase production. Various process parameters affecting enzyme production were optimized through statistical design of experiments. A maximum lipase titer of 220 U/mL was obtained after 24h of incubation in shake flask cultures with an inoculum concentration of 0.6 % v/v, incubation temperature of 30 °C and medium pH 9.0. Castor oil (0.5% v/v) was used as the inducer for lipase production. The enzyme was found to be compatible with five different commercial detergents indicating its potential to be used in detergent formulations. It also acted as a biocatalyst in a transesterification process which has many industrial applications.



Lipase production by *Pseudomonas guariconesis* under the effect of substrate (castor oil) concentration

Biopolymers and Biosurfactants

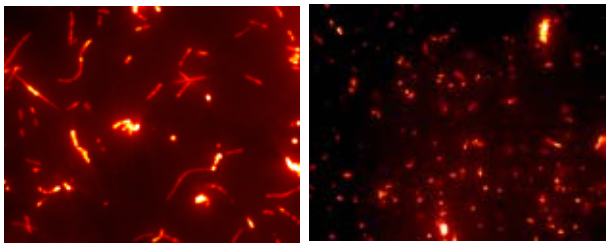
Response Surface Modelling and Optimization of Culture Media in Fermentative Production of 2,3-butanediol

2,3-Butanediol is a promising platform chemical with extensive industrial applications. The present study aims to develop a microbial fermentation approach for the production of 2,3-Butanediol. A wild strain of bacteria, *Enterobacter cloacae* SG1, was studied its capacity to ferment glucose to 2,3- butanediol. Batch fermentation parameters were optimized and media engineering was performed using statistical approach by response surface methodology for increasing the yield of 2,3-Butanediol. At the optimized condition, 25.86 g/L 2,3-butanediol was obtained from Box-Behnken design with 0.36g BDO/g of glucose. The optimization resulted in almost two times increase in the production of 2,3-Butanediol.

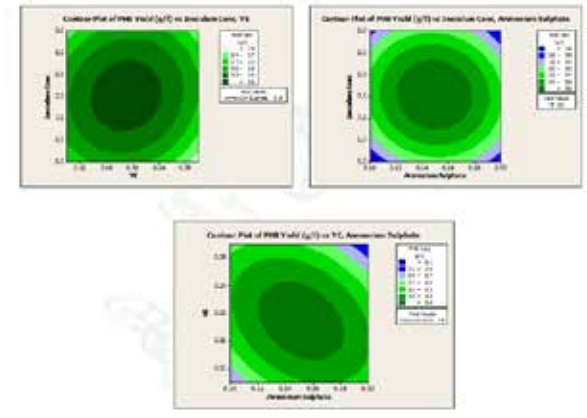
Development of a sustainable process for the production of poly-3-hydroxybutyrate using kitchen and food waste

Study was conducted to develop a process for conversion of food and kitchen waste to an eco-friendly biopolymer, thereby addressing two societal issues- waste management and bioconversion of waste to an eco-friendly biopolymer. Twenty positive isolates were obtained after primary screening with Nile red. Upon secondary screening the strain FH which is a *Bacillus* species showed highest poly-3-hydroxybutyrate production. Media engineering was carried out by adopting Plackett-Burman and Box-Behnken design experiments using waste cooking oil as sole carbon source. Maximum PHB production (3.8 g/L) was observed with ammonium sulphate concentration of 0.5%, yeast extract concentration of 0.2% and inoculum concentration of 7.5%.

The extracted polymer was characterized by FTIR, ^{1}H NMR and ^{13}C NMR. Standard (PHB from Sigma Aldrich) and the extracted polymer gave similar profiles, indicating that the extracted polymer is PHB.



Positive isolates showing orange red fluorescence after Nile red staining

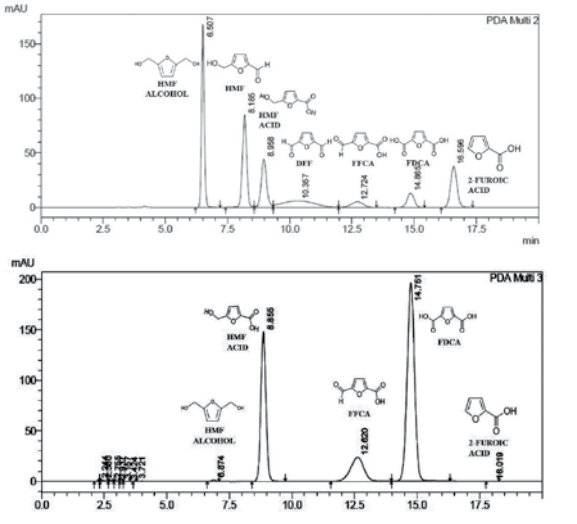


Contour plots showing interactions of various process parameters affecting PHB production by *Bacillus* sp. using waste cooking oil as sole carbon source

Microbial Metabolites

Whole cell based biocatalytic production of 2,5 furan dicarboxylic acid (FDCA)

Study was performed to develop an eco-friendly biological process for the production of 2,5-Furandicarboxylic acid (FDCA) from 5-hydroxymethylfurfuraldehyde (HMF) using microorganisms. Microorganisms were isolated from the soil samples and evaluated for its biotransformation efficiency. Among the isolates, *Aspergillus flavus* APLS-1 was found to be potent for efficient conversion of HMF to FDCA. The bioconversion parameters were optimized by Box-Behnken design. The optimization resulted 67% conversion efficiency where 1g/L HMF (8 mM) was transformed to 0.83 g/L (6.6 mM) FDCA in 14 days at pH 6.5 with biomass size of 5.7 g/L and biomass age 60 hr. This is a first report on *Aspergillus* sp., capable of detoxifying HMF and produce FDCA. No DFF peaks were observed in the HPLC profile after biotransformation by *A.flavus* APLS-1. The intermediate compound analysis showed that there is a rapid conversion of HMF to HMF acid and further conversion of HFCA to FFCA and FDCA is getting delayed. It might be due to the absence of channel proteins or by the limitation of oxygen uptake for the sequential oxidation.



HPLC chromatogram analysis of intermediates in the bioconversion of HMF to FDCA by A. flavus APLS-1 (A) Standards of HMF alcohol, HMF,HMF acid, DFF, FFCA, FDCA and 2-furoic acid; (B) Production of FDCA using optimized condition

Probiotics and Nutraceuticals

Cassava starch hydrolysate as sustainable carbon source for exopolysaccharide(EPS)production by *Lactobacillus plantarum*

Cassava starch hydrolysate (CSH) proved to be a potential alternative for EPS production by *L. plantarum*. Enzymatic hydrolysis of 9 % (w/v) cassava starch resulted in nearly 85 % conversion of it to the sugars which can be directly assimilated by the bacterium. Culture medium (pH 7.3) having cassava sugar (40g/L), yeast extract (40g/L) and ammonium sulphate (5.5g/L) along with tween 80 (4g/L), calcium chloride (10mM) and hydrogen peroxide (3mM) found to be very effective for EPS production. After the double step ethanol precipitation, a maximum titer of 6.5±0.5 g/L crude EPS was obtained in static flask cultures incubated at 370C with 2% v/v inoculum and it was 4.4±0.5 g/L with the control medium having lactose as carbon source. Thermal stability and molecular weight were remained unchanged irrespective of the carbon source used.

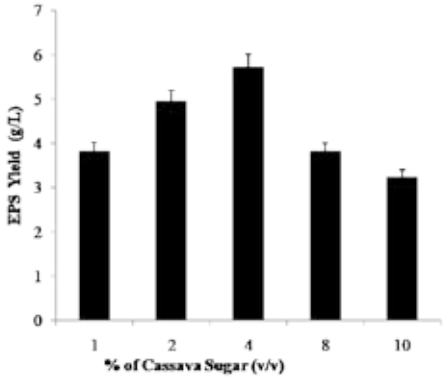
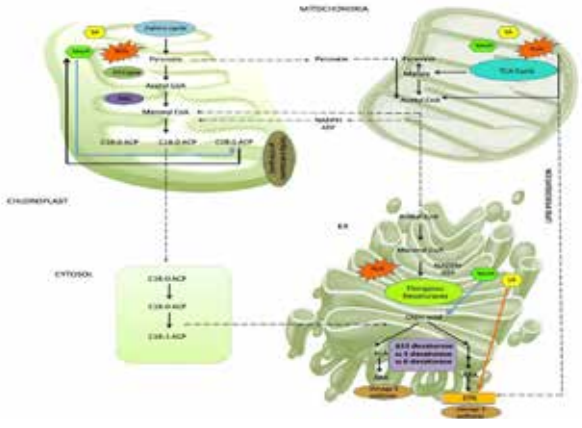


Fig.8: Effect of cassava sugar concentration on EPS Production

Mechanistic insights of stress hormones mediated lipid accumulation and modulation of specific fatty acids in Nannochloropsis oceanica CASA CC201:

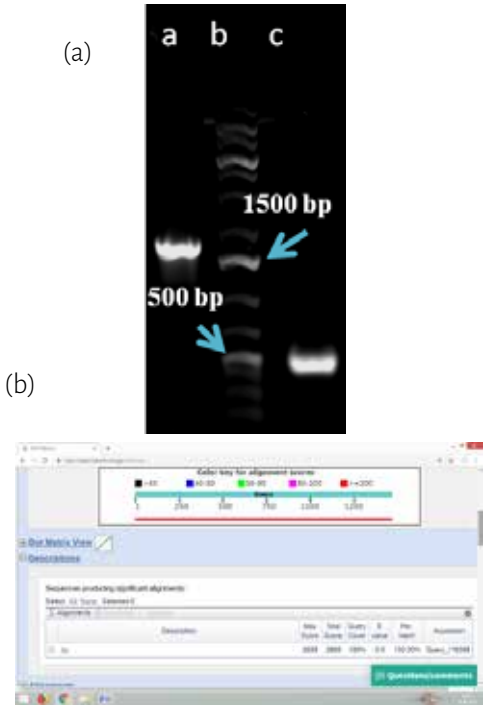
Nannochloropsis species are oleaginous marine microalgae, considered as potential feedstock for nutraceutical and pharmaceutical applications. It is necessary to overcome several drawbacks for making algae based high value metabolite accumulation economically feasible. Methyl Jasmonate and Salicylic acid were used to induce primary lipid accumulation and high value metabolite accumulation in *N.oceanica* CASA CC201 without compromising the growth characteristics. Exogenous application of MeJA promoted 1.4-fold increment of micro algal growth compared to control. Treatment with 10ppm SA induced significantly higher lipid production of 475mg/L (2.2 fold). Total carbohydrate, protein and pigment production was also found to be increased in a hormone specific and concentration dependent manner. Interestingly treatment with higher doses of MeJA promoted Monounsaturated fatty acid production, particularly oleic acid (C18:1) at early stationary growth phase, while treatment with SA induces essential omega 3 fatty acid production (EPA, C20:5). This significant modification of fatty acid compositions was correlated with the oxidative stress in terms of total Reactive oxygen species production and endogenous IAA levels. Collectively, the results indicated that treatment with stress associated plant hormones significantly increased high value metabolite accumulation specifically MUFA and PUFA production by modulation stress mechanisms and endogenous growth hormone levels .



Effect of MeJA and SA on lipid accumulation and modulation of specific class of fatty acids in N. oceanica CASA CC201.

Identification of selenoproteins gene from microalga *Scenedesmus quadricauda* CASA CC202:

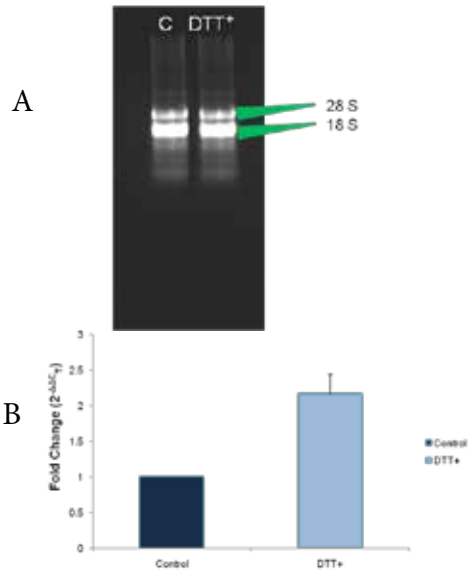
Selenoproteins are a class protein in which an unusual amino acid selenocysteine (Sec) is incorporated into it by TGA codon (normally act as stop codon) using specific cellular machinery. Most of these selenoproteins are associated with redox balancing of the cell. They are present in all domains of life except plants and fungi. Surprisingly, some of the micro algal species belong to plant kingdom do have the system to synthesize these unique proteins. We found that the microalga *Scenedesmus quadricauda* possess all the machinery to synthesize the selenoproteins and also identified selenoprotein T (SelT) from *S. quadricauda* by its whole genome sequencing and analysis. SelT gene was amplified from *S. quadricauda* by Polymerase Chain reaction (PCR) and sequenced for further confirmation.



Confirmation of the gene for selenoprotein T (SelT) from *S. quadricauda* PCR for seleopporotein gene confirmation, B) BLAST Analysis

Identification of SelT transcript level from Scenedesmus quadricauda

The transcript level analysis of SelT in *S.quadricauda* by inducing Endoplasmic reticulum (ER) stress revealed that, after an 8 hr of ER stress induction, there was a 1.2±0.2769 fold increase in its mRNA level as compared to control.



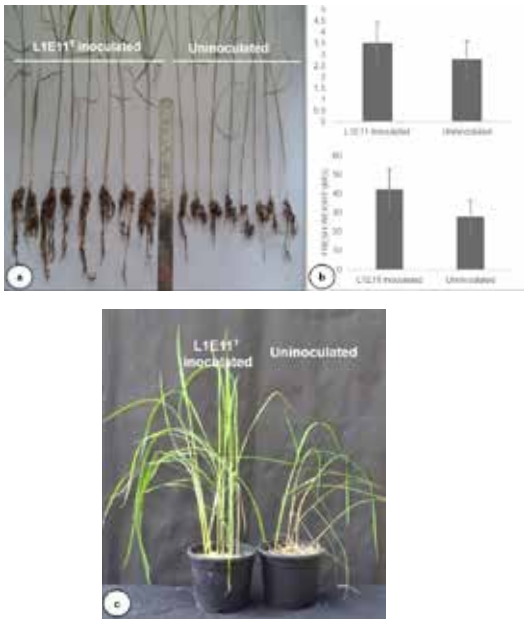
A. RNA isolated from *S.quadricauda* treated with DTT (ER stress inducer) and without DTT (control, C).B showing fold change in the SelT transcript under ER stress.

Plant Microbe Interaction

PGPR tools for improving crop productivity in stressed agricultural systems:

Phyto-beneficial properties of the novel isolates.

All three strains L1E11^T, L1E4 and 228 were able to grow on minimal salts medium with ACC as sole nitrogen source and exhibited ACCd activities in the range from 1.87±0.27 to 2.88±0.71 µmol of α-ketobutyrate/h/mg of protein. Further, we identified the presence of a putative *acds* gene (1008bp) encoding ACCd in the draft genomes of L1E11^T and 228. This result was further confirmed by polymerase chain reaction (PCR) amplification of the *acds* gene using specific primer pair F1ACC/R1ACC. These results clearly suggest an active ACCd gene functioning in the novel strains. Following this, an investigation of the phytostimulatory effects of the novel strains on pokkali rice variety (VTL-6) was checked. Initial treatment of VTL-6 seeds with strains L1E11^T, L1E4 and 228 (OD_{600}=1.0) respectively, did not have any negative effect on the seed germination



Positive growth effect of L1E11^T on VTL-6 rice plants after 14 days post inoculation (a). Respective graph shows the differences in root length and fresh weight of the L1E11^T inoculated and uninoculated plants after 14 days post inoculation (b). L1E11^T inoculated VTL-6 rice plants survives longer (a) compared to uninoculated control plants (b) under 200mM NaCl stress.

indicating that they may not be seed pathogens. Interestingly, we observed an increased root length and fresh weight in L1E11^T treated seeds as compared to non-treated pokkali seeds after 14 days of incubation. Similar results were obtained in repeat experiments (data not shown), indicating that L1E11^T able to promote rice growth. Furthermore, we found that L1E11^T treated rice plants were able to resist 200mM NaCl stress better as compared to the uninoculated control plants. All these data clearly suggest that L1E11^T can mediate growth and protect its host plant from saline stress by modulating the stress ethylene levels as like other ACCd producing plant beneficial rhizobacteria functions. However, further detailed experiments are required to prove this conclusion.

Proposal of Pokkaliibacter plantistimulans gen. nov. sp. nov., by a polyphasic taxonomic approach.

The almost complete 16S rRNA gene sequences (>1400 bp) of the three novel strains L1E11^T, L1E4 and 228 were determined. The strains were phylogenetically very similar as they shared 99.9-100% 16S rRNA sequence similarities among each other. 16S rRNA gene sequence comparisons with reference bacteria with validly published names available in GenBank and the Eztaxon e-database indicated that strains L1E11^T, L1E4, and 228 belong to the order *Oceanospirillales* within the class *Gammaproteobacteria* and were most closely related to *Balneatrix alpica* 4-87^T with only 92.1% 16S rRNA sequence similarity. The strains shared 16S rRNA gene sequence similarities lower than 91.50% with representative members of the orders *Oceanospirillales* and *Alteromonadales* other than the genus *Balneatrix*. In the 16S rRNA maximum likelihood tree, the strains L1E11^T, L1E4 and 228 formed a distinct monophyletic clade with 100% bootstrap support, which was well separated from its nearest phylogenetic neighbour, *B. alpica* 4-87^T and also from other described members of the order *Oceanospirillales*.

Apart from being phylogenetically distinct, the novel strains L1E11^T, L1E4 and 228 can be differentiated from their nearest phylogenetic neighbour, *B. alpica* 4-87^T in many phenotypic and biochemical properties as listed in Table 1. The major whole cell fatty acids detected in strains L1E11^T, L1E4 and 228 were C16:1 ω6c/ C16:1 *ω7c*, C16:0 and C18:1 *ω6c* /C18:1 *ω7c* which is in line with most members of the order *Oceanospirillales*. The comparison of the fatty acid contents under both conditions showed that the novel strains contained higher amounts of C12:0 3-OH (4.5-10.0%) than the type strain of *B. alpica* (2.2%). Further, the novel strains were well differentiated from *B. alpica* DSM 16621^T based on the presence of C12:0 and absence of significant amounts of C10:0 3-OH (Table 1). Thus, the whole cell fatty acids profile of the novel strains and its closest phylogenetic neighbour *B. alpica* DSM 16621^T appeared to be significantly different (Table 2). The type strain L1E11^T contained ubiquinone Q-8 as major respiratory quinone and an unknown phospholipid (PL), phosphatidylethanolamine (PE), and phosphatidylglycerol (PG) as major polar lipids which are in agreement with chemotaxonomic data reported for the order *Oceanospirillales*.

Maximum Likelihood phylogenetic tree based on of 16S rRNA gene sequences of L1E11T, L1E4, 228 and the members of the order Oceanospirillales. Bootstrap values greater than 70% are shown at nodes. Scale bar indicates nucleotide substitution per site.

Characters	L1E11^T	L1E4	228	***B. alpica*** **DSM 16621^T**
Human Pathogen	-	-	-	+[a]
ACC deaminase production	+	+	+	nd
Growth at				
42**℃**	+	+	-	+
46**℃**	-	-	-	+
Growth in				
6% NaCl	+	+	+	-
7% NaCl	-	-	+	-
API 20NE results				
Nitrate reduction	-	-	-	+
Indole production	-	-	-	+
Assimilation of				
L-Arabinose	+	+	+	-
Caprate	+	+	+	-
D-Maltose	+	-	-	+
Phenyl acetate	+	+	+	-
Utilisation of				
Rhamnose	-	-	+	nd
Xylose	+	+	+	-

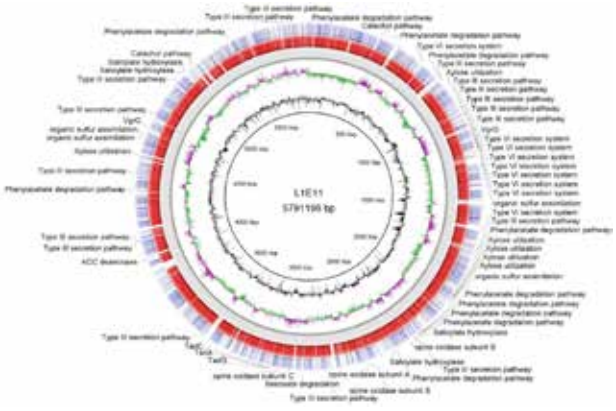
Table 1. Useful phenotypic characters which differentiates strain L1E11^T, L1E4 and 228 from their nearest phylogenetic neighbour *B. alpica* DSM 16621^T. Symbols; +, positive; -, negative; nd, not determined; a, causes pneumonia and meningitis

	L1E11^T		L1E4		228	B. alpica DSM 16621^T	
	Marine agar	Tryptic soy agar	Marine agar	Tryptic soy agar	Marine agar	Marine agar	Tryptic soy agar
Saturated							
$C_{12:0}$	3.3	2.6	3.4	3.0	2.9	-	-
$C_{16:0}$	31.7	28.3	33.6	30.1	26.4	20.6	18.3
Hydroxy							
$C_{10:0}$ 3-OH	-	-	-	-	-	3.4	3.1
$C_{12:1}$ 3-OH	1.1	-	1.2	-	-	-	-
$C_{12:0}$ 3-OH	9.0	7.3	10.0	7.8	4.5	2.2	2.2
Cyclo							
$C_{17:0}$ cyclo	2.6	-	2.3	-	-	-	-
Feature 3*	27.4	32.6	22.1	29.1	36.0	45.1	49.2
Feature 8*	22.8	26.1	24.6	27.3	27.9	27.6	26.3

Table 2. Whole cell fatty acid composition of strains L1E11^T, L1E4, 228 and *B. alpica* DSM 16621^T. All data obtained in this study. Only fatty acid percentages amounting 1% or higher are shown. Summed features represent groups of two fatty acids which could not be separated by GLC and MIDI system. Cells were grown in both marine agar and tryptic soy agar for 2 days at 28°C. *Summed Feature 3, $C_{16:1}$ ω7c/$C_{16:1}$ ω6c/ $C_{16:1}$ ω6c/$C_{16:1}$ ω7c; Summed Feature 8, $C_{18:1}$ ω7c/ $C_{18:1}$ ω6c.

Genome Based differences and AAI/ANI values

The estimated genome size of L1E11^T and 228 was larger as compared to its nearest phylogenetic relative, *B. alpica* DSM 16621^T. In addition, the genomes of L1E11^T and 228 contained higher numbers of transposases, mobile elements and CRISPR associated proteins as compared to *B. alpica* DSM 16621^T. All these data suggest that genome plasticity correlates with environmental complexity. In support of this view, a comparison of the three genomes using BRIGS software was performed, keeping L1E11^T as the reference genome. This analysis clearly showed that the genomes of two novel strains L1E11^T and 228 were highly similar. In contrast, no highly conserved regions were observed between the genomes of *B. alpica* DSM 16621^T and L1E11^T and 228, with similarities of 70% or less obtained between *B. alpica* DSM 16621^T and the reference genome. Further, we identified several unique regions in the genomes of L1E11^T and 228 that are absent in the genome of *B. alpica* DSM 16621^T. Interestingly, these identified unique regions encode gene functions that attribute plant-associated lifestyle. Thus, these genome results clearly differentiated the two novel genomes from the genome of its closest phylogenetic neighbour; *B. alpica*. Furthermore, the genome contents which may be due to their specific adaptations to the habitats from which they were isolated.



Genome comparison of L1E11^T, 228 and *B. alpica* DSM 16621^T with regard to gene functions related to plant-associated lifestyle

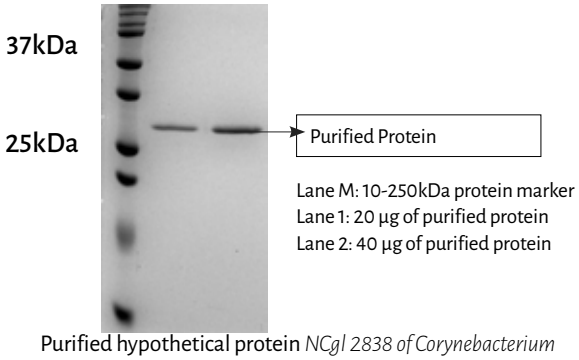
Finally, the ANI values between the two novel genomes (L1E11^T and 228) and *B. alpica* DSM 16621^T was in the range of 76.4-76.6%. These values are well below the proposed cut-off of 94% for species delineation. Together, these genomic data clearly support the distinct taxonomic status of the novel strains higher than the species level rank within the order *Oceanospirillales*.

In summary, on the basis of phylogenetic divergence, low 16S rRNA similarity values, chemotaxonomic, phenotypic and genomic data, strains L1E11^T, L1E4 and 228 can be considered to represent a novel species of a novel genus, for which the name *Pokkaliibacter plantistimulans* gen. nov. sp. nov., is proposed, with strain L1E11^T (=DSM 28732^T =MCC 2992^T) as the type strain

Genomics Proteomics and Molecular Biology of industrial Microorganisms

Cloning and overexpression of the Hypothetical protein NCgl 2838 of *Corynebacterium glutamicum* ATCC 13032

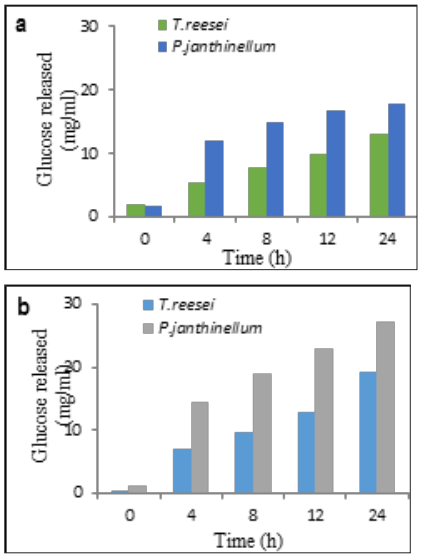
The hypothetical protein *NCgl 2838 [Corynebacterium glutamicum ATCC 13032] for* Sortase (Cg-Srt (GeneBank No. NP_602126) residues 45-274) was cloned into the *NdeI-SalI* restriction sites of the pET28a vector. The *protein* was successfully expressed as soluble functional protein in BL21 (DE) 3 E. coli cells and was purified and the *His* tagged protein is confirmed by appropriate Western blot. The purified protein showed sortase like hydrolytic activity towards sub E1-LAETG, sub E2-LAXTG an *in vitro* HPLC assay.



Purified hypothetical protein *NCgl 2838 of Corynebacterium glutamicum ATCC 13032* showing Sortase like hydrolytic activity

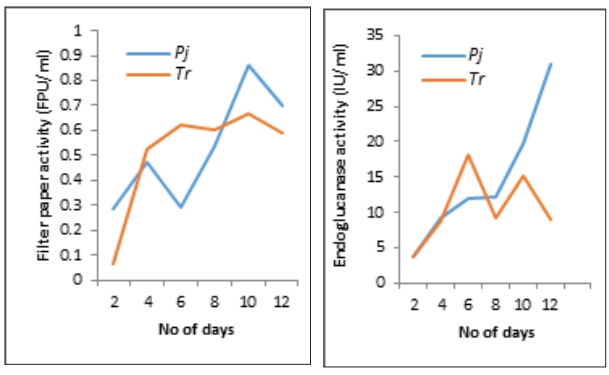
Engineering of cellulase-producing *Penicillium* sp. for quality enhancement and hyper-secretion of biomass hydrolyzing enzymes

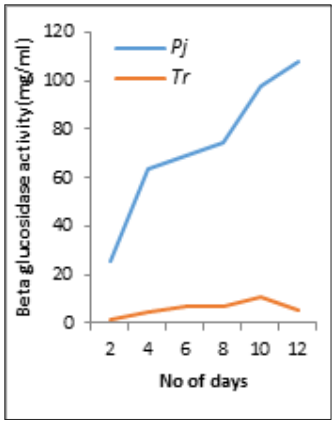
Penicillium janthinellum is a cellulase hyper-producer and produces a higher titer of cellulase in comparison to the commercially used hyper producing fungus *Trichoderma reesei* RUT C30. A comparison of the cellulose hydrolysis by these fungi shows higher glucose release from pretreated rice straw by *P janthinellum* enzyme.



Comparison of glucose release during hydrolysis reactions using cellulase enzymes from *Pjanthinellum* and *T.reesei* from A) Acid pretreated and B) Alkali pretreated rice straw

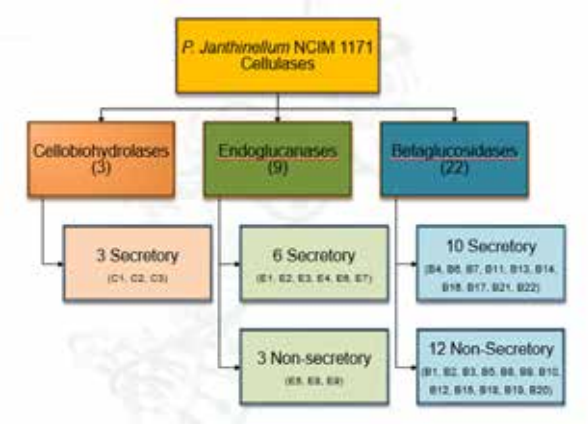
Total cellulase activity, endoglucanase activity and beta glucosidase (BGL) activity of *Pjanthinellum* was also higher than *T .reesei* indicating its huge potential as a source of biomass hydrolyzing activity.





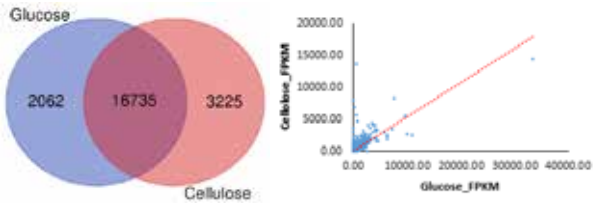
Comparison of *Pjanthinellum* and *T.reesei* for a. total cellulase activity, b. beta glucosidase activity and c. endoglucanase activity during growth in basic Mandel and Weber medium with cellulose as sole carbon source

It was also observed that blending in of a glucose tolerant BGL from *Aspergillus* unguis to the *P. janthinellum* cellulase can enhance its biomass hydrolyzing potential to a significant level. Since the organism exhibits high cellulase production and since practically nothing is known about its gene regulation, the genome of the organism was sequenced by whole genome shot gun sequencing by NGS (Genbank Accession No. NPFE00000000). Major cellulase genes identified from the genome is provided below.



Summary of cellulase genes identified and annotated from the genome of *P.janthinellum* NCIM 1171

Transcriptome analyses of the organism was performed for fungus grown in inducing (cellulose as carbon source) and uninduced (glucose as carbon source) conditions to study the differentially expressed genes and genes co-regulated with cellulases, which might help in deciphering the gene regulation in this fungus. A total of 22023 genes were expressed under these conditions of which 1167 genes were differentially expressed (Log FC>2 and FDR <0.05).



Gene expression pattern in control (glucose) and test (cellulose) conditions. The Venn diagram shows the no. of transcripts in each condition

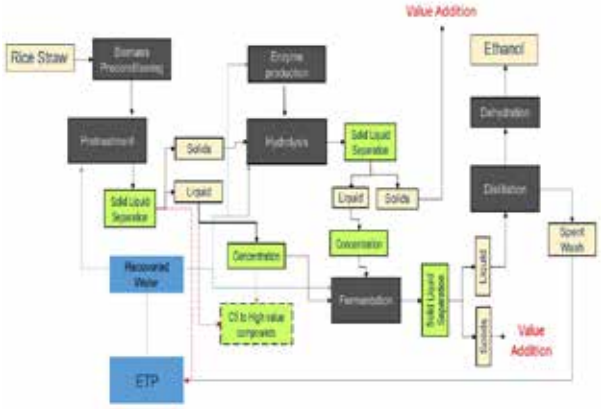
Of these 815 genes were upregulated and 352 genes were down regulated. Three of the cellobiohydrolase genes, 7 endoglucanase genes and 4 BGL genes were highly upregulated under induction conditions. A total of 39 transcription factors were differentially expressed. Three xylanase genes and one LPMO gene was also highly upregulated. Besides these, the known orthologs of fungal cellulase regulators – ClrB, Cre I, XlnR were upregulated and Ace1 was downregulated hinting a transcriptional control of cellulase production by the fungus.

Biofuels and Biorefineries

PANCSIR-2G Ethanol (PANCSIR-2GE) Program

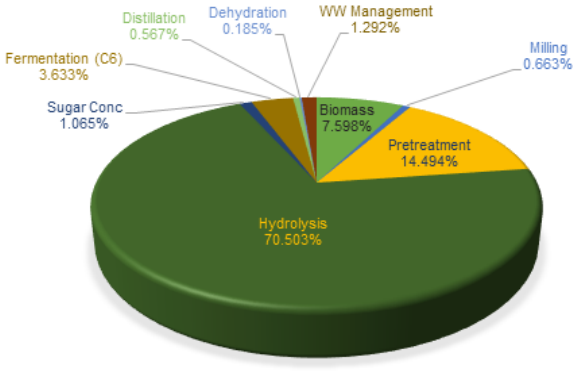
India strongly supports renewable transportation fuels and the new biofuel policy mandates ethanol blending in gasoline. The country urgently needs 2G ethanol (2GE) technologies that are cost competitive, but the existing bioethanol technologies in the country are limited in number and largely dependent on imported consumables (eg. enzymes) with very less transparency on the cost of production. CSIR represented by its constituent laboratories has been working on lignocellulosic biomass conversion to ethanol (2G Ethanol/Bioethanol) for past several years. However, we have not been able to bring out a cost effective technology for 2G ethanol production that may be considered ready for commercialization. While some labs have processes covering the entire

unit operations from biomass conversion to ethanol-distillation and dehydration; some labs have developed processes/technologies for particular unit operation(s). Individually these operations may be as good as, or even superior to their counterparts employed in the currently demonstrated global technologies. A new PAN CSIR FTT project on 2G ethanol has been launched where CSIR-NIIST is the coordinating lab. 8 other labs – CSIR-IIP, IICT, NCL, CFTRI, NEERI, CSMCRI and CGCRI are involved in the project. End to end process scheme for conversion of rice straw to ethanol was derived as represented in Figure 20. The target of the project is to achieve an operation cost of <Rs 100/L for bioethanol production from rice straw.



Schematic representing the CSIR 2GE ethanol process

Mass and energy balances of each unit operation was derived and based on these, cost estimates were made for the process operation. The contributions of each unit operation as percentage of total cost is shown below.



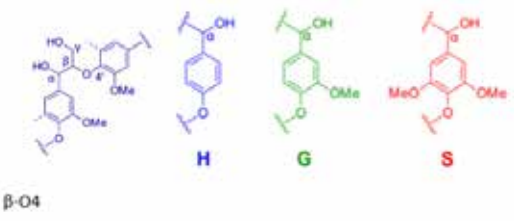
Cost contributions of individual unit operations in bioethanol production

The project has identified the major cost contributors as hydrolysis and pretreatment steps. Reduction in hydrolysis cost can be attained to some extent by lowering enzyme production costs. Attaining credits for by products is identified as a must to reduce costs to the targeted level. Zero liquid discharge process for waste water management for biorefinery is a unique CSIR 2GE USP which none of the existing technology providers in India is offering. The ZLD process is estimated to be net energy positive and can also provide credits to the 2GE process through biogas, fertilizers etc. Enzyme cocktail for biomass hydrolysis, being developed at NIIST can be major CSIR contribution and lignin value addition can significantly reduce the cost of production by adding credits

Lignin as a phenol source for phenol formaldehyde adhesives

Characterization of lignin isolated from the enzymatic residue of acid pretreated sugarcane bagasse for incorporation in phenol-formaldehyde resin.

Acid pretreatment is a strategy employed in a lignocellulosic biorefinery leading to the separation of pentose and hexose sugar. The residue left out after enzyme hydrolysis of acid pre-treated biomass is rich in lignin and can be a potential source for biochemical transformation. The current study deals with isolation of lignin from the enzymatic residue of acid pre-treated sugarcane bagasse and its characterization. The isolation method has a bearing on the properties of isolated lignin. Three different methods have been employed namely alkaline isolation, mild acidolysis and organosolv for the isolation of lignin and in turn evaluate the effect of isolation method on the physiochemical properties of lignin. Isolated lignin was



also evaluated for its reactivity towards formaldehyde for the phenol-formaldehyde resin.

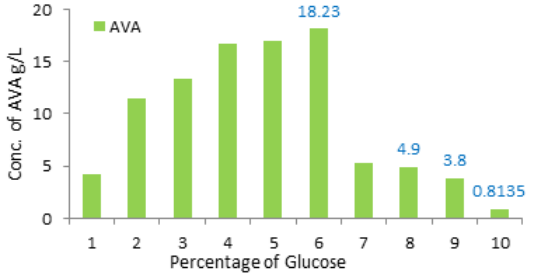
Isolation of lignin by alkali yielded better recovery compared to other two methods. However, organosolv lignin was purer as per XPS and NMR analysis. Organosolv lignin seems to be a better candidate for the replacement of phenol in phenol formaldehyde resin owing to the high content of sinapyl group whose ortho position are free to react with formaldehyde to form phenol formaldehyde resin as adhesives

Table-1 Comparison of physical properties of lignin

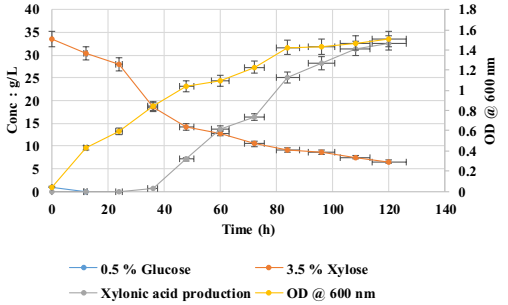
Lignin	GPC Mol. Wt (g/mol)	IR	Total Phenolic and aliphatic OH In mmol/g	2D-NMR	% lignin on surface by XPS
Alkali lignin	1292	G-S-H lignin (1327,833) 1120(C-H S unit)	Conjugated: 0.637 Unconjugated: 2.09 Total : 2.68	β-O4, G,S & H type lignin G>S	94
Dioxane lignin	3153	G-S-H lignin type (1327,833) C-H S unit (1116)	Conjugated: 0.50 Unconjugated: 0.62 Total : 1.12	β-O4, G,S & H type lignin G>H>S	86
Organosolv lignin	4230	G-S-H lignin (1327,833) C-H S unit (1100)	Conjugated: 0.944 Unconjugated: 1.180 Total : 2.122	β-O4, β-5, G,S & H type lignin S>G>H	98
Standard Kraft lignin	1692	G-S lignin type 1118 (S lignin) 1029,1325(G lignin)	Conjugated: 0.499 Unconjugated: 3.05 Total : 3.556	β-O4, β-5, G,S type lignin G>S	88

Use of metabolically engineered *Corynebacterium glutamicum* as the cell factory for the production of value added products from lignocellulosic derived sugars

C. glutamicum is able to co-utilize mixed carbon sources, making it a preferential host for utilization of complex carbon sources such as second generation biomass (plant biomass that does not have any value as food and no or less value as fodder) for the production of commodity chemicals. Xylonic acid is a promising organic acid with important application as a green solvent and effective biocatalyst and precursor for bio plastic and polymer synthesis. The α,ω- diamines and amino acids serves as potential C5 building blocks of the valuable polyamides like nylon. Initiated a research programs looking at the construction of recombinant *Corynebacterium glutamicum* strains for the production of above said chemicals. *C. glutamicum* strains were successfully made with respect to the production of- amino acids (GABA (gamma-aminobutyric acid) and 5-aminovalerate (δ-Aminopentanoate)) and the sugar acid, D- xylonic acid. The proof of concept with respect to their production in synthetic media is demonstrated.



Production of 5-Amino valerate (AMV) by genetically modified. *C.glutamicum* strain with respect to glucose percentage in CGXII medium



Utilization of Xylose and corresponding D-xylonic acid production by recombinant *C. glutamicum* strain containing xylose dehydrogranse gene (xylB) of Caulobacter crescentus In CGXII medium

RESEARCH PLANNING AND BUSINESS DEVELOPMENT
CONTRACT RESEARCH PROJECTS 2018-19

Project Title	Project Leader	Sponsoring Agency
Agro Processing & Technology Division		
Bio processing of two coded anti-diabetic medicinal plants based on ethnomedical leads- A molecular pharmacological approach	Dr P Jayamurthy	DBT
Bis Indolyl methane conjugates of Biaryls: Role in apoptosis, cell cycle regulation and PI3K/AKT/mTOR signalling pathway in Human breast and cervical cancer cells	Dr S Priya	KSCSTE
Can enrichment of Palm Neera Syrup cause immunomodulation	Dr M V Reshma	KSCSTE
Development of biflavonoid based lead molecule (NIIST -OBT-2) from Garcinia travancorica for non-alcoholic fatty liver disease	Dr G Sindhu	Dept. of Health Research, New Delhi
Development of novel leads for anti-obesity from North East traditional system through chemistry biology interphase	Dr K G Raghu	DBT
Dissect the function of fundamental cilia-genes associated with ciliopathies in patients	Dr Shobi Veleri	DBT
Enhancement of the stability & acceptability for newly developed products	Mr V V Venugopal	M/s Pankajakasturi Herbals India Ltd, TVM
Evaluation of beneficial effect of Boeravinone-B from Boerhaavia diffusa against diabetic cardiomyopathy through mitochondria mediated pathway in H9c2 cardiomyoblast and heart for development of nutraceuticals	Mr Salin Raj	Dept. of Health Research, New Delhi
Identification of proprotein convertase subtilisin kexin-9 (PCSK-9) inhibitors from Garcinia cambogia	Dr Shyni G L	Dept. of Health Research, New Delhi
In vitro evaluation of nutritional and probiotic activity of sweetners	Dr P Nisha	Tata Chemicals
Investigation of resveratrol based compounds from Dipterocarpaceae family for their anti-diabetic potential	Dr P Jayamurthy	KSCSTE
Mining and characterization of novel antimicrobial molecules produced by streptomyces species	Dr S Nishant Kumar	DST
Occurrence of acrylamide, a heat induced food toxicant, in processed food products of India: mitigation strategies and health risks	Dr P Nisha	Food Safety & Standards Authority of India

Post-harvest operations for value addition of indigenous fruits and vegetables	Dr P Nisha	Dept of Agriculture , GOK
Role of mitophagy in cardiac hypertrophy: an in vitro cell line approach	Dr Vandana Shankar	DST
Technology development for value addition/preservation of coconut water	Mr V V Venugopal	Coconut Development Board, Cochin
Valorization of spent turmeric/amla: Process development for antioxidant dietary fibre enriched products as metabolic enhancers	Dr P Nisha	BIRAC
Value addition of coconut syrup and its studies	Dr M V Reshma	Coconut Development Board, Cochin
Chemical Sciences & Technology Division		
Activity guided screening of phospho diestrease inhibitors from Indian medicinal plants to treat erectile dye function	Dr A Kumaran	ICMR
Biocompatible combined polymer polysaccharide core-shell VEGF-Targeted Nano-Carrier for sustained Intraocular pharmacotherapy towards diabetic retinopathy	Dr K K Maiti	DBT
Cucurbit[n] uril homologues and their derivatives as receptors for a few ionic and neutral analytes	Dr Rakesh Mishra	DST
Design and development of bio-based novel liquid crystalline conductive electrodes and electrolytes for high performing flexi-energy storage devices	Dr J D Sudha	DST
Design and processing of nano structured hybrid composite materials for electro chemical energy storage	Dr Narayanan Unni	DST
Design, synthesis and studies of self-assembling luminescent metallo- peptides	Dr V K Praveen	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	DST (FAST TRACK)
Development of flexible solar cells through innovative photoanode/ Active later systems	Dr J D Sudha	ISRO
Development of multiplexing detection platform of breast cancer biomakers by non-invasive Surface Enhanced Raman Scattering (SERS)- Nanoprobe	Dr K K Maiti	DST
Development of novel NIR absorbing sensitizers and their nano-conjugates for the multi model cancer imaging and therapy	Dr Joshy Joseph	DBT

Development of novel organic materials for photovoltaic applications	Dr C Vijayakumar	DST
Development of synthetic strategies for diverse compound collection of privileged structural motifs for medicinal chemistry	Dr L Ravi Shankar	KSCSTE
Dynamic molecular, supramolecular and surface chemistry for spatiotemporal modulation of smart advanced functional materials	Dr Sreejith Shankar Pooppannal	DST
Engineering intelligent theranostic nanocarrier for targeted therapy and diagnosis of Cancer	Dr K K Maiti	SERB
Engineering Nanostructured surfaces for Developing SERS Sensing Platform	Dr Yoosaf Karuvath	DBT
Fluorescent molecules and assemblies for sensing and imaging (J C Bose Fellowship)	Dr A Ajayaghosh	DST
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	DBT
Indigenous development of Semi-automatic equipments for large area dye-sensitized solar module fabrication	Dr Narayanan Unni	Ministry of Science & Technology, DST
Investigation of ultra-fast dynamics of chromophores involved in singlet exciton fission processes towards solar cell applications	Dr Karunakaran Venugopal	DST
Large area opto-electronics for Australia and India : From materials to advanced devices	Dr Narayanan Unni	DST
Low cost photonic device for diagnostic applications	Dr Animesh Samanta	DST
Mechanical stimulation induced microscopic crystalline structure changes in molecular materials: Implications on drug formulation and mechanochromic behavior	Dr Sunil Varughese	SERB
Modulating the morphology and molecular packing of self-assembled organic nanomaterials for efficient photo-induced electron transfer	Dr Yoosaf Karuvath	SERB
Nano structured electrodes for energy storage devices	Dr Raghy Raghavan	SERB
Nature Inspired chemical entities for healthcare applications	Dr B S Sasidhar	SERB
New materials for improved, cost-effective perovskites solar cells	Dr Joshy Joseph	DST

Quantum chemical modelling of CC and CN metathesis reactions and functional molecules containing unusual carbon-metal bonds	Dr C H Suresh	SERB
Revealing the interaction mechanism of the protein with lipids in the apoptosis process: electronic, vibrational and conformational relaxation dynamics of the heme in the liposomes	Dr Karunakaran Venugopal	DBT
Solar Hydrogen: An alternative avenue	Dr Suraj Soman	DST
Sulfonimidamides: Its synthesis and applications in organic synthesis; Development of new methodologies for the synthesis of hetrocyclic systems	Dr Ganesh Chandra Nandi	DST
Sustainable utilization of abundant natural resources: Synthetic transformations of zerumbone and germacrone towards chemically diverse sesquiterpenoid architectures	Dr K V Radhakrishnan	SERB
Synthesis a library of Aza-C KRN 7000 and Aza galacto lipid analogues for immunomodulatory screening	Dr L Ravi Shankar	SERB
Environmental Technology Division		
Algal biomass as a potential renewable resource of energy: Production of fuels & chemicals by heterogeneous catalysis	Dr Churchil Angel Antony Raj	DST
Determination of emission factors of dioxins from open burning of municipal wastes in Kerala	Dr K P Prathish	Kerala State Pollution Control Board
Development and demonstration of a 500kg/day food waste biomethanation plant at Trivandrum International Airport	Dr B Krishnakumar	Airport Authority of India
Development and field demonstration of waste management systems for a medium scale industry	Dr B Krishnakumar	Jai Hari Food Products, Pathanamthitta
Development of chloride free saleable iron oxide from by-products of Titanium pigment production via chloride route	Dr K P Prathish	DST
Development of hydrothermal liquefaction of microalgae for production of bio-oil	Dr Paneer Selvam	DST
Novel hybrid nanostructured surface modified electrodes for sensors and biosensors	Dr K P Prathish	DST
SMART FOUNDARY (SMART= Sustainable Metal casting using Advanced Research and Technology	Dr S Savithri	DST
STP secondary treatment, a feasibility study	Dr B Krishnakumar	Kerala Water Authority

Materials Science & Technology Division		
Alumina based LTCC & HTCC substrate for hybrid microelectronic circuits instrategic sector applications	Dr K P Surendran	DST
Bio plastic from poly(Lactic acid)/ Coir composites	Mr M Brahmakumar	Coir Board
Chemical functionalization of Si with 2D structures: Anode materials for lithium ion battery with significantly improved volumetric capacity	Dr Saju Pillai	DST
Designing green, self-healing coatings for metal protection	Dr K G Nishanth	SERB
Development and in-vitro Characterization of magnesium alloys for biocompatible and biodegradable implant applications	Dr A Srinivasan	SERB
Development of Biodegradable mulching mats using coir-polymer systems	Dr Saju Pillai	NCRMI
Development of ceramic membranes and setting up of a pre-pilot plant manufacturing facility	Dr U S Hareesh	DST (TSDP)
Development of graphene based membranes from graphite ore for desalination	Dr S S Sreejakumari	Ministry of Mines
Development of hydrophobic glaze for porcelain insulator	Dr S Ananthakumar	M/S Adithya birla
Development of light weight functionally graded metal- ceramic composite armour materials for defence applications	Dr T P D Rajan	ARMREB, New Delhi
Development of Light weight near net shape aluminium composite substrates for thermal management in electronic and avionic packaging systems	Dr T P D Rajan	DST, New Delhi
Development of Lightweight Aluminum based Crankcase for Automotive Air Compressor Brake Systems	Dr T P D Rajan	WABCO India Ltd
Development of magnetically modulated therapeutically active layered double hydroxide(LDH) as a nanomedicine with hyperthermia potential for cancer theranostics	Dr Manoj Raama Varma	SERB
Development of novel magnetodielectric materials for miniaturized microstrip patch antennas	Dr Manoj Raama varma	ISRO
Developments of environmentally benign inorganic pigments for energy saving cool roof and anti-corrosive applications	Dr K G Nishanth	SERB

Generation of structural data for new ceramic complex oxides	Dr Prabhakar Rao	ICDD
Green Synthesis of Warm White Light Emitting Single Phase Oxyfluoride Phosphors for Thermally Stable, Energy Efficient, and Elevated color Rendering LED Lamps.	Dr Subrata Das	SERB
Improvement of Flux Pinning in Bi-based superconductor Tapes	Dr Manoj Raama varma	SERB
Investigation of structural, optical, magnetic properties and electronic structure of binary inter-metallic alloys for the spintronic applications	Dr M Vasundhara	DST
Large-Scale Production of Coir/Polymer Composites for Acoustic Applications	Dr V S Prasad	NCRMI
Process development for enhancing the longevity of coir geotextiles(Coir Bhoovastra)	Dr V S Prasad	Coir Board
Process development for surface modification of coir fibers for enhanced spinnability	Dr Bhoje Gowd	Coir Board
Processing of CeO2 Nanoparticles for energy saving glaze coatings and cool textiles	Dr S Ananthakumar	IRE
Processing Of TiO2 coated hydrous Kaolin for enhanced brightness and thermal stability	Dr S Ananthakumar	M/s Surya Mine Chem
Production of polymer/coir composites for furniture Application	Mr M Brahmakumar	NCRMI
Quantitative assessment of hot tearing characteristics of aerospace magnesium alloys using instrumented constrained rod casting (CRC) technique	Dr A Srinivasan	Aeronautical Research and Development Board
Recovery of scandium metal from acid leach liquor from titanium mineral industries	Dr M Sundararajan	Ministry of Mines
Synthesis and characterization of broad spectrum ultraviolet filter with visible light emission and antioxident activity: A potential multifunctional active ingredient with multitude of applications	Dr Adersh Ashok	DST
Technology development of recycling of aluminium (SARAPS) alloys for industrial applications	Dr M Ravi	DST

Microbial Processes & Technology Division		
Bio prospecting and taxonomic studies of marine micro organisms in search of novel anti-infectives	Dr N Ramesh Kumar	Ministry of Earth Sciences
Characterization of major agro-residues biomass in India	Dr Rajeev K Sukumaran	TIFAC
Characterization, recombinant expression, process scale up validation of selected hydrolases from native action bacteria for commercial exploitation	Dr Rajeev K Sukumaran	DBT
Deciphering interacting partners of PAMPs / Effectors of collechotrichium falcatum that trigger innate immunity in sugarcane	Dr Rajeev K Sukumaran	DBT
Development of a bioprocess for the commercial production of Gibberallic acid	Dr K Madhavan Nampoothiri	Margosa Bio grow India Pvt. Ltd.
Development of a gene expression platform for heterologous protein production in the filamentous fungus Aspergillus unguis	Dr Rajeev K Sukumaran	DBT
Development of a sustainable process for the production of poly-3-hydroxybutyrate using kitchen and food waste	Dr R Sindhu	DST
Direct utilization of agroresidual biomass for the production of α,ω-diamines as well as α,ω-amino acids: strain and process development using Corynebacterium glutamicum	Dr K Madhavan Nampoothiri	DBT
Exploration and exploitation of microflora from Marcha and soil samples from high altitude soils for the production of 2,5-furan dicarboxylic acid and selected industrially important enzymes	Dr P Binod	Institute of Bio resources and sustainable Development, Manipur
Holistic processes and practices for clean energy in strengthening bioeconomic startegies	Dr P Binod	DST INDO-NORDEN
Integrated biorefinery for converting paper mill waste into chemical wealth	Dr P Binod	DBT INDO UK
Investigation of the dynamics & mechanism of flocculation by polymers and biopolymers for separation of solid particles of high rate thickeners in mineral processing industries	Dr Rakesh Kumar Yasarla	Ministry of Mines
Investigation on the synergistic effect of phytohormones on omega -3- fatty acid production from nanochloropsis sp.	Dr Muthu Arumugham	DBT

Isolation and Development of starter cultures for Dairy Products	Dr K Madhavan Nampoothiri	Accelerated Freeze Drying Co.LTD,
Loktak lake biomass (para- grass) based bio refinery for fuels and chemicals: Value addition through biotechnological and thermochemical platform	Dr Rajeev K Sukumaran	IBSD, Manipur
Microbiome analysis of saline tolerant Pokkali rice varieties of coastal agri saline fields(Pokkali and Kaippad tract) of Kerala and evaluating their core endophyte beneficial rhizobacteria for enhancing rice growth under saline conditions	Dr N Ramesh Kumar	DBT
Molecular and functional characterization of active saline adapted nitrogen fixing plant growth promoting bacteria of native grown coastal saline tolerant rice varieties (Pokkali) of Kerala	Dr N Ramesh Kumar	SERB
Molecular approach to enhance folate production in probiotic lactic acid bacteria	Dr K Madhavan Nampoothiri	KSCSTE
Quantification of substrate across membrane proteins	Dr Harsha Bajaj	DBT, New Delhi
Study on chemo-enzymatic transformation of lignin derived from lignocellulosic biomass for potential application as adhesives	Dr Leena Perumal	DST WOS A

CONSULTANCY PROGRAMMES

Project Title	Project Leader	Client
Analysis of water samples from Chimery, Vazhavi & Cheerakuzhi river basins	Dr K P Prathish	KSRSE, GOK
Characterization and confirmation of drug intermediates	Dr L Ravi Shankar	M/s. Apicore Pharmaceuticals Pvt.Ltd.
Characterization and interpretation of chemical intermediates(Cis) and active pharmaceutical ingredients(APIs)	Dr L Ravi Shankar	M/s Omgene Life Sciences Pvt. Ltd.
Characterization of silicone and silicone derivatives	Dr E Bhoje Gowd	M/s. Momentive Performance Materials (India) Pvt.Ltd.
Design of ETP for Kottarakara temple, TDB	Dr Ajit Haridas	TDB Thiruvananthapuram
EIA and EMP study for IREL NK Block-II & NK Block-II EE	Dr J Ansari	IRE Ltd
EIA study for KMML I V VII Phase II	Dr J Ansari	KMML
EIA study for KMML pond	Dr J Ansari	KMML
Estimation of phenolics in cashew formulation and validation of procedure	Dr J D Sudha	Western India Cashew Company Pvt. Ltd.
Hospital STP design	Dr Ajit Haridas	HLL Infra Tech Services Ltd,TVM
KWA water treatment plant fly & red worm problem	Dr B Krishnakumar	Kerala Water Authority
Microstructure analysis of industrial yarns	Dr E Bhoje Gowd	M/s SRF Ltd
Mineralogical, geochemical and morphological characterisation of raw ilmentite, reduced ilmenite, leached ilmenite and synthetic rutile	Dr K Harikrishna Bhat	KMML
Odour control and effluent pre-treatment at Al Badr Fish Canning unit at CSEZ, Kakkanad	Dr Ajit Haridas	WAPCOS Ltd
Odour control for shrimp feed factory	Dr Ajit Haridas	Avanti Feeds Limited
Performance improvement of ETP	Dr Ajit Haridas	BPCL -Kochi refinery
Process details for biogas recovery from spent tapioca leaf	Dr B Krishnakumar	ICAR-CTCRI
Sampling and analysis of water samples from Malampuzha and Chittoorpuzha	Dr K P Prathish	KSREC
Technical assistance for designing ETP for RBI, TVM	Dr B Krishnakumar	RBI, Trivandrum
Technical support to flow + solver code of Autocast XI	Dr S Savithri	3D Foundary Tech Pvt Ltd
X-ray photoelectron spectroscopy (XPS) of metallic powder samples of VSSC, Thumba, Trivandrum	Dr Saju Pillai	Department of space, Vikram Sarabhai space centre (VSSC), Trivandrum

हस्ताक्षर किए एमओयू / समझौते

अनु क्रमांक	शीर्षक	समझौता ज्ञापन की प्रकृति	उस फर्म / फर्मों का नाम जिनके साथ समझौता ज्ञापन / समझौता किया गया है	परियोजना का मुखिया
1	गैस और वाष्प अणुओं के लिए सिरेमिक अड्सोरबंट्स का विकास	भिन्नता का डीड	नोरितके, लिमिटेड, जापान	डॉ स अनंतकुमार
2	एक 500केजी/डे फूड वेस्ट बायोमीशन प्लांट स्थापित करना	समझौता	स्वैच फ्यूचर एनर्जी सॉल्यूशंस, तिरुवनंतपुरम	डॉ। बी कृष्णकुमार
3	डायनेमिक पावर विंडो (डीपीडबल्यू) प्रौद्योगिकी का संयुक्त विकास	गोपनीय प्रकटीकरण समझौते	असाही इंडिया ग्लास लिमिटेड (एआईएस), नई दिल्ली	डॉ आदर्श अशोक
4	डायनेमिक पावर विंडो (डीपीडबल्यू) प्रौद्योगिकी का संयुक्त विकास	समझौता ज्ञापन	एम/एस असही इंडिया ग्लास लिमिटेड (एआईएस), न्यू दिल्ली	डॉ आदर्श अशोक
5	झरझरा सिरेमिक समर्थन और सिरेमिक झिल्ली का विनिर्माण प्रौद्योगिकी	समझौता	सीएसआईआर-सेंट्रल ग्लास एंड सिरेमिक रिसर्च इंस्टीट्यूट, हैदराबाद	डॉ। यू एस हरेश
6	एंडोफाइटिक बैक्टीरियल फॉर्मुलेशन अर्थात विनिर्माण। संयंत्र टॉनिक	तकनीकी हस्तांतरण	ड्रा शेख मोहिउद्दीन, पश्चिम बंगाल	डॉ। बी एस दिलीप कुमार
7	फार्मास्यूटिकल्स योगों	गोपनीय प्रकटीकरण समझौते	सानुई-कॉनकेयर (इंडिया) पायथ लिमिटेड, मायवम	डॉ सुनील वरघसे
8	सिंथेटिक और प्राकृतिक उत्पादों के विरोधी संक्रामक / एंटीवायरल गुण	सहयोग समझौता	राजीव गांधी सेंटर फॉर बायोटेक्नोलॉजी, त्रिवेंद्रम	डॉ ल रविशंकर
9	सूखे काली मिर्च (काली) और परिपक्व हरी मिर्च से सफेद काली मिर्च का प्रसंस्करण (पाइपर नाइग्रम एल)	तकनीकी हस्तांतरण	श्री अब्दुल मनाफ ए, कोल्लम	डॉ। बी एस दिलीप कुमार
10	नारियल पानी के सीटू संरक्षण और मूल्यवर्धन में प्रौद्योगिकी विकास	समझौते का ज्ञापन	नारियल विकास बोर्ड, कोचीन	वेणुगोपाल में श्री वी
11	कोकोनट सिरप और इसके अध्ययन का मूल्यवर्धन	समझौते का ज्ञापन	नारियल विकास बोर्ड, कोचीन	वेणुगोपाल में श्री वी
12	पी-जीपी अवरोधकों का संश्लेषण	सहयोग समझौता	बोगर प्रयोगशालाओं, आंध्र प्रदेश और मैसर्स विष्णु इंस्टीट्यूट ऑफ फार्मास्यूटिकल एजुकेशन एंड रिसर्च (वीआईपीईआर), आंध्र प्रदेश और विष्णु कॉलेज ऑफ फार्मेसी (एसवीसीपी), तेलंगाना	डॉ ल रविशंकर
13	छोटे-कोण एक्स-रे बिखरने, चौड़े-कोण एक्स-रे विवर्तन और फूरियर ट्रांसफॉर्मर स्पेक्ट्रोस्कोपी (एफटीए) पर आधारित सामग्री	सामग्री परीक्षण के लिए समझौता	मोमेंटिव परफॉरमेंस मैटेरियल्स (इंडिया) प्राइवेट लिमिटेड, बैंगलोर	डॉ भोजे गौड
14	गैर-प्रकटीकरण समझौते के लिए समझौता	गैर प्रकटीकरण समझौता	रिकॉन ऑयल इंडस्ट्रीज प्राइवेट लिमिटेड मुंबई	डॉ। के जी रघु

15	ठोस राज्य किण्वन, माइक्रोबियल योगों और प्रक्रिया का सत्यापन	प्रायोजित अनुसंधान के लिए समझौता	त्वरित फ्रीज सुखाने कं लिमिटेड, कोचीन	डॉ। माधवन नामपुथिरी
16	एनआईआर परावर्तक सीईओ2 नैनोकणों के प्रसंस्करण के लिए ऊर्जा की बचत ग्लेज़िंग कोटिंग्स और शांत वस्त्र	प्रायोजित अनुसंधान के लिए समझौता	मेसर्स इंडियन रेयर अर्थ लिमिटेड टेक्नोलॉजी डेवलपमेंट काउंसिल, कोल्लम	डॉ स अनंतकुमार
17	ऑटोमोटिव एयर कंप्रेसर ब्रेक सिस्टम के लिए हल्के एल्यूमीनियम आधारित क्रैंककेस का विकास	गोपनीय समझौता	डबल्यूएबीसीओ इंडिया लिमिटेड, चेन्नई	डॉ। टी पी डी राजन
18	स्वास्थ्य देखभाल के लिए नैनो बायोसेंसर और माइक्रो तरल पदार्थ	समझौते का ज्ञापन	आरसीसी, टीवीएम	डॉ क क मैटी
19	स्विचेबल इलेक्ट्रोक्रोमिक स्मार्ट विंडो अनुप्रयोगों के लिए अणुओं, सामग्रियों और प्रोटोटाइप का विकास	पारस्परिक गैर प्रकटीकरण सम्झौता	डीसीएम श्रीराम लिमिटेड, गुड़गांव	डॉ। बिस्वप्रिया देब
20	खर्च की गई हल्दी का मूल्यांकन	समझौता ज्ञापन	अर्जुन प्राकृतिक लिमिटेड, अलवाए	डॉ। पी निशा
21	दर्द, सूजन और गठिया के खिलाफ अपनी क्षमता के लिए तैयारी के विभिन्न समय पर एवारथिस का एक तुलनात्मक अध्ययन	पारस्परिक गैर प्रकटीकरण सम्झौता	आर्य वैद्य फार्मेसी (कोयम्बटूर) लिमिटेड, कोयंबटूर	डॉ। पी। जयमूर्ति
22	गुरुत्वाकर्षण मर कास्टिंग और निचोड़ कास्टिंग द्वारा संसाधित उच्च शक्ति अल-सी-क्यूई-एमजी-श्री मिश्र धातु के माइक्रोस्ट्रक्चर यांत्रिक गुणों की स्थापना के लिए अध्ययन	प्रकटीकरण समझौते	श्री कालीश्वरी मेटल फाउंडर्स (पी) लैंडेड, शिवकाशी	डॉ एम रवि
23	एंटीवायरल लीड के रूप में सिंथेटिक यौगिकों के डिजाइन, संश्लेषण और जैविक मूल्यांकन	सामग्री स्थानांतरण	कैथोलिक विश्वविद्यालय बेल्जियम	डॉ। जुबी जॉन
24	बायो फिल्टर मीडिया	तकनीकी हस्तांतरण	ए.पी. इंजीनियर्स, तमिलनाडु	डॉ अजीत हरिदास
25	स्वीटनर्स के पोषण और प्रीबायोटिक गतिविधि का विट्रो मूल्यांकन	पारस्परिक गैर प्रकटीकरण सम्झौता	टाटा केमिकल्स लिमिटेड, महाराष्ट्र	डॉ निशा पी
26	उन्नत चमक और थर्मल स्थिरता के लिए टीआईओ लेपित हाइड्रॉलिक काओलिन का प्रसंस्करण	समझौता	मैसर्स सूर्या माइन केम, अहमदाबाद	डॉ स अनंतकुमार
27	उपन्यास का विकास रसायन विज्ञान जीव विज्ञान इंटरफेज़ के माध्यम से उत्तर पूर्व पारंपरिक प्रणाली से मोटापा विरोधी के लिए होता है	समझौते का ज्ञापन	डीबीटी	डॉ। के जी रघु
28	केले का फ़ाइबर एक्सट्रैक्शन	तकनीकी हस्तांतरण	इंडस ट्री सेराफ्स फाउंडेशन बैंगलोर द	राजीव के सुकुमारन
29	नए विकसित उत्पादों के लिए स्थिरता और स्वीकार्यता में वृद्धि	समझौता	मैसर्स पंकजा कस्तूरी हर्बल्स इंडिया लिमिटेड, त्रिवेंद्रम	वेणुगोपाल में श्री वी

MoUs/ Agreements Signed

SN	Title	Nature of the MoU	Name of the firm/firms with whom the MoU/Agreement is entered into	Project leader
1	Development of Ceramic adsorbents for gas and vapour molecules	Deed of Variation	M/s. Noritake Co., Ltd., Japan	Dr S Ananthakumar
2	Installing A 500KG / Day Food Waste Biomethanation Plant	Agreement	Ms. Swatch Future Energy Solutions, Thiruvananthapuram	Dr B Krishnakumar
3	Joint development of Dynamic Power Window (DPW) Technology	Confidential Disclosure Agreement	M/s. Asahi India Glass Limited (AIS), New Delhi	Dr Adarsh Ashok
4	Joint development of Dynamic Power Window (DPW) Technology	MoU	M/s. Asahi India Glass Limited (AIS), New Delhi	Dr Adarsh Ashok
5	Manufacturing technology of porous ceramic support and ceramic membranes	Agreement	M/s. CSIR-Central Glass & Ceramic Research Institute, Kolkata	Dr U S Hareesh
6	Manufacturing Endophytic bacterial formulation viz. PLANT TONIC	Technology Transfer	Dr. Sekh Mahiuddin, West Bengal	Dr B S Dileep Kumar
7	Pharmaceutical formulations	Confidential Disclosure Agreement	Sanofi-Synthlabo (India) Pvt Ltd, Mumbai	Dr Sunil Varughese
8	Anti-infective/antiviral properties of synthetic and natural products	Collaboration Agreement	M/s. Rajiv Gandhi Centre for Biotechnology, Trivandrum	Dr L Ravi Shankar
9	Processing of white pepper from dried pepper (black) and matured green pepper (Piper nigrum L)	Technology Transfer	Shri. Abdul Manaf A, Kollam	Dr B S Dileep Kumar
10	Technology Development for in situ Preservation and Value Addition of Coconut Water	MoA	M/s. Coconut Development Board, Cochin	Mr V V Venugopal
11	Value addition of Coconut Syrup and its studies	MoA	M/s. Coconut Development Board, Cochin	Mr V V Venugopal
12	Synthesis of p-gp inhibitors	Collaboration Agreement	M/s. BogaR Laboratories, Andhra Pradesh AND M/s. Vishnu Institute of Pharmaceutical Education and Research (VIPER), Andhra Pradesh & Sri. Vishnu College of Pharmacy (SVCP), Telangana	Dr L Ravi Shankar

13	Materials based on small-angle X-ray scattering, wide-angle X-ray diffraction and Fourier transform infrared spectroscopy (FTIR)	Agreement for Material Testing	M/s. Momentive Performance Materials (India) Private Limited, Bangalore	Dr E Bhoje Gowd
14	Agreement for Non-Disclosure Agreement	Non-Disclosure Agreement	M/s. Recon Oil Industries Private Limited Mumbai	Dr K G Raghu
15	Solid state fermentation, microbial formulations and validation of process	Agreement for Sponsored Research	M/s. Accelerated Freeze Drying Co. Ltd., Cochin,	Dr Madhavan Nampoothiri
16	Processing of NIR reflective CeO2 nanoparticles for energy saving glaze coatings and cool textiles	Agreement for Sponsored Research	M/s Indian Rare Earth Limited Technology Development Council, Kollam	Dr S Ananthakumar
17	Development of Lightweight Aluminum based Crankcase for Automotive Air Compressor Brake Systems	Confidentiality Agreement	WABCO India Limited, Chennai	Dr T P D Rajan
18	Nano biosensors and Micro fluidics for Health care	Memorandum of Agreement	RCC, TVM	Dr K K Maiti
19	Development of molecules, materials and prototypes for switchable electrochromic smart window applications	Mutual Non-Disclosure Agreement	DCM Sriram Ltd, Gurgaon	Dr Biswapriya Deb
20	Valorization of spent turmeric generated	MoU	Arjuna Natural Ltd, Alwaye	Dr P Nisha
21	A comparative study of avarthys at various times of preparation for their potential against pain, inflammation and arthritis	Mutual Non-Disclosure Agreement	Arya Vaidya Pharmacy (Coimbatore) Limited, Coimbatore	Dr P Jayamurthy
22	Study for establishing microstructure mechanical properties of high strength Al-Si-Cu-Mg-Sr alloy processed by gravity die casting and squeeze casting	Disclosure Agreement	Sri Kaliswari Metal Powders(P) Ltd, Sivakasi	Dr M Ravi
23	Design, synthesis and biological evaluation of synthetic compounds as antiviral leads	Material transfer	Katholieke Universiteit Belgium	Dr Jubi John
24	Bio filter media	Technology Transfer	A.P. Engineers, Tamil Nadu	Dr Ajit Haridas
25	Vitro Evaluation of Nutritional and Prebiotic Activity of Sweeteners	Mutual Non-Disclosure Agreement	M/s. TATA Chemicals Limited, Maharashtra	Dr Nisha P

26	Processing Of TiO2 coated hydrous Kaolin for enhanced brightness and thermal stability	Agreement	M/s Surya Mine Chem, Ahmedabad	Dr S Ananthakumar
27	Development of novel leads for anti-obesity from North East traditional system through chemistry biology interphase	Memorandum of Agreement	DBT	Dr K G Raghu
28	Banana Fibre Extraction	Technology Transfer	Indus Tree Crafts Foundation, Bengaluru	Dr Rajeev K Sukumaran
29	Enhancement of the stability & acceptability for newly developed products	Agreement	M/s Pankaja Kasthuri Herbals India Ltd, TVM	Mr V V Venugopal

पेटेंट

भारत में दायर

Patent No	Title	Grant Date	Inventors
303798	सॉलिड-स्टेट लाइटिंग के लिए उच्च फलकों के साथ मॉलिक्यूलर प्रोसेस, ज़िंक के सहकारी संघों का चयन, दो फोटो इमेजिंग	30/11/2018	अय्यप्पनपाल अजयघोष, किजुमुरि पी। दिव्या, सम्पत श्रीनिवासन
304520	एनआईईआरआईटी और एक प्रक्रिया के लिए डीईई ने एनएएलएपीपीड एसओएल-फिल फिल्मा के आधार पर परीक्षण किया।	17/12/2018	संताकुमार धान्य, तुलसीदास राव
30763	ढंके हुए और मुद्रित लेटेक्स रबर शीट की ड्रिलिंग के लिए एक प्राकृतिक प्राकृतिक पानी का उपयोग	19/02/2019	पोककट्टू प्ट्रोसे थॉमस, थिरुथानाथिल पठार पीओयूएलओएसई, कुमार पिल्लई राजेंद्र प्रसाद, मुरकन कृष्णम रावन

वदिश में दायर

Patent No	Title	Grant Date	Inventors
9993814	अर्धचालक नैनोट्यूब-फ्लायेश और अर्धचालक नैनोट्यूब-मैटल ऑक्साइड कम्पोजिट पार्टिकिलिटी, उनका प्रोसिडिंग के जरिए मायन-एक्सचेंज मैकेनिक, और डाई पार्टी में उनके पास आने के लिए विधि है।	12/06/2018	शुक्ला सत्यजीत विष्णु, पडिनहटटाइल हरषे, नारायण हरषे, जोसे मनु, करुणाकरन रेम्या
6360896	सेक्विन एबूमिन प्रॉडक्ट्स के सेलेक्टिंग लेबलिंग और सेंसिंग के लिए एक स्क्वैराइन आधारित फ्लोराइड प्रोसेस्ड, पीएच मॉनीटरिंग और थाइलिस कॉलिंग इन सेल्स और प्रेजेन्शन थेरोफ के लिए प्रोसीजर।	29/06/2018	अय्यप्पनपालि अजयघोष, पालपुरावन स्थल
10035914	कोबाल्ट से जुड़े इनगनल ब्ल्यू पिग्मेंट्स मैग्नीशियम हवलिंग ट्रांज़िशन एलीमेंट्स ऑक्सिडेस और एक ही प्रक्रिया के लिए प्रक्रिया	31/07/2018	पडला पाराभकर राव, सरस्वती दिवाई
10144722	सॉलिड-स्टेट लाइटिंग के लिए उच्च फलकों के साथ मॉलिक्यूलर प्रोसेस, ज़िंक के सहकारी संघों का चयन, दो फोटो इमेजिंग	04/12/2018	अय्यप्पनपाल अजयघोष, किजुमुरि पी। दिव्या, सम्पत श्रीनिवासन
CN106414618B	कोबाल्ट की ओर से नए इनरोलॉजिकल ब्ल्यू पिग्मेंट्स मैग्नीशियम हवलिंग ट्रांज़िशन एलीमेंट ऑक्सिडेस और उसी प्रक्रिया के लिए एक प्रक्रिया	25/01/2019	पडला पाराभकर राव, सरस्वती दिवाई

भारत में मंजूर

Title	Inventors	File No	Filing Date
सेरेकिन और उसके सिद्धांत के लिए प्रक्रिया के प्रकटीकरण के कार्यान्वयन के लिए किट की देखरेख	कुस्तब कुमार मैती, वार्षा करुणाकरन, कुंजुरमन सुजाथन	201811028087	26/JUL/2018
थर्मामीटरिक सामग्री और उपचार सूत्र	डेब बिसवाप्रिय,चाककोथ, लखनऊ, इग्नतिऔस विजठा मेशरम मनोज रामकृष्ण, सिंह जे आइविंदर, तंजौर पुली युवराज	201811035273	19/SEP/2018
ऑक्सिजन लिमिटेड द्वारा दिए गए बायोमेट्रिक स्पैनिश स्पेंट वॉश से कलर के रिमूवल के लिए एक प्रक्रिया	अजित हरिदास, चर्चिल एंटेनाराज	201811048597	21/DEC/2018
अलपैलफोसफोकोलिन्स और मिलटेफोसिन के प्रसार और विस्थापन के लिए उन्नत एकल गैस प्रक्रिया	लंकला पल्ली, रवीशंकर, थंगरासु अरुण कुमार, अय्यप्पनपालि अजयघोष	201911003844	31/JAN/2019

भारत में मंजूर

Title	Inventors	File No	Filing Date
एक स्थायी और / या छूट को कम करने के लिए प्रक्रिया	कृष्णकुमार भस्कराण	11 2016 006 253.2	11 /07/2018
एक थर्मो-लैमिनेटेड बहुपत्नीकृत जिक्रोन उच्च तापमान सह-पंजीकृत सिरेमिक (एचटीसीसी) टेप और प्रक्रिया के आधार पर आधारित	कुझाइकिल पैठमहरन सूरेन्द्रन	2018-537797	19/07/2018
एक जैव सुरक्षा निजीकरण और / या छूट को कम करने के लिए	कृष्णकुमार भस्कराण, अनुपमा विनजा नादराजा	16/071374	19/07/2018
पाइलियम के उपचार की प्रक्रिया के लिए प्रक्रिया	ससिध बलप्पा सोम्पापा,माध्यमिक थोडी फतहथाल सलफैना, अय्यप्पनपालि अजयगृह	PCT/IN2018/050898	31/12/2018

PATENTS

GRANTED IN INDIA

Patent No	Title	Grant Date	Inventors
303798	Molecular probes with high fluorescence for solid-state lighting, selective discrimination of counterions of zinc, two photon imaging	30/11/2018	Ayyappanpillai Ajayaghosh, Kizhumuri P. Divya, Sampath Srinivasan
304520	Dye entrapped sol-gel film based test strip sensor for nitrite and a process thereof	17/12/2018	Santhakumar Dhanya, Talasila Prasada Rao
30763	An improved natural convection drier useful for the drying of coagulated and pressed latex rubber sheets	19/02/2019	Pokkattu Pathrose Thomas, Thiruthanathil Pathrose Poulose, Kumara Pillai Rajendra Prasad, Murukan Krishnamma Praveen

GRANTED ABROAD

Patent No	Title	Grant Date	Inventors
9993814	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	12/06/2018	Shukla Satyajit Vishnu, Padinhattayil Hareesh, Narayani Harsha, Jose Manu, Karunakaran Remya
6360896	A squaraine based fluorescent probe for selective labeling and sensing of serum albumin proteins, ph monitoring and thiol imaging in cells and a process for the preparation thereof	29/06/2018	Ayyappanpillai Ajayaghosh, Palappuravan Anees
10035914	Inorganic blue pigments from cobalt doped magnesium having transition element oxides and a process for the preparing the same	31/07/2018	Padala Prabhakar Rao, Saraswathy Divya
10144722	Molecular probes with high fluorescence for solid-state lighting, selective discrimination of counterions of zinc, two photon imaging	04/12/2018	Ayyappanpillai Ajayaghosh, Kizhumuri P. Divya, Sampath Srinivasan
CN106414618B	New inorganic blue pigments from cobalt doped magnesium having transition element oxides and a process for the preparing the same	25/01/2019	Padala Prabhakar Rao, Saraswathy Divya

FILED IN INDIA

Title	Inventors	File No	Filing Date
Screening kit for detection of precancerous lesions of cervix and process for the preparation thereof	Kaustabh Kumar Maiti, Varsha Karunakaran, Kunjuraman Sujathan	201811028087	26/07/2018
Thermoelectric materials and the preparation thereof	Deb Biswapriya, Chakkooth Vijayakumar, Ignatious Vijitha, Meshram Manoj Ramakrishna, Singh Jaivinder, Tanjore Puli Yuvaraj	201811035273	19/09/2018
A process for the removal of color from biomethanated distillery spent wash by oxygen limited wet oxidation	Ajit Haridas, Churchil Angel Antonyraj	201811048597	21/12/2018
Improved single vessel process for preparation and purification of alkylphosphocholines and miltefosine thereof	Lankalapalli Ravi Shankar, Thangarasu Arun Kumar, Ayyappanpillai Ajayaghosh	201911003844	31/01/2019

FILED ABROAD

Title	Inventors	File No	Filing Date
A bioprocess for reducing perchlorate and/or nitrate	Krishnakumar Bhaskaran, Anupama Vijaya Nadaraja	11 2016 006 253.2	11 /07/2018
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	2018-537797	19/07/2018
A bioprocess for reducing perchlorate and/or nitrate	Krishnakumar Bhaskaran, Anupama Vijaya Nadaraja	16/071374	19/07/2018
Process for the preparation of pyrylium salts	Sasidhar Balappa Somappa, Chettiyal Thodi Fathimath Salfeena, Ayyappanpillai Ajayaghosh	PCT/IN2018/050898	31/12/2018

परीक्षण और विश्लेषण सेवाएँ सेल

सीएसआईआर-एनआईआईएसटी की टेस्टिंग एंड एनालिटिकल सर्विसेज (टीएएससी) इन-हाउस और बाहरी आर & डी गतिविधियों, शिक्षाविदों और देश के उद्योगों को पूरा करती है। अत्याधुनिक सुविधा देश के दक्षिणी भाग में सर्वश्रेष्ठ में से एक है और लैब के लिए राजस्व का एक सतत प्रवाह उत्पन्न करने के लिए बड़े पैमाने पर उपयोग किया जाता है। बाहरी नमूना विश्लेषण भुगतान के आधार पर किया जाता है। रिपोर्ट की अवधि के दौरान विभिन्न शैक्षणिक संस्थानों और विश्वविद्यालयों के लगभग 113 छात्रों, 57 आरएंडडी संस्थानों और 15 उद्योगों ने इस सुविधा का उपयोग किया था और बाहरी एजेंसियों और छात्रों से नमूने के परीक्षण और विश्लेषण से 11.94627 लाख रुपये का राजस्व उत्पन्न हुआ था। उपकरणों के बीच, एक्स-रे इलेक्ट्रॉन माइक्रोस्कोपी (एक्सपीएस) ने क्रमशः 2.80 लाख, एनएमआर / एचआरएमएस और एसईएम / एक्सआरडी सुविधाओं को इकट्ठा किया।

सीएसआईआर ने अपनी विश्लेषणात्मक सुविधाओं का एक राष्ट्रीय पोर्टल शुरू किया था जिसे "एनालिसिसिसिर" कहा जाता है। इस पोर्टल के माध्यम से पूरे सीएसआईआर की परिष्कृत विश्लेषणात्मक इंस्ट्रूमेंटेशन सुविधा को दुनिया में कहीं से भी बुक किया जा सकता है। वर्तमान में इस सुविधा का उपयोग परीक्षण मोड के तहत किया जा रहा है और सीएसआईआर-एनआईआईएसटी ने इस पोर्टल के माध्यम से अपनी प्रमुख उपकरण बुकिंग को सफलतापूर्वक स्थानांतरित कर दिया है। वर्तमान में पोर्टल में सीएसआईआर-एनआईआईएसटी के 256 उपयोगकर्ता हैं।

TESTING AND ANALYTICAL SERVICES CELL

The Testing and Analytical Services (TASC) of CSIR-NIIST caters to the in-house and external R&D activities, academia and Industries of the Country. The state of the art facility is one of the best in southern part of the Country and extensively utilized generating a steady flow of revenue for the Lab. The external sample analysis is carried out on payment basis.

During the period of the report approximately 113 students from various educational institutes and universities, 57 R&D institutions and 15 Industries had utilized this facility and a revenue of Rs.11.94627 lakhs was generated from the testing and analysis of the sample from the external agencies and students. Among the instruments, the X-ray Electron Microscopy (XPS) collected 2.80 lakhs, NMR/HRMS and SEM/XRD facilities generated Rs.3.22 lakhs and Rs.1.49 lakhs respectively.

CSIR had commenced a National Portal of its analytical facilities termed “AnalytiCSIR”. Through this portal, the sophisticated analytical instrumentation facility of entire CSIR can be booked from anywhere in the world. The facility currently is being used under test mode and CSIR-NIIST had successfully migrated its major equipment booking through this portal. The portal at present has 256 users from CSIR-NIIST.

ज्ञान संसाधन केंद्र

ज्ञान संसाधन केंद्र, संस्थान में अनुसंधान और विकास के सभी क्षेत्रों में पुस्तकों, पत्रिकाओं, प्रिंट और इलेक्ट्रॉनिक मीडिया में समृद्ध सामग्री का संग्रह करने वाला सहायक विभाग है। संस्थान के वैज्ञानिकों, तकनीकी व्यक्तियों, और अनुसंधान विद्वानों की जानकारी की आवश्यकता को पूरा करने के अलावा, केरसी अकादमिक और अनुसंधान संस्थानों से आने वाले अनुसंधान विद्वानों के लिए भी अपनी सेवा का विस्तार करता है। केआरसी ने 2018-19 की अवधि के दौरान संग्रह को बढ़ाकर 13917 पुस्तकें, 10947 मानक और 11387 बाउंड वॉल्यूम ऑफ पीरियडिकल कर दिया है। 2018 के दौरान, केआरसी ने विली से 17 ई-पुस्तकें खरीदीं और संग्रह में छह हिंदी पुस्तकों सहित 59 नई किताबें शामिल की गईं। इसके अतिरिक्त, 27 पुस्तकें प्राप्त हुईं। उपरोक्त संग्रह के अलावा, विद्वानों के पास स्प्रिंगर,नैचर, अमेरिकन केमिकल सोसाइटी, रॉयल सोसाइटी ऑफ केमिस्ट्री, विली ब्लैकवेल, ऑक्सफोर्ड यूनिवर्सिटी प्रेस से राष्ट्रीय ज्ञान संसाधन कंसोर्टियम के माध्यम से ऑनलाइन पत्रिकाओं तक पहुंच है। शोधकर्ताओं के लिए स्पेशलाइज्ड डेटाबेस वाइज साइंसफाइंडर, वेब ऑफ साइंस, डर्वेंट इनोवेशन इंडेक्स, क्यूपैट और एएसटीएम शामिल हैं। एनआईएसटी शोधकर्ताओं की अतिरिक्त जानकारी की आवश्यकता जै गेट प्लस के माध्यम से अन्य सीएसआईआर, डीएसटी, संस्थानों से संसाधन साझा करने के माध्यम से पूरी हुई। पारंपरिक सेवाओं के अलावा, वैज्ञानिकों और छात्रों के अनुरोध पर साहित्य खोज, पेटेंट खोज, प्रशस्ति पत्र विश्लेषण किया गया। केआरसी ने उच्च गुणवत्ता वाली पत्रिकाओं में प्रकाशित करने के लिए शोधकर्ताओं की सहायता की और साहित्यिक चोरी की जाँच और पूर्व कला खोज में मदद की। केंद्र स्वचालित है और ई-गवर्नेंस के मानदंडों की पुष्टि करता है।

केआरसी संस्थान की वेबसाइट, सोशल मीडिया पेज, और संस्थागत भंडार भी रखता है। वे नियमित रूप से अपडेट होते हैं आईआर वर्तमान में 2600 जर्नल लेख, 319 पीएचडी थ्रेस और 220 समाचार आइटम शामिल हैं। केंद्र ने एक द्विवार्षिक समाचार पत्र 'प्रकाशित किया है। केआरसी नियमित रूप से संदर्भ प्रबंधन सॉफ्टवेयर, साहित्य खोज, पूर्व कला खोज, खुली पहुंच, अनुसंधान मूल्यांकन, शोधकर्ताओं के लिए सोशल मीडिया, साहित्यिक चोरी को रोकने और प्रभावी संचार आदि पर प्रशिक्षण प्रदान कर रहा है।

सूचना प्रौद्योगिकी सेवाएं

प्रयोगशाला परिसर गीगाबिट फाइबर ऑप्टिक बैकबोन के माध्यम से परस्पर जुड़ा हुआ है और एनकेएन से 100 एमबीपीएस लीज्ड लाइन के साथ जुड़ा हुआ है और सभी इंटरनेट और इंट्रानेट आवश्यकताओं को पूरा करने के लिए बीएसएनएल से 28 एमबीपीएस लीज्ड लाइन भी है। नेटवर्क को विनियमित किया जाता है और वायर्ड और वायरलेस नेटवर्क के माध्यम से 1050+ इंटरनेट कनेक्शन के लिए सिस्टम और नेटवर्क के प्रदर्शन के संबंध में एक वास्तविक समय, अंत-से-अंत दृश्य प्राप्त करने के लिए सुरक्षित किया जाता है।

AADHAR सक्षम बायोमेट्रिक अटेंडेंस सिस्टम आठ अलग-अलग स्थानों पर स्थापित किया गया था। संस्थागत आईडी कार्ड सभी अनुमन्य उपयोगकर्ताओं को जारी किए गए थे और दरवाजों और दरवाजों तक सुरक्षित पहुंच बनाए रखी गई थी।

डिजिटल प्रदर्शन प्रणाली को अनुसंधान के परिणामों, नोटिसों और परिपत्रों, लॉरेल आदि के प्रदर्शन के लिए सात अलग-अलग स्थानों पर रखा गया और रखा गया। यूनिट मुद्रण और स्कैनिंग की सुविधा भी प्रदान करती है और आईटी उत्पादों और प्रयोगशाला के उपकरणों के अधिग्रहण में गुणवत्ता आश्वासन सुनिश्चित करने में सहायता भी प्रदान करती है।।

नए दिशानिर्देशों के अनुसार साइट के पुन: निर्माण के साथ ही संस्थान की वेबसाइट के लिए STQC प्रमाणन प्रगति पर है। संस्थान में आयोजित राष्ट्रीय और अंतर्राष्ट्रीय सम्मेलनों के लिए वेबसाइटों का विकास और रखरखाव किया गया। सॉफ़्टवेयर इंस्टॉलेशन, पुनर्स्थापना, मरम्मत, सॉफ़्टवेयर अपडेट, नेटवर्क और आईटी से संबंधित मुद्दों के लिए शोधकर्ताओं को डेस्कटॉप के एएमसी के प्रबंधन के अलावा लैपटॉप और साथ ही अन्य कंप्यूटर बाह्य उपकरणों की सहायता प्रदान की। कई सॉफ्टवेयर इंस्टॉलेशन और डेटाबेस को बनाए रखा गया था। इंस्टीट्यूशनल रिपॉजिटरी, लिबसाइट, केमट्रे, सिग्लोट, उत्पत्ति, एजप्रोक्सी के लिए स्टोर और खरीद सॉफ़्टवेयर, डी-स्पेस और कोहा। एप्लिकेशन, मेल और वेबसाइट सामग्री के लिए समय-समय पर बैकअप लिया गया। सर्वर ग्रेड एंटीवायरस सॉफ्टवेयर को तैनात करके इंटरनेट सुरक्षित किया जाता है।

सूचना का अधिकार

भारत में हर सार्वजनिक प्राधिकरण के काम में पारदर्शिता और जवाबदेही को बढ़ावा देने के लिए वैज्ञानिक और तकनीकी मामलों के लिए सूचना के अधिकार अधिनियम -2005 का कार्यान्वयन। अवधि के दौरान, 83 आरटीआई अनुप्रयोगों और 6 अपीलों को जानकारी प्रदान की जाती है।

सीएसआर कौशल पहल

सीएसआईआर एनआईआईएसटी ने सीएसआईआर कौशल पहल कार्यक्रम के तहत विभिन्न खंडों के तहत लघु अवधि के पाठ्यक्रम पेश किए। पाठ्यक्रम हैं; विश्लेषणात्मक रसायन विज्ञान और इंस्ट्रूमेंटेशन तकनीक, संचालन और रखरखाव किण्वकों / बायोरिएक्टर, तकनीक की फाइटोकेमिकल प्रोफाइलिंग और लक्षण वर्णन, न्यूट्रास्युटिकल्स और कार्यात्मक खाद्य पदार्थ: विकास और मान्यता, डायोनिंस और पीसीबी, धातु कास्टिंग और विशेषता, रिमोट सेंसिंग और जीआईएस के नमूने और विश्लेषण में उन्नत प्रशिक्षण। ईआईए और प्रबंधन, सामग्री विशेषता तकनीक और इम्यूनोलॉजी तकनीक में आवेदन। इलेक्ट्रॉनिक और प्रिंट मीडिया के माध्यम से कार्यक्रमों को व्यापक प्रचार दिया गया। 2018-19 के दौरान, 46 उम्मीदवारों को हाथों पर प्रायोगिक गतिविधियों और केस स्टडी के निष्पादन में गहन प्रशिक्षण दिया गया था। वित्तीय वर्ष के दौरान, CSIR - NIIST और कृषि कौशल परिषद (ASCI) गुरुग्राम के बीच एक समझौता ज्ञापन पर हस्ताक्षर किए गए। मार्च 2018 के दौरान चेन्नई में ट्रेनर के प्रशिक्षण कार्यशाला में दो स्टाफ सदस्यों ने भाग लिया।

KNOWLEDGE RESOURCE CENTRE

Information services

The Knowledge Resource Centre is the supporting division having rich collection of books, periodicals, reference materials in print and electronic media in all areas of R&D being carried out in the institute. Besides catering to the information need of scientists, technical personals and research scholars of the institute, KRC also extend its service to the visiting research scholars from academic and research institutions. During the period 2018-19, KRC enhanced the collection to 13917 Books, 10947 Standards and 11387 Bound Volumes of Periodicals. During 2018, KRC purchased 17 e-books from Wiley and 59 new books including six Hindi books were added to the collection. Additionally, 27 books were received gratis. Apart from the above collection, the scholars have access to online journals from SpringerNature, American Chemical Society, Royal Society of Chemistry, Wiley Blackwell, Oxford University Press through National Knowledge Resource Consortium. Specialized databases viz SciFinder, Web of Science, Derwent Innovation Index, Qpat and ASTM are also provided to researchers. The additional information requirement of NIIST researchers fulfilled through resource sharing from other CSIR, DST institutes through J-GatePlus. In addition to the 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. The center is automated and confirms to the norms of e-governance.

KRC also maintains the institute website, Social media pages and institutional repository. They are updated regularly. The IR presently consists of 2600 journal articles, 319 PhD Theses and 220 News items. The center publishes 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 laboratory campus is interconnected through gigabit fiber optic backbone and linked with 100 mbps leased line from NKN and also 28 mbps leased line from BSNL to fulfill all the Internet and intranet requirements. The network is regulated and secured to gain a real-time, end-to-end view with respect to system and network performance to 1050+ internet connection through wired and wireless network.

AADHAR enabled Biometric Attendance System was installed at eight different locations. Institutional ID cards were issued to all permissible users and secured access to doors and gates are maintained.

Digital Display System were placed and maintained in seven different locations for exhibiting research outcomes, notices and circulars, laurels etc. The unit also provides printing and scanning facility and also provides assistance in ensuring Quality assurance in the acquisition of IT products and devices of the lab.

The STQC certification for the institute's website is in progress along with the revamping of the site as per the new guidelines. Websites were developed and maintained for national and international conferences held in the institute. Provided help to researchers for software installations, reinstallations, repairs, software updates, network and IT related issues apart from managing the AMC of desktops, laptops as well as other computer peripherals. Many software installations and databases were maintained viz. Stores and Purchase Software, D-Space and Koha

for Institutional Repository, Libsuite, Chemdraw, Sigmaplot, Origin., Ezproxy. Backups were taken periodically for applications, mails and website contents. The internet is secured by deploying server grade antivirus software.

RTI

Implementation of Right to Information Act-2005 in the institute for Scientific & Technical matters to promote transparency and accountability in the working of every public authority in India. During the period, information is provided to 83 RTI applications and 6 appeals.

CSR Skill Initiative

CSIR NIIST introduced short term courses under various segments under CSIR Skill Initiative programme. The courses are; Analytical Chemistry and Instrumentation Techniques, Operation and Maintenance of fermenters / bioreactors, Techniques of Phytochemical profiling and characterization, Nutraceuticals and Functional Foods: Development and Validation, Advanced Training in Sampling and Analysis of Dioxins and PCBs, Metal Casting and Characterization, Remote sensing and GIS application in EIA and Management, Materials Characterization Techniques and Immunology Techniques. The programmes were given wider publicity through electronic and print media. During 2018-19, 46 candidates were given intensive training in the execution of hands-on experimental activities and case studies. During the financial year, an MOU was signed between CSIR – NIIST and Agriculture Skill Council of India (ASCI) Gurugram. Two staff members attended the trainer's training workshop at Chennai during March 2018.

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एनआईआईएसटी वैज्ञानिकों द्वारा विदेश दौरा

नाम	दौरा किया देश & अवधि	यात्रा का उद्देश्य
डॉ यू एस हरीश	जापान (02/04/2018-06/04/2018)	मेसर्स नोरिटेक कंपनी में बैठक के लिए और टोक्यो इंस्टीट्यूट ऑफ टेक्नोलॉजी, जापान में व्याख्यान देने के लिए
डॉ पी बिनोद	फिनलैंड (16/05/2018-30/05/2018)	पूर्वी फिनलैंड कुओपियो विश्वविद्यालय, फिनलैंड में इंडो नॉर्डन परियोजना की समीक्षा बैठक के लिए फिनलैंड का दौरा
डॉ टी पी डी राजन	जर्मनी (25/05/2018-26/05/2018	बोर्नो में इंडो-जर्मन साइंस एंड टेक्नोलॉजी सेंटर की संयुक्त वैज्ञानिक परिषद की बैठक में भाग लेने के लिए जर्मनी का दौरा
डॉ के माधवन नंपूतिरी	जर्मनी (04/07/2018-24/07/2018)	इंडो-जर्मन्स अनुसंधान कार्यक्रम के तहत काम करने के लिए बेलेफेल्ड विश्वविद्यालय जर्मनी का दौरा
डॉ पी बिनोद	हांगकांग (16/08/2018-18/08/2018)	हांगकांग पर चौथे अंतर्राष्ट्रीय सम्मेलन में भाग लेने के लिए
डॉ एन रमेशकुमार	जर्मनी (06/09/2018-28/09/2018)	रासायनिक पारिस्थितिकी के लिए अधिकतम प्लांडे संस्थान का दौरा
डॉ सी एच सुरेश	ऑस्ट्रेलिया (20/09/2018-29/09/2018)	क्वींसलैंड विश्वविद्यालय ऑस्ट्रेलिया का दौरा
डॉ पी बिनोद	जर्मनी (1/10/2018-14/10/2018)	बीलेफेल्ड जर्मनी के विश्वविद्यालय का दौरा करने के लिए
डॉ ई भोजे गौड़	जापान (4/12/2018- 7/12/2018)	हिरोशिमा के किताकुशू विश्वविद्यालय में अंतर्राष्ट्रीय पॉलिमर सम्मेलन में भाग लेने के लिए
डॉ पी निशा	स्पेन (27/2/2019- 27/5/2019)	स्पेन के राष्ट्रीय अनुसंधान परिषद, वेलेंसिया, स्पेन की यात्रा करने के लिए
डॉ ए अजयघोष	जापान (7/3/2019- 16/3/2019)	ओसाका प्रान्त विश्वविद्यालय का दौरा करने के लिए
डॉ एम वसुंधरा	रूस (12/3/2019- 17/3/2019)	रूसी अकादमी के विज्ञान की यूराल शाखा के मिहेव इंस्टीट्यूट ऑफ मेटल फिजिक्स का दौरा करने के लिए

FOREIGN VISITS BY NIIST SCIENTISTS

NAME	PLACE OF VISIT & PERIOD	PURPOSE OF VISIT
Dr U S Hareesh	Japan(02/04/2018-06/04/2018)	Meeting of M/S Noritake company and lecture at Tokyo Institute of Technology
Dr P Binod	Finland(16/05/2018-30/05/2018)	Review meeting of INDO NORDEN Project at University of Eastern Finland
Dr T P D Rajan	Germany(25/05/2018-26/05/2018	To attend the joint scientific council meeting of Indo- German Science & Technology Centre
Dr K Madhavan Nampoothiri	Germany (04/07/2018-24/07/2018)	To visit Bielefeld university Germany to work under Indo-German research program
Dr P Binod	Hongkong(16/08/2018-18/08/2018)	To attend the 4th international Conference in Hongkong
Dr N Rameshkumar	Germany(06/09/2018-28/09/2018)	To visit Max Plank Institute for Chemical Ecology
Dr C H Suresh	Australia(20/09/2018-29/09/2018)	To visit Queensland University Australia
Dr P Binod	Germany(01/10/2018-14/10/2018)	To visit university of Bielefeld Germany
Dr E Bhoje Gowd	Japan (04/12/2018- 7/12/2018)	To attend International Polymer Conference at University of Kitakyushu, Hiroshima
Dr P Nisha	Spain(27/02/2019- 27/5/2019)	To visit Spanish National Research Council, Valencia, Spain
Dr A Ajayaghosh	Japan (07/03/2019- 16/3/2019)	To visit Osaka Prefecture University
Dr M Vasundhara	Russia (12/03/2019- 17/03/2019)	To visit Miheev Institute of Metal Physics of Ural Branch of Russian Academy of Sciences

विदेशी वैज्ञानिकों / प्रतिष्ठित व्यक्तियों के एनआईआईएसटी का दौरा

Name	Country from	Date	Purpose of visits
डॉ। शिवरामपनिकर श्रीजीत	**सिंगापुर**	24.09.2018	बायो इमेजिंग और सेंसिंग के लिए "इंजीनियरिंग फंक्शनल मटेरियल और सॉफ्ट-ऑर्गेनिक नैनोहाइब्रिड्स" पर व्याख्यान देने के लिए।
प्रो गिल्बर्ट स्टॉर्क	फ्रांस	22.10.2018	मेमोरियम में कार्यक्रम
प्रो टेको यामागुची	जापान	07.12.2018	"ईंधन कोशिकाओं और इलेक्ट्रोलिसिस के लिए हाइड्रोजन अर्थव्यवस्था और व्यवस्थित सामग्री डिजाइन" पर व्याख्यान देने के लिए
प्रो शिगयुकि यागी	जापान	12.12.2018	चक्रवाती प्लेटिनम (द्वितीय) परिसरों के "फॉस्फोरसेंट एक्सिमेसर फॉर्मेशन का नियंत्रण" पर व्याख्यान देने के लिए
प्रो सुरेश सी पिल्लई	आयरलैंड	09.01.2019	बेहतर पांडुलिपि तैयार करने के लिए टिप्स: एक संपादक का दृष्टिकोण
प्रोफेसर रमन सिंह	ऑस्ट्रेलिया	08.03.2019	ग्राफीन कोटिंग और नैनोक्रिस्टलाइन मिश्र धातु संरचना: उल्लेखनीय उपन्यास संक्षारण प्रतिरोध के लिए दो उपन्यास नैनो प्रौद्योगिकी दृष्टिकोण
डॉ। मसिलामणि जिगनमोहन	चेन्नई	12.07.2018	"रूथेनियम (II) कैटालॉज्ड रिडॉक्स-न्यूट्रल सी एच बॉन्ड फंक्शनलाइज़ेशन ऑफ एरोमैटिक्स हेटेरोमैटिक्स" पर एक व्याख्यान देने के लिए
प्रोफेसर उदयमित्र	बेंगलुरु	03.08.2018	आचार्य पीसी रे स्मारक व्याख्यान
डॉ। वंदना भल्ला	पंजाब	08.10.2018	सुपरमॉलेकुलर एनसेंबल: संभावित उत्प्रेरक और पाली उत्प्रेरक सिस्टम" पर व्याख्यान देने के लिए
प्रो मनोज कुमार	पंजाब	08.10.2018	"आणविक मान्यता, बायोइमेजिंग और डायग्नोस्टिक अनुप्रयोगों के लिए" फ्लोरोसेंट पार्स के विकास पर व्याख्यान देना"
संतनु भट्टाचार्य प्रो	कोलकाता	22.11.2018	"भविष्य के कार्बनिक संश्लेषण" पर व्याख्यान देने के लिए
डॉ। गिबी घी वर्गीज	तिरुवनंतपुरम	28.11.2018	"अनुसंधान कौशल के अनुकूलन के लिए उत्साहजनक रवैया" पर एक व्याख्यान देने के लिए
प्रोफेसर अतुल नारंग	दिल्ली	14.12.2018	पिचियास्टैपिस की सतत संस्कृतियों में इथेनॉल उत्पादन के काइनेटिक्स" पर एक व्याख्यान देने के लिए

VISITS OF FOREIGN SCIENTISTS/EMINENT PERSONALITIES TO NIIST

Name	Country from	Date	Purpose of visits
Dr Sivaramapanicker Sreejith	Singapore	24.09.2018	To deliver a lecture on "Engineering Functional Materials and Soft-organic Nanohybrids for Bio imaging and Sensing"
Prof Gilbert Stork	France	22.10.2018	Programme for In memoriam
Prof Takeo Yamaguchi	Japan	07.12.2018	To deliver a lecture on "Hydrogen Economy and Systematic Material Design for Fuel Cells and Electrolysis"
Prof Shigeyuki Yagi	Japan	12.12.2018	To deliver a lecture on "Control of Phosphorescent Excimer Formation of Cyclometalated Platinum (II) Complexes"
Prof Suresh C Pillai	Ireland	09.01.2019	Tips for improved Manuscript Preparation: An Editor's perspective
Prof Raman Singh	Australia	08.03.2019	Graphene Coating and Nanocrystalline Alloy Structure: Two Novel Nanotechnology Approaches for Remarkable Corrosion Resistance
Dr Masilamani Jeganmohan	Chennai	12.07.2018	To deliver a lecture on "Ruthenium(II)-Catalyzed Redox-Neutral C-H Bond Functionalization of Aromatics Heteroaromatics"
Professor UdayMaitra	Bengaluru	03.08.2018	Acharya PC Ray memorial Lecture
Dr Vandana Bhalla	Punjab	08.10.2018	To deliver a lecture on "Supramolecular Ensembles: Potential Catalytic and Poly catalytic Systems"
Prof Manoj Kumar	Punjab	08.10.2018	To deliver a lecture on "Development of Fluorescent Probes for Molecular Recognition, Bioimaging and Diagnostic Applications"
Prof Santanu Bhattacharya	Kolkata	22.11.2018	To deliver a lecture on "Future of Organic Synthesis"
Dr Giby Ghee Vargheese	Thiruvananthapuram	28.11.2018	To deliver a lecture on "Fostering Attitude for Optimizing Research Skills"
Prof Atul Narang	Delhi	14.12.2018	To deliver a lecture on "Kinetics of Ethanol production in continuous cultures of *Pichia stipities*"

पीएचडी पुरस्कृत

Sl. No.	नाम	थीसिस शीर्षक	सुपरवाइजिंग गाइड	पुरस्कृत की तिथी
		एसीएसआईआर		
1	अयमान सलिह ओमर इदरिस	फंगल सेलुलोज उत्पादन और अनुप्रयोग	डॉ राजीव के सुकुमारन	02.04.2018
2	संथिनी पी वी	बाइसिकल ओलेफिन्स के डिसेममेट्रीज़ेशन और इंडोल्स के मल्टीकंपोनेंट रिएक्शंस के माध्यम से हेटरोसायकल और कार्बोसायकल का संश्लेषण	डॉ आर लक्समी वर्मा	13.04.2018
3	अजेश विजया	कार्बोसायकल और हेटेरोसायकल का निर्माण हेटरोबायिकल ओलेफिन्स में स्टेरिकस्ट्रेन का उपयोग	डॉ के वी राधाकृष्णन	03.05.2018
4	अभिलाष प	माइक्रोइलेक्ट्रॉनिक अनुप्रयोगों के लिए ढांकता हुआ सब्सट्रेट और स्क्रीन प्रिंट करने योग्य स्याही	डॉ के.पी. सुरेंद्रन	30.05.2018
5	धन्या बी पी	जेरुम्बोनेयंद के सिंथेटिक संशोधन उनके जैविक मूल्यांकन	डॉ के वी राधाकृष्णन	02.06.2018
6	रेम्य पी आर	ग्रबस्बैंड स्कॉक कैटलर्स द्वारा सीसी बॉन्ड मेटाथिसिस पर घनत्व कार्यात्मक सिद्धांत अध्ययन: मेटल-कार्बन बॉन्डिंग, मैकेनिज्म, और मेटेलासाइकल	डॉ सी एच। सुरेश	20.06.2018
7	शमील टी	ऑर्गेनिक डोनर-एक्सेसर सिस्टम्स फॉर मेटल आयन रिकॉग्निशन एंड ओएलईडी एप्लीकेशन	डॉ डी रमैया	29.06.2018
8	संदीपा के वी	फंक्शनल फुलरीन का डिजाइन: ऑप्टोइलेक्ट्रोनिक के लिए उनके फोटोफिजिकल और डीएनए सेल्फ-असेंबली गुणों की जांच Applications	डॉ जोशी जोसेफ	20.07.2018
9	श्रीजिथ एम	सेंसिंग और पीडीटी अनुप्रयोगों के लिए दो आयामी स्तरित नैनोमेट्रोज के आर्गेनिककोनजेट्स के डिजाइन, संश्लेषण और फोटोफिजिकल गुण	डॉ जोशी जोसेफ	20.07.2018
10	अपर्णा पी एस	डायज़ैबिसाइक्लिक ओलेफिंस के संक्रमण के माध्यम से संक्रमण मेटलकैटलजेड एस 2 सी-एच सक्रियण: फंक्शनलाइज़्ड साइक्लोपेंटेनिस तक पहुंच	डॉ आर लक्समी वर्मा	23.07.2018
11	अतुल क	संरचना का मूल्यांकन संपत्ति की संपत्ति जीडी&सीए अददेड़ एमजी-एएल & एएमपी; एमजी-ज़ेडएन अललोय।	डॉ ए। श्रीनिवासन	26.09.2018
12	मोहम्मद हिफ्सुद्दीन बी एम	चिरल ओलिगो के डिजाइन, संश्लेषण, स्व-असेंबली और चिरोप्टिकलसी गुण (पी-फेनिलीनथीलीन) डेरीवातिवेस	डॉ ए। अजयघोष	23.10.2018

13	सुधेश के वी	ऑर्गेनेल टारगेटिंग, फोटोडायनामिक थैरेपी और थेरानॉस्टिक एप्लिकेशन के लिए ल्यूमिनेसेंट प्रोब	डॉ ए अजयघोष	23.10.2018
14	डेला थेरेस डेविस	विभिन्न आकारों और आकृतियों के आणविक आयनों में हाइड्रोजन भंडारण पर घनत्व कार्यात्मक सिद्धांत अध्ययन	डॉ सी एच सुरेश	05.11.2018
15	प्रिया पी	पोषक तत्वों को हटाने और प्रमुख हमलावरों के बायोमीटेशन क्षमता	डॉ बी कृष्णकुमार	16.11.2018
16	ज्योति बी नायर	एंटी कैंसर ड्रग्स के लक्षित वितरण के लिए आणविक ट्रांसपोर्टरों के डिजाइन, संश्लेषण और जैविक मूल्यांकन	डॉ कौस्तुभ कुमार मैती	20.11.2018
17	ग्रीष्मा गोपालन	कुछ चुने हुए औषधीय पौधों की फाइटोकेमिकल जांच और एक प्रचुर मात्रा में प्राकृतिक उत्पाद ज़ेरुम्बोन के सिंथेटिक परिवर्तन	डॉ के वी राधाकृष्णन	20.11.2018
18	एंजेल मैरी जोसेफ	मैक्रोइलक्ट्रोणिक्स अनुप्रयोगों के लिए उपन्यास अल्ट्रा-कम-सामग्री	डॉ बोजेगौड़	20.12.2018
19	अरिंदम मल	संश्लेषण, लक्षण वर्णन और आयनिक सहसंयोजी ऑर्गेनोनाज़ोज़ेट के अनुप्रयोग	डॉ ए अजयघोष	27.12.2018
20	राम्या कृष्ण	मूल उपन्यास 1 मोकयकलोपरोपने1-कार्बोक्ष्यलते (एसीसी) के आण्विक और कार्यात्मक लक्षण वर्णन दक्षिणी भारत, केरल के तटीय खारा सहनशील पोककली चावल की किस्मों से डेमिन्सेज़ युक्त एफ्फाइटोबेफिशियल स्प्रिज़ोबैक्टीरिया।	डॉ एन रमेश कुमार	28.12.2018
21	मिंजु थॉमस	जेओलिटिकिमिडजोलते फ्रेमवर्क -8 (ज़ेडआईएफ़-8) व्युत्पन्न झरझरा सामग्री अनुप्रयोगों	डॉ यू एस हरेश	28.12.2018
22	जगदीश के	उपन्यास कार्बन-कार्बन और कार्बन-हेटेरोटॉम बॉन्ड बनाने की प्रतिक्रियाओं और संबंधित रसायन विज्ञान की खोज	डॉ बी एस ससिधर	28.12.2018
23	राखी आर	जमीन पर DFT और रेखीय पॉलीकेनैनलोगों और पॉलीसाइक्लिक एरोमैटिक हाइड्रोकार्बन के उत्तेजित गुणों का अध्ययन करता है	डॉ। सी। एच। सुरेश	30.01.2019
24	अंजलि बी	सक्रियण बाधा, संभावित घटाना और प्रतिदीप्तिशील आणविक इलेक्ट्रोस्टैटिक क्षमता की भविष्यवाणी करना: कार्बनिक और ऑर्गेनोमैटिक्स सिस्टम	डॉ सी एच सुरेश	21.02.2019
25	अथिरा कृष्णा	डिजाइन, संश्लेषण, फोटोफिजिकल और इलेक्ट्रोफाइनेंस की पढ़ाई ट्राइफेनिलमाइन और कार्बाजोल डेरिवेटिव	डॉ आर लक्समी वर्मा	25.03.2019
केरल विश्वविद्यालय				
26	रंजीत एस	तरल क्रिस्टलीय ऊर्जा अनुप्रयोगों के लिए सामग्री का संचालन	डॉ जे डी सुधा	17.04.2018

27	अन्नू राजू	पॉलीस्टीरिन-क्ले नैनोकम्पोजिट्स के आत्म-असेंबलिंग और एंटी-करप्शन लक्षण	डॉ टी.पी.डी. राजन	24.04.2018
28	प्रीथानुज प्रीथलायम	पेंटफुल्वेनेस और इसके डेरिवेटिव्स की ट्रांज़िशन मेटल कैटालिज़्ड ट्रांस्फ़ॉर्मेशन: कार्बाइल और हेटेरिसाइकल की ओर फैसिलिटी स्ट्रेटेजीज़	डॉ के वी राधाकृष्णन	04.07.2018
29	सिलजा अब्राहम	जैविक इलेक्ट्रॉनिक्स अनुप्रयोगों के लिए नई प्रभार परिवहन सामग्री का डिजाइन	डॉ जोशी जोसेफ	11.07.2018
30	जयप्रभा जे एस	जलीय माध्यम में प्लांट बायोमास के अवायवीय अवक्रमण का विश्लेषण	डॉ वी बी मणिलाल	30.07.2018
31	रेशमा एल आर	मैक्रोस्कोपिक रूप से रोगाणुरोधी अनुप्रयोगों के लिए स्टार्च आधारित हाइड्रोजेल का आदेश दिया	डॉ जे डी सुधा	31.08.2018
32	भाग्य उथमन	कुछ Gd-Si-Ge आधारित इंटरमेटॉलिक्स और लैंथेनम टेल्यूरियम मैंगनीज में संरचनात्मक, चुंबकीय और मैग्नेटोकलोरिक अध्ययन	डॉ मनोज रामा वर्मा	14.09.2018
33	वैसाख एस एस	हाई थर्मल कंडक्टिंग एपॉक्सी पॉलिमर डाइलेट्रिक्स के प्रसंस्करण के लिए नोवेल नैनो / माइक्रो सिरेमिक फिलर्स का डिजाइन	डॉ एस अनंतकुमार	02.11.2018
34	माया जी पिल्लई	चावल के मोथ पर विभिन्न पौधों के अर्क की विषाक्तता पर एक अध्ययन कॉर्सेरा सेफेलोनिकासटेनटन (लेपिडोप्टेरा: पाइरालिडे)	डॉ बीना जॉय	22.12.2018
		सीयूएसएटी		
35	शमला एल	भोजन में एक्रिलामाइड पर अध्ययन: वास्तविक और मॉडल प्रणालियों में एक्रिलामाइड गठन पर अग्रदूतों का प्रभाव	डॉ पी निशा	05.05.2018
36	संदीप ए	स्व-असेंबली, सी 3 का संगठन और फोटोफिजिकलप्रोटेक्ट्स - सममित डिस्कोटिक अणु	डॉ ए अजयघोष	31.08.2018
37	आर थिरुमलाई कुमारन	प्रतिदीप्ति मॉड्यूलेशन और स्व-इकट्ठे पी- फेनिलिथेनिलीन का अनुप्रयोग डेरिवेटिवस	डॉ ए अजयघोष	31.08.2018
38	बबीता के बी	ज़िंक ऑक्साइड पर जांच - ग्राफीन ऑक्साइड नैनोमेट्रोज और नैनोकम्पोजिट्स: संश्लेषण, कार्यात्मक गुण और अनुप्रयोग	डॉ एस अनंतकुमार	16.02.2019

Ph D Awarded

Sl. No.	Name	Thesis Title	Supervising Guide	Date of Award
		AcSIR		
1	Ayman Salih Omer Idris	Fungal cellulose production and applications	Dr. Rajeev K. Sukumaran	02.04.2018
2	Santhini P. V.	Synthesis of Heterocycles and Carbocycles via Desymmetrization of Bicyclic Olefins and Multicomponent Reactions of Indoles	Dr. R. Luxmi Varma	13.04.2018
3	Ajesh Vijayan	Construction of Carbocycles and Heterocycles Utilizing the StericStrain in Heterobicyclic Olefins	Dr. K. V. Radhakrishnan	03.05.2018
4	Abhilash P.	Dielectric Substrates and Screen Printable Inks for Microelectronic Applications	Dr. K. P. Surendran	30.05.2018
5	Dhanya B. P.	Synthetic Modifications of Zerumboneand their Biological Evaluation	Dr. K. V. Radhakrishnan	02.06.2018
6	Remya P. R.	Density Functional Theory Studies on CC Bond Metathesis by Grubbsand Schrock Catalysts: Metal-Carbon Bonding, Mechanisms, andMetallacycles	Dr. C. H. Suresh	20.06.2018
7	Shameel T.	Organic Donor-Acceptor Systems for Metal Ion Recognition and OLED Applications	Dr. D. Ramaiah	29.06.2018
8	Sandeepa K. V.	Design of Functional Fullerenes: Investigation of their Photophysical and DNA Self-Assembly Properties for Optoelectronic Applications	Dr.Joshy Joseph	20.07.2018
9	Sreejith M.	Design, Synthesis and Photophysical Properties of OrganicConjugates of Two-dimensional Layered Nanomaterials for Sensing and PDT Applications	Dr.Joshy Joseph	20.07.2018
10	Aparna P. S.	Desymmetrization of Diazabicyclic Olefins via Transition MetalCatalyzed sp2 C-H Activation : Access to FunctionalizedCyclopentenes	Dr. R. Luxmi Varma	23.07.2018
11	Athul K. R.	Structure - Property Evaluation of Gd&CaAdded Mg-Al & Mg-Zn Alloys.	Dr. A. Srinivasan	26.09.2018

12	Mohamad Hifsudeen B. M.	Design, Synthesis, Self-Assembly and Chiroptical Properties of ChiralOligo (p-phenyleneethynylene) Derivatives	Dr. A. Ajayaghosh	23.10.2018
13	Sudheesh K. V.	Luminescent Probes for Organelle Targeted Imaging, PhotodynamicTherapy and Theranostic Applications	Dr. A. Ajayaghosh	23.10.2018
14	Della Therase Davis	Density Functional Theory Studies on Hydrogen Storage in MolecularAnions of Different Sizes and Shapes	Dr. C. H. Suresh	05.11.2018
15	Priya P.	Nutrient removal and biomethanation potential of prominent invadingmacrophytes	Dr. B. Krishnakumar	16.11.2018
16	Jyothi B. Nair	Design, Synthesis and Biological Assessment of Molecular Transporters for Targeted Delivery of Anti-Cancer Drugs	Dr.Kaustabh Kumar Maiti	20.11.2018
17	Greeshma Gopalan	Phytochemical investigation of some selected medicinal plants and synthetic transformations of an abundant natural product zerumbone	Dr. K. V. Radhakrishnan	20.11.2018
18	Angel Mary Joseph	Novel Ultra-Low-Materials for Microelectronic Applications	Dr. E Bhoje Gowd	20.12.2018
19	Arindam Mal	Synthesis, characterization and applications of ionic covalent organicnanosheets	Dr. A. Ajayaghosh	27.12.2018
20	Ramya Krishna	Molecular and functional characterization of native novel 1aminocyclopropane 1-carboxylate (ACC) deaminase containingphytobeneficialrhizobacteria from coastal saline tolerant pokkali rice varieties of southern India, Kerala	Dr. N. Ramesh Kumar	28.12.2018
21	Minju Thomas	Zeoliticimidazolate framework-8 (ZIF-8) derived porous materials forfunctional applications	Dr. U. S. Hareesh	28.12.2018
22	Jagadeesh K.	Exploration of novel carbon-carbon and carbon-heteroatom bond forming reactions and related chemistry	Dr. B. S. Sasidhar	28.12.2018
23	Rakhi R.	DFT studies on ground and excited state properties of linear polyaceneanalogues and polycyclic aromatic hydrocarbons	Dr. C. H. Suresh	30.01.2019
24	Anjali B.	Predicting activation barrier, reduction potential and fluorescenceusing molecular electrostatic potential: Organic and organometallicsystems	Dr. C. H. Suresh	21.02.2019
25	Athira Krishna	Design, synthesis, photophysical and electroluminescence studies of triphenylamine and carbazole derivatives	Dr. R. Luxmi Varma	25.03.2019

University of Kerala				
26	Renjith S	Liquid Crystalline conducting Materials for Energy Applications	Dr J D Sudha	17.04.2018
27	Annu Raju	Self-Assembling and Anti-Corrosion Characteristics of Polystyrene-Clay Nanocomposites	Dr T P D Rajan	24.04.2018
28	Preethanuj Preethalayam	Transition Metal Catalyzed Transformations of Pentafulvenes and Its Derivatives: Facile Strategies Toward Carbocycles and Heterocycle	Dr K V Radhakrishnan	04.07.2018
29	Silja Abraham	Design Of New Charge Transport Materials For Organic Electronics Applications	Dr Joshy Joseph	11.07.2018
30	Jayaprabha J S	Analysis Of Anaerobic Degradation Of Plant Biomass In Aqueous Medium	Dr V B Manilal	30.07.2018
31	Reshma L R	Macroscopically ordered starch based hydrogels for antimicrobial applications	Dr J D Sudha	31.08.2018
32	Bhagya Uthaman	Structural, Magnetic and Magnetocaloric studies in some Gd-Si-Ge based Intermetallics and Lanthanum Tellurium Manganites	Dr Manoj Raama Varma	14.09.2018
33	Vaisakh S S	Design of Novel Nano/Micro Ceramic Fillers for the Processing of High Thermal Conducting Epoxy Polymer Dielectrics	Dr S Ananthakumar	02.11.2018
34	Maya G Pillai	A Study on the toxicity of different plant extracts on the rice moth Corcyra cephalonicaStainton (Lepidoptera: Pyralidae)	Dr Beena Joy	22.12.2018
CUSAT				
35	Shamala L	Studies on acrylamide in food: Effect of precursprs on acrylamide formation in real and model systems	Dr P Nisha	05.05.2018
36	Sandeep A	Self- Assembly, organogelation and photophysicalproperties of C3- Symmetrical discotic Molecules	Dr A Ajayaghosh	31.08.2018
37	R Thirumalai Kumaran	Fluorescence modulation and application of Self-assembled P- Phenyleneethynylene derivatives	Dr A Ajayaghosh	31.08.2018
38	Babitha K B	Investigations on ZnO – Graphene Oxide Nanomaterials and Nanocomposites : Synthesis, Functional Properties and Application	Dr S Ananthakumar	16.02.2019

प्रबंधन परिषद्

01/01/2018 से 31/12/2019 की अवधि केलिए

MANAGEMENT COUNCIL

Period 01/01/2018 to 31/12/2019

अध्यक्ष

निदेशक, एनआईआईएसटी

सदस्य

डॉ अश्विनी कुमार नांगिया
निदेशक, सीएसआईआर-एनसीएल, पुना

डॉ एस सावित्री
मुख्य वैज्ञानिक

डॉ सी चंद्रशेखर भट्ट (दिसंबर 2018 तक)
प्रमुख, आरपीबीडी, सीएसआईआर-एनआईआईएसटी

डॉ पी निशि (जनवरी 2019 से)
प्रमुख, आरपीबीडी, सीएसआई आर-एनआईआईएसटी

श्री सी के चंद्रकांत
प्रधान वैज्ञानिक

डॉ यू एस हरीश
वरिष्ठ वैज्ञानिक

डॉ पी जयमूर्ति
वैज्ञानिक

श्री एम ब्रह्मकुमार
प्रधान तकनीकी अधिकारी

सीओएफए/एफएओ, एनआईआईएसटी

सदस्य सचिव

प्रशासन नियंत्रक/प्रशासन अधिकारी, एनआईआईएसटी

CHAIRMAN

Director, CSIR-NIIST

MEMBERS

Dr Ashwini Kumar Nangia,
Director, CSIR-NCL, Pune

Dr S Savithri,
Chief Scientist

Dr C Chandrasekhara Bhat (up to December 2018)
Head, RPBD, CSIR-NIIST

Dr P Nishy (from January 2019)
Head, RPBD, CSIR-NIIST

Shri C K Chandrakanth,
Principal Scientist

Dr U S Hareesh,
Senior Scientist

Dr P Jayamurthy,
Scientist

Shri M Brahmakumar,
Principal Technical Officer

CoFA/FAO Member

MEMBER SECRETARY

CoA / AO, NIIST

हाल ही में भर्ती हुए वैज्ञानिक 2018-19
Recently Recruited Scientists 2018-19

डॉ श्रीदेव
Dr. Shridevi D

श्रीदेव डॉ. तिरुमलेश बी वी
Dr. Thirumalesh BV

श्री वेंकटेश टी.
Mr. Venkatesh T

डॉ. अन्जिनेयुलु कोत्ताकोटा.
Dr. Anjineyulu Kothakota

डॉ. इंदू शर्मा
Dr. Indu Sharma

श्री धानी बाबू तलाकाला
Mr. Dhani BabuTalakala

डॉ. सूरज सोमन
Dr. Suraj Soman

डॉ. राजकुमार
Dr. Rajkumar

डॉ इशिता नियोगी
Dr. Ishita Neogi

डॉ प्रवीण वी के
Dr Praveen V K

डॉ पार्थ कुंडू
Dr Partha Kundu

श्री सौरभ साकरे
Mr Saurab Sakhre

डॉ सुशांत कुमार साहू
Dr Sushanta Kumar Sahoo

डॉ कुमरन ए
Dr Kumaran A

पदोन्नतियाँ / PROMOTIONS

डॉ सावित्री एस
Dr S Savithri
मुख्य वैज्ञानिक
Chief scientist

डॉ. के माधवननंपूतिरि
Dr. K. Madhavan Nampoothiri
व. प्रधानवैज्ञानिक
Senior Principal Scientist

डॉ. राजीवसुकुमारन
Dr. Rajeev. K. Sukumaran
प्रधानवैज्ञानिक
Principal Scientist

डॉ. सत्यजित विश्णु शुक्ला
Dr. Satyajit Vishnu Shukla
प्रधान वैज्ञानिक
Principal Scientist

श्री अब्दुल हलीम
Mr. Abdul Haleem
व. वैज्ञानिक
Senior Scientist

श्री वी. मणि
Mr. Moni V
व. वैज्ञानिक
Senior Scientist

डॉ. पी निशा
Dr. P. Nisha
व. वैज्ञानिक
Senior Scientist

डॉ. पी जयमूर्ती
Dr. P. Jayamurthy
व. वैज्ञानिक
Senior Scientist

श्री रमेश कुमार आर के
Mr.Ramesh Kumar R K
सहा. अनुभाग अधिकारी
Assistant Section Officer

सेवानिवृत्ति/ RETIREMENT

डॉ. ए. सुन्दरेशन
Dr. A. Sundaresan
मुख्य वैज्ञानिक
Chief Scientist
VRS: 10.10.2018

डॉ अजीत हरिदास
Dr Ajit Haridas
मुख्य वैज्ञानिक
Chief Scientist
VRS : 25.02.2019

श्री टी पी मारेट
Shri D.P. Maret
Finance & Account Officer
VRS : 31.12.2018

सुश्री लता टी एस
Ms Latha T S
सहायक अनुभाग अधिकारी
Assistant Section Officer
VRS : 06.04.2018

डॉ. सी चन्द्रशेखरा भट्ट
Dr. Chandrasekhara Bhat
व. प्रधान वैज्ञानिक
Sr.Principal Scientist
Retired: 31.12.2018

डॉ लक्ष्मी वर्मा
Dr Luxmi Varma
व. प्रधान वैज्ञानिक
Sr.Principal Scientist
Retired: 31.03.2019

श्रीमती विजया प्रसाद
Mrs. Vijaya Prasad
वरिष्ठ तकनीकी अधिकारी (3)
Sr Technical Officer (3)
Retired: 31.01.2019

श्री राजू एस
Mr. Raju S
वरिष्ठ आशुलिपिक (एम ए सी पी)
Sr Stenographer (MACP)
Retired: 31.03.2019

सेवा से इस्तीफा /RESIGNATION FROM SERVICE

श्रीमती अस्वथी टी एम
Mrs. Aswathy T M
जूनियर सचिवालय सहायक (जी)
Jr Secretariat Assistant (G)

डॉ सदाथ सलीम
Dr Sadath Salim
चिकित्सा अधिकारी
Medical Officer

सीएसआईआर- एनआईआईएसटीमें स्थानांतरण / Transfer to CSIR-NIIST

श्री एन एस राजू
Mr N S Raju
प्रशासन नियंत्रक
Controller of Administration

श्री थॉमस टी कुरियाकोस
Mr Thomas T. Kuriakose
भंडार व क्रय नियंत्रक
Controller of S&P

श्री सी. क्रिस्तु राज
Mr. C. Christu Raj
प्रशासन नियंत्रक
Controller of Administration

श्री हरिकृष्णन वी
Mr. Harikrishnan V
खंड अधिकारी (एफ & ए)
Section Officer (F&A)

सीएसआईआर-एनआईआईएसटीसे स्थानांतरण
Transfer from CSIR-NIIST

डॉ पी सुजाता देवी
Dr P Sujatha Devi
व.प्रिंसिपल वैज्ञानिक
Senior Principal Scientist

श्रीमती दिव्या मोहन
Mrs Divya Mohan
Technical officer
तकनीकी अधिकारी

श्री दुलीप कुमार मणि
Mr. Duleep Kumar Mani
भंडार व क्रय नियंत्रक
सीएसआईआर- सीएलआरआई, चेन्नई
CSIR-CLRI Chennai

श्रीमती सोभना एस
Mrs Sobhana S
प्रशासन नियंत्रक, सीएसआईआर,
मद्रास कॉम्प्लेक्स, चेन्नई
CoA, CSIR, Madras Complex, Chennai

पुरस्कार तथा सम्मान /
AWARDS AND HONOURS

डॉ सूरज सोमण केरल राज्य युवा वैज्ञानिक पुरस्कार (KSYSA) 2018 के लिए केरल के माननीय मुख्यमंत्री श्री पिनारयी विजयन से प्राप्त कर रहे है
Dr Suraj Soman receiving the Kerala State Young Scientist Award (KSYSA) for 2018 from the Honourable Chief Minister of Kerala Sri. Pinarayi Vijayan.

डॉ सी एच सुरेश ने रसायन विज्ञान में महत्वपूर्ण योगदान के लिए केमिकल रिसर्च सोसाइटी ऑफ इंडिया (CRSI) कांस्य पदक प्राप्त किया।

Dr. C. H. Suresh, received the Chemical Research Society of India (CRSI) Bronze Medal for Significant contributions to Chemistry.

डॉ ई भोजे गौड़ ने 19 दिसंबर, 2018 को IISER, पुणे में SPSI-MACRO 2018 के दौरान सोसायटी फॉर पॉलिमर साइंस, इंडिया का प्रोफेसर कौशल किशोर मेमोरियल अवार्ड प्रोफेसर आर ए माशेलकर से प्राप्त किया।

Dr. E. Bhoje Gowd received the Professor Kaushal Kishore Memorial Award of the Society for Polymer Science, India during SPSI-MACRO 2018 at IISER, Pune on December 19, 2018 from Prof. R.A. Mashelkar.

डॉ टी.पी.डी. राजन को एनआईजीआईएस अवार्ड फॉर एक्सीलेंस इन जंग विज्ञान और प्रौद्योगिकी 2018 डॉ वी.के. सारस्वत, पूर्व रक्षा मंत्रालय के मुख्य वैज्ञानिक सलाहकार और वर्तमान में NITI अयोग सदस्य और जवाहरलाल नेहरू विश्वविद्यालय के चांसलर, 2 अक्टूबर, 2018 को जयपुर में आयोजित कॉर्क 2018 सम्मेलन के दौरान दे रहे है

NIGIS Award for Excellence in Corrosion Science and Technology for 2018 presented to Dr. T.P.D. Rajan by Dr. V.K. Saraswat, former Chief Scientific Advisor to Ministry of Defence and presently Member, NITI Aayog and Chancellor of Jawaharlal Nehru University during the CORCON 2018 conference held at Jaipur on October 2, 2018.

डॉ. बिनोद पी को आई आई टी रुड़की में 18 दिसंबर 2018 को डॉ. सारस्वत सदस्य नीतीयोग द्वारा आई एस ईई एस फेलो पुरस्कार से सम्मानित किया गया

Dr. Binod P being conferred Fellow award by ISEES is honoured by Dr. Saraswat, Member Niti Aayog at IIT Roorkee on 18 Dec. 2018

31/03/2019 को कर्मचारी समूह की सूची

डॉ ए अजयघोष
निदेशक
निदेशक का कार्यालय
श्री किरन जे.एस
तकनीकी सहायक
श्री विष्णु गुर्जर
कनिष्ठ आशुलिपिक

कृषि प्रसंस्करण तथा प्रौद्योगिकी प्रभाग

डॉ के जी रघु
वरिष्ठ प्रिंसिपल वैज्ञानिक एवं प्रधान
डॉ बी एस दिलीपकुमार
वरिष्ठ प्रिंसिपल वैज्ञानिक
श्री वी वी वेणुगोपाल
प्रिंसिपल वैज्ञानिक
डॉ श्रीमती एम वी रेश्मा
वरिष्ठ वैज्ञानिक
डॉ (श्रीमती) पी निशा
वरिष्ठ वैज्ञानिक
डॉ पी जयमूर्ती
वरिष्ठ वैज्ञानिक
डॉ(श्रीमती) प्रिया एस
वैज्ञानिक
श्री टी वेंकटेश
वैज्ञानिक
डॉ अन्जिनेयुलु कोत्ताकोटा
वैज्ञानिक
डॉ इंदू शर्मा
वैज्ञानिक
डॉ (श्रीमती) बीना जोय
प्रिंसिपल तकनीकी अधिकारी
श्री डी आर शोभन कुमार
वरिष्ठ तकनीकी अधिकारी(1)
श्रीमती दिव्या मोहन
तकनीकी अधिकारी

रसायन विज्ञान तथा प्रौद्योगिकी प्रभाग

डॉ पी सुजाता देवी
वरिष्ठ प्रिंसिपल वैज्ञानिक एवं प्रधान
डॉ के वी राधाकृष्णन
वरिष्ठ प्रिंसिपल वैज्ञानिक
डॉ सी एच सुरेश
वरिष्ठ प्रिंसिपल वैज्ञानिक
डॉ के एन नारायणन उण्णी
प्रिंसिपल वैज्ञानिक
डॉ ए कुमरन
प्रिंसिपल वैज्ञानिक
डॉ कौस्ताभ कुमार मैती
वरिष्ठ वैज्ञानिक
डॉ बिश्वप्रिया देब
वरिष्ठ वैज्ञानिक
डॉ करुणाकरन वेणुगोपाल
वरिष्ठ वैज्ञानिक
डॉ सुनिल वर्गीस
वरिष्ठ वैज्ञानिक
डॉ वी के प्रवीण
वरिष्ठ वैज्ञानिक
डॉ यूसफ करुवात
वरिष्ठ वैज्ञानिक
डॉ एल रविशंकर
वरिष्ठ वैज्ञानिक
डॉ जोशी जोसफ
वरिष्ठ वैज्ञानिक
डॉ बी एस शशिधर
वैज्ञानिक
डॉ सी विजयकुमार
वैज्ञानिक
डॉ डी श्रीदेवी
वैज्ञानिक
डॉ सूरज सुमन
वैज्ञानिक
डॉ इशिता नेगी
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

पर्यावरण प्रौद्योगिकी प्रभाग

डॉ (श्रीमती) एलिज़बत जेकब
मुख्य वैज्ञानिक तथा प्रधान
डॉ (श्रीमती) एस सावित्री
मुख्य वैज्ञानिक
डॉ जे अंसारी
वरिष्ठ प्रिंसिपल वैज्ञानिक एवं प्रधान, ईएसडी
डॉ बी कृष्णकुमार
प्रिंसिपल वैज्ञानिक
श्री बी अब्दुल हलीम
वरिष्ठ वैज्ञानिक
डॉ पार्थ कुंडू
वरिष्ठ वैज्ञानिक
डॉ के पी प्रतीश
वैज्ञानिक
श्री सौरभ साकरे
वैज्ञानिक
श्री धानी बाबू तलाकाला
वैज्ञानिक
श्री वी के षाजिकुमार
वरिष्ठ तकनीकी अधिकारी (2)
श्री जोशी जोर्ज
वरिष्ठ तकनीकी अधिकारी (1)
श्रीमती पी एम सहरूबा
तकनीकी अधिकारी
श्री टी पी पौलोस
वरिष्ठ तकनीशियन (3)

पदार्थ विज्ञान तथा प्रौद्योगिकी प्रभाग

डॉ के हरिकृष्ण भट्ट
मुख्य वैज्ञानिक एवं प्रधान
डॉ पी प्रभाकर राव
मुख्य वैज्ञानिक
डॉ मनोज रामावर्मा
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

प्रिंसिपल वैज्ञानिक
डॉ यु एस हरीश
प्रिंसिपल वैज्ञानिक
डॉ ई भोजे गौड
प्रिंसिपल वैज्ञानिक
डॉ के जयशंकर
प्रिंसिपल वैज्ञानिक
डॉ ए श्रीनिवासन
वरिष्ठ वैज्ञानिक
डॉ एम सुन्दराराजन
वरिष्ठ वैज्ञानिक
डॉ के पी सुरेन्द्रन
वरिष्ठ वैज्ञानिक
डॉ सजु पिल्लै
वरिष्ठ वैज्ञानिक
डॉ सुब्रता दास
वरिष्ठ वैज्ञानिक
डॉ (श्रीमती) एम वसुंधरा
वैज्ञानिक
डॉ के जी निशांत
वैज्ञानिक
डॉ एस एस श्रीजाकुमारी
वैज्ञानिक
डॉ सुशांत कुमार साहू
वैज्ञानिक
डॉ वी एस प्रसाद
प्रिंसिपल तकनीकी अधिकारी
श्री एम ब्रह्मकुमार
प्रिंसिपल तकनीकी अधिकारी
श्री ए पीर मोहम्मद
वरिष्ठ तकनीकी अधिकारी (2)
डॉ एस रामस्वामी
वरिष्ठ तकनीकी अधिकारी (1)
श्री वी हरीश राज
तकनीकी अधिकारी
श्री एम पी वर्की
प्रयोगशाला सहायक

माइक्रोबियल प्रोसेस तथा प्रौद्योगिकी प्रभाग

डॉ राजीवकुमार सुकुमारन
प्रिंसिपल वैज्ञानिक एवं प्रधान
डॉ के माधवन नंपूतिरि
वरिष्ठ प्रिंसिपल वैज्ञानिक
डॉ पी बिनोद
वरिष्ठ वैज्ञानिक
डॉ एन रमेश कुमार
वरिष्ठ वैज्ञानिक
डॉ मुत्तु अरुमुगम
वैज्ञानिक
श्री एम किरन कुमार
वैज्ञानिक
डॉ लक्ष्मी राकेश कुमार यासरला
वैज्ञानिक
डॉ तिरुमलेश बी वी
वैज्ञानिक
श्री पी एन शिवनकुट्टि नायर
वरिष्ठ तकनीशियन (2)

एस एंड टी सेवा प्रभाग

इंजीनियरिंग एवं सेवा प्रभाग

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 एस हरिदासन पिल्लै
वरिष्ठ तकनीशियन (1)
श्री एम जयदीप
वरिष्ठ तकनीशियन (1)
श्री के एस प्रमोद
तकनीशियन (2)
श्री के सुरेश कण्णन
तकनीशियन (2)
श्री यु धरणीपति
तकनीशियन (2)
श्री बी राधाकृष्णन
तकनीशियन (2)
श्री टी वी सतीश
ग्रुप सी गैर तक. (एमएसीपी)

नॉलिज रिसोर्स सेंटर

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

अनुसंधान योजना तथा व्यवसाय विकास

श्री सी के चन्द्राकान्त
प्रिंसिपल वैज्ञानिक
श्री आर एस प्रवीण राज
वरिष्ठ वैज्ञानिक
डॉ दीपा बालन
वैज्ञानिक
डॉ राजकुमार
वैज्ञानिक
श्री बी वेणुगोपाल
वरिष्ठ तकनीशियन (2)

प्रशासन

श्री सी क्रिस्तु राज
प्रशासन नियंत्रक
श्री एन एस राजू
प्रशासन नियंत्रक
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
श्री के पी कृष्णन
सहायक अनुभाग अधिकारी
श्रीमती मेर्सी जोसफ
सहायक अनुभाग अधिकारी
सुश्री नीतू इंदुचूडन
सहायक अनुभाग अधिकारी
श्री आर के रमेशकुमार
वरिष्ठ सचिवालय सहायक
श्रीमती पी एस पद्मिनी
वरिष्ठ आशुलिपिक (एमएसीपी)
श्री ओ वी शशिकुमार
वरिष्ठ आशुलिपिक (एमएसीपी)

श्री बी सतीशकुमार
क. सचिवालय सहायक
सुश्री ए एल सजिता
क. सचिवालय सहायक
श्री प्रवीण कण्णाल
वरिष्ठ तकनीशियन (1)
श्री टी एच बशीर
वरिष्ठ तकनीशियन (2)
श्रीमती शाना एस नायर
स्टाफ नर्स
श्रीमती एम गीता
प्रयोगशाला सहायक
श्री के उण्णिकृष्णन
ग्रुप सी गैर तकनीकी (एमएसीपी)
श्री के मधु
बेयरर (एमएसीपी)
श्री ए श्रीकुमारन
वाशबॉय (एमएसीपी)

वित्त एवं लेखा

श्रीमती पी वी विजि
अनुभाग अधिकारी (वित्त एवं लेखा)
श्रीमती रमणी देवराज
अनुभाग अधिकारी (वित्त एवं लेखा)
श्री वी हरिकृष्णन
अनुभाग अधिकारी (वित्त एवं लेखा)
श्री संजीव सदानन्दन
सहायक अनुभाग अधिकारी
श्रीमती कोमला सोमन
सहायक अनुभाग अधिकारी
श्रीमती जी गीता
सहायक अनुभाग अधिकारी
श्री विष्णु वी एल
कनिष्ठ आशुलिपिक
श्री पी रजित
मल्टी टास्किंग स्टाफ

भण्डार एवं क्रय

श्री थॉमस टी कुरियाकोस
भंडार व क्रय नियंत्रक
श्री सी एम कृष्णदास
सहायक अनुभाग अधिकारी
श्री एम अनिलकुमार
सहायक अनुभाग अधिकारी
सुश्री शीबा सैतू
क. सचिवालय सहायक
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 (एमएसीपी)
श्री जी भक्तवत्सलम
ग्रुप सी गैर तकनीकी

STAFF LIST AS ON 31/03/2019

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Director

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Mr Vishnu Gurjar
Junior Stenographer

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Mrs Divya Mohan
Technical Officer

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Senior Principal Scientist

Dr C H Suresh
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Dr K N Narayanan Unni
Principal Scientist

Dr A Kumaran
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Senior Scientist

Dr Biswapriya Deb
Senior Scientist

Dr Karunakaran Venugopal
Senior Scientist

Dr Sunil Varughese
Senior Scientist

Dr V K Praveen
Senior Scientist

Dr Yoosaf Karuvath
Senior Scientist

Dr L Ravi Shankar
Senior Scientist

Dr Joshy Joseph
Senior Scientist

Dr B S Sasidhar
Scientist

Dr C Vijayakumar
Scientist

Dr Shridevi
Scientist

Dr Suraj Soman
Scientist

Dr Ishita Neogi
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Mr Robert Phillip
Senior Technical Officer (I)

Mrs S Viji
Senior Technical Officer (I)

Mr Kiran Mohan
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Dr (Mrs) S Savithri
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Dr Parthakundu
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Dr K P Prathish
Scientist

Mr Saurabh Sakhre
Scientist

Mr Dhani Babu Talakala
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Mr Joshy George
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Dr S V Shukla
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Dr E Bhoje Gowd
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Dr A Srinivasan
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Dr M Sundararajan
Senior Scientist
Dr K P Surendran
Senior Scientist
Dr Saju Pillai
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Dr Subrata Das
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Dr (Mrs) M Vasundhara
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Dr K G Nishanth
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Principal Technical Officer
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Dr P Binod
Senior Scientist
Dr N Ramesh Kumar
Senior Scientist
Dr Muthu Arumugam
Scientist
Mr M Kiran Kumar
Scientist
Dr L Rakesh Kumar Yasarala
Scientist
Dr B V Thirumalesh
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S & T SERVICES

ENGINEERING SERVICES DIVISION

Mr R Rajeev
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Superintending Engineer
Mr Chandra Shekar Neelam
Assistant Executive Engineer
Mr B Karthik
Assistant Engineer (Civil)
Mr P Arumugam
Assistant Engineer (Civil)
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Mr M Jayadeep
Senior Technician(1)
Mr K S Pramod
Technician (2)
Mr K Suresh Kannan
Technician (2)

Mr U Dharanipathy
Technician(2)
Mr B Radhakrishnan
Technician(2)
Mr T V Satheesh
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Senior Scientist
Mr S B Ribin Jones
Senior Scientist
Mr M Ramasamy Pillai
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Mr S Pushkin
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Mr Pushpakumar K R Nair
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Dr Deepa Balan
Scientist
Dr Raj Kumar
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Mr N S Raju
Controller Of Administration
Mr K F Joseph
Section Officer (G)
Mr M K Sivadasan
Section Officer (G)

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Senior Security Officer
Mrs K S Lathidevi
Hindi Officer
Mr K P Krishnan
Assistant Section Officer
Mrs Mercy Joseph
Assistant Section Officer
Mrs Neethu Induchoodan
Assistant Section Officer
Mr R K Ramesh Kumar
Assistant Section Officer
Mrs P S Padmini
Senior Stenographer (MACP)
Mr O V Sasikumar
Senior Stenographer (MACP)
Mr B Satheesh Kumar
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Junior Secretariat Assistant
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Senior Technician(2)
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Mrs M Geetha
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Gr C (NT) (MACP)
Mr K Madhu
Bearer(MACP)
Mr A Sreekumaran
Washboy(MACP)

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Mrs P V Viji
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Mrs Remani Devaraj
Section Officer (F&A)
Mr V Harikrishnan
Section Officer (F&A)
Mr Sanjeev Sadanandan
Assistant Section Officer
Mrs Komala Soman
Assistant Section Officer
Mrs G Geetha
Assistant Section Officer
Mr Vishnu V L
Junior Stenographer
Mr P Rejith
Multi Tasking Staff

STORES & PURCHASE

Mr Thomas T Kuriakose
Controller Of Stores & Purchase
Mr C M Krishnadas
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Mr M Anilkumar
Assistant Section Officer (S&P)
Mrs Sheeba Saithu
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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)

घटनाएं और समारोह

जिग्यासा - वैज्ञानिक-छात्र कनेक्ट कार्यक्रम

छात्रों के साथ बातचीत करते वैज्ञानिक

18 अप्रैल 2018 को। सीएसआईआर-एनआईआईएसटी में जिग्यासा-2018 आयोजित किया गया। संस्थान निदेशक डॉ ए अजयघोष ने कार्यक्रम का उद्घाटन किया। तिरुवनंतपुरम शहर के छह केन्द्रीय विद्यालय स्कूलों से 85 छात्रों और शिक्षकों ने इस कार्यक्रम में भाग लिया।

सीएसआईआर-एनआईआईएसटी में जिग्यासा का समन्वय डॉ सी एच सुरेश, प्रिंसिपल वैज्ञानिक, और डॉ आर लक्ष्मी वर्मा, वरिष्ठ प्रिंसिपल वैज्ञानिक व प्रमुख, रसायन विज्ञान तथा प्रौद्योगिकी प्रभाग द्वारा किया गया । इस कार्यक्रम में प्रयोगशाला दौरा, और वैज्ञानिकों और शोध विद्वानों के साथ बातचीत आदि शामिल थी।

राष्ट्रीय प्रौद्योगिकी दिवस समारोह

सीएसआईआर-एनआईआईएसटी में 11 मई, 2018 को राष्ट्रीय प्रौद्योगिकी दिवस मनाया । संस्थान निदेशक डॉ ए अजयघोष ने स्वागत भाषण दिया और दिन के मुख्य अतिथि का परिचय किया । पद्मश्री एम सी दथन, वैज्ञानिक सलाहकार, केरल सरकार और पूर्व निदेशक, वीएसएससी, तिरुवनंतपुरम समारोह में मुख्य अतिथि थे और उन्होंने राष्ट्रीय प्रौद्योगिकी दिवस व्याख्यान दिया । उन्होंने अपने भाषण में केरल के औद्योगिक क्षेत्रों द्वारा सामना किए जाने वाले अवसरों और चुनौतियों पर प्रकाश डाला और संबंधित क्षेत्रों में प्रतिस्पर्धी होने के लिए नई लागत प्रभावी प्रौद्योगिकियों को शुरू करने के महत्व पर जोर दिया दिया । डॉ आर लक्ष्मी वर्मा, अध्यक्षा, अकादमिक कार्यक्रम समिति ने धन्यवाद प्रस्ताव दिया।

पद्म श्री एम सी दथन, वैज्ञानिक सलाहकार, केरल सरकार और पूर्व निदेशक, वीएसएससी, त्रिवेंद्रम ने दर्शकों को संबोधित करते हुए

पद्मश्री लक्ष्मीकुट्टी अम्मा का सम्मान समारोह

डॉ ए अजयघोष, निदेशक, सीएसआईआर-एनआईआईएसटी ने पद्म श्री लक्ष्मीकुट्टी अम्मा को सम्मानित करते हुए

पारंपरिक दवा के प्रयोग में अपनी सफलता के लिए केरल के तिरुवनंतपुरम जिले के कल्लार वन क्षेत्र से लक्ष्मीकुट्टी अम्मा को पद्मश्री पुरस्कार से सम्मानित किया गया, जो भारत का चौथा सर्वोच्च नागरिक पुरस्कार है । लक्ष्मीकुट्टी अम्मा को 'वनमुत्तश्शी' (मलयालम में जंगल की दादी) के रूप में जाना जाता है । पद्मश्री लक्ष्मीकुट्टी अम्मा के सम्मानार्थ 22 मई 2018 को संस्थान में आयोजित समारोह में डॉ ए अजयघोष, निदेशक, सीएसआईआर-एनआईआईएसटी ने उन्हें सम्मानित किया । पद्मश्री लक्ष्मीकुट्टी अम्मा पारंपरिक दवा का प्रयोग करने वाली एक प्रसिद्ध जहर चिकित्सक है। उन्होंने वन पौधों से सोरायसिस, मधुमेह, माइग्रेन जैसी बीमारियों के लिए पारंपरिक दवाओं की तैयारी पर व्याख्यान दिया। डॉ के जी रघु, प्रधान , कृषि प्रसंस्करण तथा प्रौद्योगिकी प्रभाग ने इस कार्यक्रम का समन्वय किया।

एमएसएमई के लिए टेक्नोलॉजी सोर्सिंग फेस्ट: एमएसएमई - टेक्नोलॉजी डेवलपर्स इंटरफेस प्रोग्राम

डॉ.अजयघोष ए, निदेशक सीएसआईआर-एनआईआईएसटी उद्घाटन सत्र के दौरान दर्शकों को संबोधित करते हुए

एमएसएमई विकास संस्थान, एमएसएमई मंत्रालय, त्रिशूर ने एनआईआईएसटी, तिरुवनंतपुरम और अन्य हितधारकों के सहयोग से 12 जून, 2018 को"एमएसएमई के लिए प्रौद्योगिकी सोर्सिंग फेस्ट": एमएसएमई - प्रौद्योगिकी डेवलपर्स इंटरफेस कार्यक्रम आयोजित किया। कार्यक्रम दक्षिणी राज्यों से एमएसएमई, आर एंड डी लैब्स और प्रौद्योगिकी प्रदाताओं के दक्षिणी शिखर सम्मेलन के रूप में आयोजित किया गया था। एमएसएमई के लिए प्रौद्योगिकी स्रोतों का प्रदर्शन करना और प्रौद्योगिकी प्रदाताओं के सहयोग से बेहतर प्रौद्योगिकी प्रबंधन के लिए प्रौद्योगिकी हस्तांतरण को सुगम बनाना कार्यक्रम का उद्देश्य था। श्री पी.वी. वेलायुधन, निदेशक एमएसएमई-डीआई, त्रिशूर ने गणमान्य व्यक्तियों और प्रतिभागियों का स्वागत किया। डॉ ए.अजयघोश, निदेशक सीएसआईआर- एनआईआईएसटी, तिरुवनंतपुरम ने समारोह की अध्यक्षता की। श्री के बिजू आईएएस, निदेशक, इंडस्ट्रीज एंड कॉमर्स ने एमएसएमई के लिए आयोजित प्रौद्योगिकी फेस्ट का उद्घाटन किया। श्री एस शिवगणनम, एआईए, एमएसएमई मंत्रालय, भारत सरकार ने मुख्य भाषण दिया और केएसएसआईए का राज्य अध्यक्ष श्री दामोदर अवनूर, ने आशीर्वाद भाषण दिया। श्री जी एस प्रकाश, उप निदेशक, एमएसएमई-डीआई, त्रिशूर ने धन्यवाद प्रस्ताव दिया। कार्यक्रम में प्रौद्योगिकी प्रस्तुति, आर एंड डी संस्थानों द्वारा प्रौद्योगिकियों की प्रदर्शनी, एमएसएमई की तकनीकी आवश्यकताओं और इंटरएक्टिव बैठक शामिल थीं।

एमएसएमई को खाद्य एवं कृषि प्रसंस्करण, पर्यावरण और अपशिष्ट प्रबंधन, ऊर्जा कुशल प्रौद्योगिकियों और कंपोजिट्स के क्षेत्र में वैज्ञानिक संगठन द्वारा विकसित नई प्रौद्योगिकियों को अपनाने के लिए कार्यक्रम फायदेमंद था और मूल्य वृद्धि के अवसर के अलावा तकनीकी उन्नयन और आधुनिकीकरण के लिए भी उन्हें मदद मिली । केएफआरआई, पीची, आरआरआईआई, कोट्टयम, आईडब्लूएसटी, बेंगलुरु, आईआईसीटी, हैदराबाद, केरल कृषि विश्वविद्यालय, वेल्लायणी, एससीआईटीएमएसटी, केएससीएसटीई, सीसीआरआई, आलप्पुषा, वीएसएससी, सीपीसीआरआई, कासरगोड, सी-डैक, सीआईपीईटी, सीएफटीआरआई, मैसूर इत्यादि जैसे वैज्ञानिक संगठनों ने सम्मेलन में भाग लिया। कार्यक्रम में पैनल चर्चा, बातचीत, आधुनिक प्रौद्योगिकी हस्तांतरण के अवसर, प्रौद्योगिकियों की प्रदर्शनी आदि शामिल थे। कार्यक्रम में लगभग 250 एमएसएमई इकाइयों ने भाग लिया।

अंतर्राष्ट्रीय योग दिवस

योग का अभ्यास करती एनआईआईएसटी परिवार

सीएसआईआर से प्राप्त निर्देशों के अनुसरण में संस्थान में 21 जून, 2018 को अंतर्राष्ट्रीय योग दिवस के अवसर पर एक मास ड्रिल और योग अभ्यास का आयोजन किया गया।

ई-टूल्स पर हिंदी कार्यशाला/अभिमुखीकरण कार्यक्रम

कंप्यूटर पर सामान्यत: प्रयोग होने वाले सॉफ्टवेयरों के अलावा सी-डैक द्वारा हिंदी में काम करने के लिए विकसित सॉफ्टवेयरों जैसे श्रुतलेखन, मंत्रा, प्रवाचक, वाइस टु टाइपिंग आदि के प्रयोग द्वारा कुशलतापूर्वक हिंदी में काम करने संबंधी व अन्य उपयोगी जानकारी देने के लिए संस्थान के अधिकारियों /कर्मचारियों के लिए दिनांक 25.07.2018 को एक कार्यशाला व अभिमुखीकरण कार्यक्रम का आयोजन किया गया। श्री अनिल कुमार, मुख्य प्रबंधक (रा.भा), भारतीय स्टेट बैंक, स्थानीय मुख्य कार्यालय, तिरुवनंतपुरम कार्यशाला में अतिथि वक्ता रहे। हिंदी में प्रवीणता/ कार्यसाधक ज्ञान प्राप्त 23 अधिकारी /कर्मचारी ने कार्यशाला में भाग लिया।

अतिथि वक्ता ने सबसे पहले प्रतिभागियों को राजभाषा विभाग द्वारा ओनलाइन माध्यम से हिंदी स्वयं सीखने के लिए विकसित लीला हिंदी प्रबोध, प्रवीण तथा प्राज्ञ पाठ्यक्रम संबंधी जानकारी दी। इसके बाद, कंप्यूटरों में भाषा इंडिया की साइट से इंडिक लैंग्वेज इनपुट टूल्स डाउनलोड करने की विधी को समझाया। कार्यशाला के दौरान मशीन साधित अनुवाद सिस्टम –मंत्र राजभाषा के बारे में भी प्रतिभागियों को समझाया गया जिससे प्रशासनिक, वित्तीय,कृषि लधु उद्योग सूचना प्रौद्योगिकी स्वाश्थ्य, रक्षा, शिक्षा एवं बैंकिंग क्षेत्रों के दस्तावेजों का अंग्रेजी से हिंदी में अनुवाद कर सकता है। फिर, अतिथि वक्ता ने श्रुतलेखन-राजभाषा, जो भाषण प्रौद्योगिकी के क्षेत्र में एक मील का पत्थर है, के बारे में प्रतिभागियों को समझाया। उन्होंने बताया कि श्रुतलेखन-राजभाषा एक हिंदी स्पीकर स्वतंत्र, निरंतर भाषण पहचान प्रणाली है, जो कंप्यूटर को मानव भाषण को पहचानने में सक्षम बनाता है और हिंदी यूनिकोड में आउटपुट प्रदान करता है। उपयोगकर्ता उपयुक्त इनपुट डिवाइस यानी एक माइक्रोफोन के माध्यम से एप्लिकेशन के साथ कम्यूनिकेट

श्री अनिल कुमार, मुख्य प्रबंधक (रा.भा), भारतीय स्टेट बैंक, स्थानीय मुख्य कार्यालय, तिरुवनंतपुरम कार्यशाला का संचालन करते हुए

कर सकता है। भाषण को प्रोसेस करने के लिए कंप्यूटर एनालॉग सिग्नल को डिजिटल सिग्नल में परिवर्तित करता है। प्रोसेसिंग के बाद टेक्स्ट उत्पन्न होता है।

इसके बाद, प्रतिभागियों को राजभाषा विभाग द्वारा विकसित ई- महोशब्दकोश का परिचय दिया गया। अतिथि वक्ता ने प्रतिभागियों से अपील किया कि अपने अपने डेस्कटॉप पर इन सभी सॉफ्टवेयरों को डाउनलोड करके अपने दैनंदिन कार्यों में इनका प्रयोग सुनिश्चित करें। फीडबैक के रूप में प्रतिभागियों को टीमों में विभाजित करके एक प्रश्नोत्तरी भी आयोजित की गयी।

हिंदी सप्ताह

आयोजन समिति के अध्यक्ष डॉ. पी. प्रभाकर राव उद्घाटन सत्र में प्रतिभागियों का स्वागत करते हुये

संस्थान में 14 सितंबर 2018 को हिंदी दिवस मनाया गया और 21 सितंबर तक हिंदी सप्ताह के रूप में मनाया गया। दिनांक 14 सितंबर को हिंदी सप्ताह का औपचारिक उद्घाटन समारोह आयोजित किया गया।

आयोजन समिति के अध्यक्ष डॉ. पी.प्रभाकर राव ने समारोह में उपस्थित सभी का स्वागत किया। उन्होंने अपने स्वागत भाषण में केंद्र सरकार कार्यालयों में हिंदी दिवस और हिंदी सप्ताह के आयोजन की प्रासंगिकता पर संक्षिप्त जानकारी प्रस्तुत की। डॉ. ए. अजयघोष, निदेशक, सीएसआईआर-एनआईआईएसटी ने उद्घाटन सत्र की अध्यक्षता की और हिंदी सप्ताह समारोह के औपचारिक उद्घाटन की घोषणा की। समारोह के दौरान माननीय गृह मंत्री श्री राजनाथ सिंह का हिंदी दिवस संदेश प्रोजक्टर की सहायता से प्रतिभागियों को दिखाया गया।

उद्घाटन सत्र के बाद संस्थान में नव नयिुक्त वैज्ञानकि डॉ. सुशांत कुमार साहू नें " अक्षय संसाधनों से जैव-आधारति बहुलक" पर वैज्ञानकि प्रस्तुति दी।

इसके पश्चात पूरे सप्ताह के दौरान परियोजना स्टाफ, अनुसंधान छात्र आदि सहित संस्थान के संपूर्ण स्टाफ सदस्यों निम्नलिखित प्रतियोगिताएं आयोजित की गयी।

1) हिंदी ऑनलाइन प्रश्नोत्तरी 2) हिंदी प्रश्नोत्तरी
3) हिंदी अंताक्षरी
4) क्या सोशल मीडिया लोकतंत्र के लिए एक बड़ी चुनौती है विषय पर वाद- विवाद

इसके अलावा संस्थान के कर्मचारियों के स्कूल छात्रों के लिए (कक्षा-1 से कक्षा-XII के छात्रों) 19 सितंबर को हिंदी प्रश्नोत्तरी प्रतियोगिता चलायी गयी।

सभी प्रतियोगिताओं में अनुसंधान छात्रों सहित तथा स्टाफ सदस्यों ने बडी संख्या में तथा अत्यंत उत्साह के साथ भाग लिया।

21 सतिंबर 2018 शाम को समापन समारोह व पुरस्कार वतिरण आयोजति कयिा गया। समारोह के अध्यक्ष ने हदिं ी सप्ताह समारोह के दौरान आयोजति वभिन्नि कार्यक्रम का उल्लेख करते हुये प्रतयिोगतिाओं के सफल भागीदारों का साधुवाद कयिा।। मुख्य अतथिि ने अपने हदिं ी सप्ताह समापन भाषण में आम जनता की भाषा के रूप में हदिं ी सीखने का औचत्यि और महत्ता पर बताया और वभिन्नि प्रतयिोगतिाओं के सफल भागीदारों को पुरस्कार वतिरति कयिा।

डॉ. सुशात कुमार साहू "अक्षय संसाधनों से जैव-आधारित बहुलकों पर " अपनी प्रस्तुति देते हुये

प्रतियोगिता में भाग लेते हुये प्रतिभागियॉ

श्री आर. कृष्णदास, आईबीएस, उप महानिदेशक, ,दूरदर्शन केंद्र तिरुवनंतपुरम, सभा का संबोधन करते हुये

सीएसआईआर स्थापना दिवस

मुख्य अतिथि डॉ वी.के. रामचंद्रन सी एस आई आर स्थापना दिवस पर भाषण दे रहे हैं

सीएसआईआर-एनआईआईएसटी में 27 सितंबर 2018 को सीएसआईआर-स्थापना दिवस मनाया गया। संस्थान की गतिविधियों को दिखाने के लिए उक्त दिन को एक खुले दिन के रूप में मनाया गया और विभिन्न शैक्षणिक संस्थानों के लगभग 400 छात्रों ने आर एंड डी सुविधाओं का दौरा किया। सीएसआईआर-एनआईआईएसटी के निदेशक डॉ ए अजयघोष ने स्वागत भाषण दिया और सीएसआईआर स्थापना दिवस समारोह की अध्यक्षता की। डॉ वी के रामचंद्रन, उपाध्यक्ष, केरल राज्य योजना बोर्ड, केरल सरकार, तिरुवनंतपुरम, समारोह में मुख्य अतिथि थे और उन्होंने सीएसआईआर स्थापना दिवस व्याख्यान दिया। वर्ष 2017-18 के दौरान सीएसआईआर-एनआईआईएसटी के सेवानिवृत्त कर्मचारियों और सीएसआईआर में 25 साल की सेवा पूरी करने वाले कर्मचारियों को सम्मानित किया गया और वर्ष 2017-18 का छात्रवृति पुरस्कार वितरित किया गया। अकादमिक कार्यक्रम समिति की अध्यक्षा डॉ आर लक्ष्मी वर्मा ने धन्यवाद प्रस्ताव दिया।

एनआईआईएसटी स्थापना दिवस

एन आई आई एस टी स्थापना दिवस के दौरान वार्षिक रिपोर्ट का विमोचन

6 अक्टूबर 2018 को सीएसआईआर-एनआईआईएसटी में सीएसआईआर-एनआईआईएसटी स्थापना दिवस मनाया गया। संस्थान की गतिविधियों को दिखाने के लिए उक्त दिन को एक खुले दिन के रूप में मनाया गया और विभिन्न शैक्षणिक संस्थानों के लगभग 350 छात्रों ने आर एंड डी सुविधाओं का दौरा किया। सीएसआईआर-एनआईआईएसटी के निदेशक डॉ ए अजयघोष ने स्वागत भाषण दिया और सीएसआईआर स्थापना दिवस समारोह की अध्यक्षता की। श्री केशवेन्द्र कुमार, आईएएस, सचिव, आयुष विभाग व निदेशक, राज्य मिशन, राष्ट्रीय स्वास्थ्य मिशन, केरल सरकार, तिरुवनंतपुरम समारोह के मुख्य अतिथि थे। उन्होंने संस्थान की वैज्ञानिक उपलब्धियों की सराहना की । मुख्य अतिथि द्वारा वर्ष 2017-18 के सीएसआईआर-एनआईआईएसटी की वार्षिक रिपोर्ट जारी की गई । डॉ टी पी डी. राजन, संयोजक, अकादमिक कार्यक्रम समिति, सीएसआईआर-एनआईआईएसटी, तिरुवनंतपुरम ने धन्यवाद प्रस्ताव दिया।

सतर्कता जागरूकता सप्ताह

संस्थान में सतर्कता जागरूकता सप्ताह 29 अक्टूबर से 2 नवंबर 2018 तक मनाया गया। सतर्कता जागरूकता सप्ताह हिंदी और अंग्रेजी दोनों में प्रतिज्ञा के प्रशासन के साथ शुरू हुआ। कर्मचारियों को सीवीसी की साइट पर जाकर ई-प्रतिज्ञा लेने के लिए प्रोत्साहित किया गया। श्री थॉमस के कुरीकोस, भंडार एवं खरीद नियंत्रकद्वारा सभी स्टाफ सदस्यों और छात्रों के लाभ के लिए "टेंडरिंग - इन विजिलेंस परिप्रेक्ष्य" पर एक बातचीत आयोजित की गई। । सप्ताह के दौरान विभिन्न प्रतियोगिताओं को आयोजित किया गया, अर्थात् "व्यक्तिगत या प्रणाली भ्रष्टाचार को जन्म देती है?" विषय पर बहस, "भ्रष्टाचार मिटाओ-नया भारत बनाओ" विषय पर नारा लेखन पर एक प्रतियोगिता आयोजित की गई थी। 2 नवंबर 2018 को मान्य समारोह आयोजित किया गया था और अध्यक्षता श्री बी.एस. मोहम्मद यासीन, आईपीएस, एडीजीपी (सतर्कता) मुख्य अतिथि ने अन्य राज्यों की तुलना में केरल में भ्रष्टाचार

श्री बी.एस. मोहम्मद यासीन, आईपीएस, एडीजीपी (सतर्कता) ने दर्शकों को संबोधित करते हुए

विरोधी और सतर्कता पर एक जानकारीपूर्ण भाषण दिया। उन्होंने विभिन्न प्रतियोगिताओं के विजेताओं को पुरस्कार भी प्रदान किए।

वैज्ञानिक और औद्योगिक अनुसंधान परिषद (सीएसआईआर) के महानिदेशक का दौरा

16 नवंबर 2018 को आर सी की तीसरी बैठक के अवसर पर सी एस आई आर-एन आई आई एस टी के स्टाफ, छात्रों और आर सी सदस्यों को संबोधित करते हुए डी जी, सी एस आई आर डॉ शेखर सी मैंडे

डॉ शेखर सी मांडे सचिव, डी एस आई आर और महानिदेशक, वैज्ञानिक और औद्योगिक अनुसंधान परिषद (सी एस आई आर), नई दिल्ली ने 16 अक्टूबर 2018 को पदभार ग्रहण करने के बाद, 16 -17 नवंबर, 2018 को सी एस आई आर - एन आई आई एस टी का दौरा किया। । एन आई आई एस टी की अनुसंधान गतिविधियों से परिचित होने के लिए 16 नवंबर 2018 को वे अनुसंधान परिषद की बैठक में शामिल हुए। 17 नवंबर 2018 को उन्होंने कर्मचारियों और छात्रों को संबोधित किया और राष्ट्र और समाज के लिए सीएसआईआर के योगदान के बारे में जानकारी दी। उन्होंने बाढ़ राहत गतिविधियों में सक्रिय रूप से शामिल होने के लिए सीएसआईआर-एनआईआईएसटी के कर्मचारियों और छात्रों की सराहना की जब राज्य तबाही का सामना कर रहा था। सिस्टम में आने वाली चुनौतियों के बारे में चर्चा करने के लिए उन्होंने वैज्ञानिकों, प्रशासनिक कर्मचारियों और छात्रों के साथ अलग-अलग इंटरेक्टिव सेशन किया।

युवा शोधकर्ताओं के लिए बहुलक रसायन

उद्घाटन का एक दृश्य

सीएसआईआर-एनआईआईएसटी, तिरुवनंतपुरम तथा एसपीएसआई, तिरुवनंतपुरम के संयुक्त तत्वावधान में 17 नवंबर 2018 को पीसीवाईआर-2018 का आयोजन किया गया और प्रख्यात प्रोफेसर अभिजीत पी देशपांडे, आईआईटीएम, चेन्नई ने इसका उद्घाटन किया। डॉ सुधा जे डी ने पूरे कार्यक्रम का संयोजन किया। इस सम्मेलन में पॉलिमर के संश्लेषण, संशोधन, और अभिलक्षण, बहुलक मिश्रणों, कंपोजिट और पॉलिमर के प्रसंस्करण, स्मार्ट पॉलिमर, चालक पॉलिमर्स और बायोपॉलिमर्स के ऑप्टो इलेक्ट्रॉनिक गुण और अनुप्रयोगों, पॉलिमर के जैव-संबंधित अनुप्रयोग, पॉलिमर स्थिरता और निम्नीकरण, पॉलिमरों की भौतिकी (सिद्धांत, मॉडलिंग और सिमुलेशन) पर हाल के रुझानों और घटनाक्रमों पर चर्चा की गई। इस सम्मेलन के माध्यम से, युवा शोधकर्ताओं को प्रतिष्ठित दर्शकों के सामने आमंत्रित व्याख्यान देने का एक अनूठा अवसर मिला

इसके अलावा, सम्मेलन ने युवा वैज्ञानिकों को पोस्टर प्रस्तुत करने और बहुलक विज्ञान और प्रौद्योगिकी के क्षेत्र में उनके काम और ज्ञान पर चर्चा करने के लिए एक आदर्श मंच प्रदान किया। इस कार्यक्रम से लगभग 300 छात्र लाभान्वित हुए।

संपिण्डन विज्ञान और प्रसंस्करण (आईसीएसएसपी7) पर सातवां अंतर्राष्ट्रीय सम्मेलन

आईसीएसएसपी 2018 का समापन सत्र

सीएसआईआर-राष्ट्रीय अंतर्विषयी विज्ञान तथा प्रौद्योगिकी (सीएसआईआर-एनआईआईएसटी) और भारतीय प्रौद्योगिकी संस्थान, मद्रास के संयुक्त तत्वावधान में 19-22, नवंबर 2018 के दौरान तिरुवनंतपुरम में संपिण्डन विज्ञान और प्रसंस्करण (आईसीएसएसपी7) पर सातवां अंतर्राष्ट्रीय सम्मेलनआयोजित किया गया । आईसीएसएसपी, जो एक त्रिवार्षिक अंतर्राष्ट्रीय सम्मेलन है, का आयोजन वर्ष 2001 से किया जा रहा है और इसका उद्देश्य शोधकर्ताओं को ठोसकरण के व्यापक क्षेत्र में हाल के अग्रिमों पर अपने ज्ञान का आदान-प्रदान करने के लिए अवसर प्रदान करना है। इस श्रृंखला में, आईसीएसएसपी7 सम्मेलन की अध्यक्षता प्रोफेसर जॉन बानहार्ट, तकनीकी विश्वविद्यालय, बर्लिन, जर्मनी द्वारा की गयी। डॉ यूटीएस पिल्लै, सीएसआईआर-एनआईआईएसटी इसके संयोजक थे, डॉ टी.पी.डी. राजन और डॉ एस सावित्री सह संयोजक थे और डॉ ए श्रीनिवासन कोषाध्यक्ष थे। आईसीएसएसपी7 में क्षेत्र के प्रख्यात शोधकर्ताओं की 71 आमंत्रित मौखिक प्रस्तुतियॉ और विभिन्न देश के युवा शोधकर्ताओं की 67 पोस्टर प्रस्तुतियॉ शामिल थीं

विज्ञान, प्रौद्योगिकी और अनुप्रयोग में इलेक्ट्रॉन माइक्रोस्कोप के उभरते रुझान

(एसटीएईएम-2018) पर राष्ट्रीय सम्मेलन और माइक्रोस्कोप विज्ञान तथा प्रौद्योगिकी अकादमी की 5 वीं वार्षिक बैठक (एएमएसटी)

एसटीएईएम 2018 का उद्घाटन सत्र

सीएसआईआर-राष्ट्रीय अंतर्विषयी विज्ञान तथा प्रौद्योगिकी (सीएसआईआर-एनआईआईएसटी), तिरुवनंतपुरम और माइक्रोस्कोप विज्ञान तथा प्रौद्योगिकी अकादमी (एएमएसटी), भारत के संयुक्त तत्वावधान में 19 - 21, दिसंबर 2018 के दौरान तीन दिवसीय राष्ट्रीय सम्मेलन का आयोजन किया गया । सम्मेलन का उद्देश्य उन्नत सामग्री की माइक्रोस्कोपी में वैज्ञानिक जानकारी की अत्याधुनिक स्थिति और विज्ञान तथा प्रौद्योगिकी के क्षेत्र में हाल के विकास का आदान-प्रदान करना था। संगोष्ठी ने प्रतिभागियों को ज्ञान का आदान-प्रदान करने और राष्ट्रीय ख्याति प्राप्त वरिष्ठ वैज्ञानिक के साथ बातचीत करने के लिए एक मंच प्रदान किया ताकि संबंधित क्षेत्र में नवीनतम परिदृश्य से परिचित हो सकें।

डायोक्सिन इंडिया 2019

डाइऑक्सिन इंडिया 2019 उद्घाटन

संसाधन व्यक्ति द्वारा प्रदर्शन

सीएसआईआर- एनआईआईएसटी ने 19-21 फरवरी 2019 के दौरान एजीलेंट टेक्नोलॉजीस के सहयोग से "डायोक्सिन और पीसीबी मॉनिटरिंग के लिए उन्नत विश्लेषणात्मक समाधान" पर तीन दिवसीय डायोक्सिन इंडिया 2019 कार्यशाला का आयोजन किया। कार्यशाला सीएसआईआर के कौशल विकास कार्यक्रम के हिस्से के रूप में आयोजित की गई थी। नमूना तैयार करने और विश्लेषण में नवीनतम रुझानों को शुरू करने और डाइऑक्सिन उत्सर्जन को कम करने के लिए वैज्ञानिक ठोस अपशिष्ट प्रबंधन की आवश्यकता पर जोर देने के लिए कार्यक्रम को विशेष रूप से नियामक एजेंसियों (पर्यावरण और खाद्य क्षेत्र) और अनुसंधान संस्थानों के विश्लेषकों और इंजीनियरों को प्रशिक्षित किया गया था। सीएसआईआर-एनआईआईएसटी के निदेशक डॉ ए अजयघोष ने कार्यशाला का उद्घाटन किया। कार्यशाला ने डायऑक्सिन की निगरानी के सभी पहलुओं जैसे नमूनाकरण, नमूना तैयार करना, नमूना साफ करना, परिमाणीकरण और रिपोर्टिंग को कवर किया और नियामक आवश्यकताओं पर ध्यान दिया। इसके अलावा, नगरपालिका ठोस कचरे के खुले जल से डाइऑक्सिन के उत्सर्जन पर सीएसआईआर-एनआईआईएसटी अध्ययन के मुख्य परिणाम भी कार्यशाला के दौरान प्रस्तुत किए गए।

डॉ के पी प्रतीश, वैज्ञानिक - प्रभारी, डाइऑक्सिन रिसर्च लेबोरेटरी ने कार्यशाला का समन्वय किया और आंतरिक संसाधन व्यक्ति और कार्यशाला के आयोजक थे। अन्य संसाधन व्यक्ति और उनकी प्रस्तुति का विषय डॉ अनूप कृष्णन, सहायक निदेशक, निर्यात निरीक्षण एजेंसी, कोच्चि, भारत सरकार ने खाद्य और फ़ीड निर्यात बाजार में विनियमों पर व्याख्यान दिया; श्री अभिजीत पथक, वैज्ञानिक, एयर लैब, सीपीसीबी, नई दिल्ली एयर सैंपलिंग पर व्याख्यान दिया; श्री चंद्रशेखर कंदस्वामी, वैज्ञानिक- GC / MS, एजीलेंट टेक्नोलॉजीस ने GC-MS परिमाणीकरण और साधन विधि मान्यता पर भाषण दिया और GC प्रजातंत्र पर श्री प्रभाकरन, अनुप्रयोग वैज्ञानिक, एजीलेंट टेक्नोलॉजीस, ने भाषण दिया । सुश्री एंजेलिका कॉपफ, प्रधान, विक्रय, एल सी टेक, जर्मनी ने ऑटोमेटेड सैंपल प्रिपरेशन सिस्टम पर भाषण दिया और डॉ प्रशांत राजंकर, प्रोग्राम कोऑर्डिनेटर, पर्यावरण संबंधी समस्याओं से निपटने के लिए एनजीओ संगठन ने विषाक्त लिंक पर भाषण दिया।

भारतीय बायोमेडिकल साइंसेज अकादमी की आठवाँ वार्षिक बैठक

दर्शकों को संबोधित करते एपीटीडी के प्रमुख डॉ के.जी. रघु

भारतीय बायोमेडिकल साइंसेज अकादमी की आठवाँ वार्षिक बैठक सीएसआईआर- एनआईआईएसटी, तिरुवनंतपुरम में 25 - 27 फरवरी 2019 से मनाई गई। सम्मेलन का उद्घाटन डॉ ए अजयघोष निदेशक, सीएसआईआर एनआईआईएसटी द्वारा डॉ चूरमनी सरोज गोपाल और अन्य गणमान्य व्यक्तियों की उपस्थिति में किया गया। उद्घाटन समारोह के बाद नूरुल इस्लाम पुरस्कार और IABS पुरस्कार डॉ अजयघोष द्वारा वितरित किए गए थे।

सीडीआरआई लखनऊ के पूर्व निदेशक डॉ मधु दीक्षित, शांतीश्वरूप भटनागर अवार्ड से सम्मानित भारतीय विज्ञान संस्थान, बेंगलुरु के डॉ सथेस राघवन द्वारा प्लेनरी व्याख्यान दिए गए थे। कनाडा के यूनिवर्सिटी ऑफ सस्केचवान में पैथोलॉजी के प्रोफेसर डॉ जय कालरा ने ट्रेंड ऑन मेडिकल त्रुटि प्रकटीकरण और इसके निहितार्थ- एक वैश्विक दृष्टिकोण पर बात की। डॉ हरि एस शर्मा द्वारा पूर्ण व्याख्यान वायुमार्ग सूजन और सीओपीडी के रोगियों में ऊतक रीमॉडेलिंग पर था।

भारतीय चिकित्सा पद्धति, महामारी विज्ञान, कैंसर, प्राकृतिक उत्पादों और पोषक तत्वों, मधुमेह, औषधि खोज, सीवीडी और तपेदिक के क्षेत्र से संबंधित क्षेत्रों के विभिन्न चिकित्सा विद्यालयों और अनुसंधान संस्थानों के प्रतिष्ठित वैज्ञानिकों द्वारा व्याख्यान दिए गए थे। युवा शोधकर्ताओं द्वारा पोस्टर और मौखिक प्रस्तुतियों पर एक समानांतर सत्र था।

प्लेनरी स्पीकर सहित 330 प्रतिभागी थे। भारत के 22 राज्यों से हमारा प्रतिनिधित्व था। इस सम्मेलन के दौरान 80 आमंत्रित व्याख्यान, 79 लघु मौखिक प्रस्तुतियाँ और 80 पोस्टर प्रस्तुतियाँ हुई। शोधकर्ताओं के बीच मजबूत और प्रभावी चर्चा हुई जो ज्ञान को अद्यतन करने के साथ-साथ अनुसंधान की गुणवत्ता में सुधार के लिए उपयोगी पाई गई। सम्मेलन का समापन 27 फरवरी 2019 को वेलेडिकोरी समारोह के साथ हुआ।

राष्ट्रीय विज्ञान दिवस समारोह

डॉ। टी। रामासामी पूर्व सचिव, विज्ञान और प्रौद्योगिकी विभाग, राष्ट्रीय विज्ञान दिवस व्याख्यान देते हैं

सीएसआईआर-नेशनल इंस्टीट्यूट फॉर इंटरडिसिप्लिनरी साइंस एंड टेक्नोलॉजी (CSIR-NIIST), 28 फरवरी, 2019 को राष्ट्रीय विज्ञान दिवस मनाया गया। CSIR-NIIST के निदेशक डॉ ए अजयघोष ने स्वागत भाषण दिया और मुख्य अतिथि का परिचय दिया। विज्ञान और प्रौद्योगिकी विभाग के पूर्व सचिव डॉ टी रामासामी ने राष्ट्रीय विज्ञान दिवस व्याख्यान दिया। राष्ट्रीय विज्ञान दिवस की उत्पत्ति " रामन प्रभाव" जो फोटॉन के बिखरने की घटना है, जो भारतीय वैज्ञानिक महोदय चंद्रशेखर वेंकट रामन द्वारा खोजे गए। इस उल्लेखनीय खोज के लिए उन्हें 1930 में नोबेल पुरस्कार मिला और यह भारत का पहला नोबेल पुरस्कार था विज्ञान के क्षेत्र में । उनकी प्रसिद्ध घटना की खोज को चिह्नित करने के लिए भारत में प्रत्येक वर्ष राष्ट्रीय विज्ञान दिवस मनाया जाता है। राष्ट्रीय विज्ञान दिवस के दौरान डॉ टी रामासामी ने "भारतीय विज्ञान: एक परिप्रेक्ष्य" विषय पर व्याख्यान दिया। डॉ टी.पी.डी. राजन, अकादमिक

EVENTS AND CELEBRATIONS

Jigyasa - Scientist-Students Connect Programme

Jigyasa - Scientist-Students Connect Programme was conducted at CSIR-NIIST on April 18, 2018. The Programme was inaugurated by the Director, CSIR-NIIST, Dr. A. Ajayaghosh. The programme comprised of interaction with scientists and research scholars and visit to departments to know the R & D infrastructure and facilities of the laboratory. Around 85 students and teachers from six Kendriya Vidyalaya Sangathan schools in Thiruvananthapuram city attended this programme. It was coordinated by Dr. C. H. Suresh, Principal Scientist and Dr. R. Luxmi Varma, Sr. Principal Scientist & Head, Chemical Sciences and Technology Division.

Scientists interacting with students

National Technology Day

CSIR-NIIST celebrated the National Technology Day on May 11, 2018. Dr. A. Ajayaghosh, Director, CSIR-NIIST delivered the welcome address and introduced the Chief Guest of the day. The National Technology Day Lecture was delivered by the chief guest Padma Shri. M. C. Dathan, Scientific Advisor, Government of Kerala & Former Director, VSSC, Trivandrum. He highlighted the opportunities and challenges faced by the industrial sector in Kerala and emphasised the importance of introducing new cost-effective technologies to be competitive in the respective sectors. Dr. R. Luxmi Varma, Chairperson, Academic Programme Committee proposed the vote of thanks.

Padma Shri. M. C. Dathan, Scientific Advisor, Government of Kerala & Former Director, VSSC, Trivandrum addressing the audience

Felicitation Ceremony of Padma Shri Lakshmikutty Amma

Dr. A. Ajayaghosh, Director, CSIR-NIIST felicitating Padma Shri Lakshmikutty Amma

Padma Shri Lakshmikutty Amma fondly referred to as 'Vanamuthassi' (Grandmother of the jungle in Malayalam) from Kallar forest area at Thiruvananthapuram in Kerala, India who received India's fourth-highest civilian honour Padma Shri for her breakthrough in practising traditional medicine was felicitated at CSIR-NIIST on May 22, 2018 by Dr. A. Ajayaghosh, Director, CSIR-NIIST. She is a famous poison healer practising traditional medicine. She gave a lecture on traditional medicines for diseases like psoriasis, diabetes, migraine etc. from forest plants. Dr.K.G.Raghu, Head, Agro Processing and Technology Division coordinated the event.

Technology sourcing fest for MSMEs: MSME – Technology Developers Interface Programme

Dr.Ajayaghosh A, Director CSIR-NIIST addressing the audience during inaugural session

MSME Development Institute, Thrissur, Ministry of MSME in association with CSIR- NIIST, Thiruvananthapuram and other stakeholders organised "Technology Sourcing Fest for MSMEs": MSME – Technology Developers Interface Programme on June 12, 2018. The programme was convened as a Southern Summit of MSMEs, R&D Institutes and Technology providers from southern states. The programme was intended to showcase technology sources for MSMEs and to facilitate technology transfer for better technology management in association with technology providers.

Shri K.Biju IAS, Director of Industries & Commerce, inaugurated the Technology Fest for MSMEs in the presence of Dr. A. Ajayaghosh, Director CSIR-NIIST and Shri P.V.Velayudhan, Director MSME-DI, Thrissur. Shri S.Sivagnanam, AIA, Ministry of MSME, delivered the keynote address and Shri Damodar Avanoor, State President KSSIA felicitated the programme. The programme included technology presentation, an exhibition of technologies by R&D Institutions, presentation on technology requirements of MSMEs and interactive meetings.

The programme was beneficial to MSMEs to adopt new technologies in the field of Food & Agro-processing, Environment and waste management, Energy-efficient technologies and composites developed by Scientific organization and it not only help them for technological up-gradation and modernization besides the opportunity for value addition. Scientific organizations such as KFRI, Peechi, RRII, Kottayam, IWST, Bengaluru, IICT, Hyderabad, Kerala Agricultural University, Vellayani, SCITMST, KSCSTE, CCRI, Alappuzha, VSSC, CPCRI, Kasargode, C-DAC, CIPET, CFTRI, Mysore etc. Around 250 MSME units participated in the programme.

International Yoga Day

NIIST family practicing yoga

As per instructions from CSIR, the Institute organized a mass drill and yoga practice on the occasion of International Yoga day observed on June 21, 2018.

Hindi Workshop / Orientation Program on e-Tools

A workshop cum orientation program was organized on July 25, 2018, to give awareness and practical training on effective tools to work in Hindi on the computers, such as Sruthlekhan, Mantra, Pravachak, voice to typing etc. Mr. Anil Kumar, Chief Manager (Rajbhasha), State Bank of India, Local Head Office, Thiruvananthapuram was the resource person. 23 employees having proficiency in Hindi participated in the workshop.

Mr. Anil Kumar, Chief Manager (Rajbhasha), State Bank of India, giving lecture on e-tools in Hindi

The workshop comprised of the introduction of the self-learning packages ie, Leela Hindi Prabodh, Praveen and Pravaah courses developed by the Department of Official Language for learning Hindi online, the procedure for downloading Indic Language input tools from Bhasha India's site. During the workshop the participants were introduced to the machine-derived translation system -Mantra, with the help of which documents related to administrative, financial, agricultural, small scale industries, Information Technology, health, defence, education and banking sectors could be translated from English to Hindi. Participants were introduced to the tool Sruthlekhen- Rajbhasha which is a landmark in the field of speech technology. Sruthlekhen- Rajbhasha is a Hindi Speaker Free, continuous speech recognition system, which enables the computer to recognize human speech and to provide output in Hindi Unicode. Thereafter the participants were introduced to the e-dictionary developed by the Department of Official Language. The guest speaker appealed to the participants to download all these software on their desktop and make use of them in their daily activities. The workshop ended with a quiz programme.

Hindi Week

The Institute observed September 14, 2018, as Hindi Day and the week succeeding up to September 21, 2018, was observed as Hindi week. A formal inauguration ceremony of Hindi Week was organized on September 14, 2018.

Dr. P. Prabhakar Rao, Chairman, Organizing Committee welcomed the participants. In his welcome address, he gave brief information on the relevance of organizing Hindi Divas and Hindi Week in Central Government Offices. Dr. A. Ajayaghosh, Director, CSIR-NIIST chaired the inaugural session and offered the presidential address and announced the formal inauguration of the Hindi Week of 2018. During the function, participants were shown the Honorable Home Minister Shri Rajnath Singh's Hindi Day message with the help of a projector.

Dr. P. Prabhakar Rao, Chairman Organizing Committee welcoming the participants

After the inauguration session, Dr. Sushanta Kumar Sahoo, Scientist, gave a scientific presentation on "Bio-based polymer from renewable resources" in Hindi.

Dr. Sushanta Kumar Sahoo giving presentation on" Bio-based polymers from renewable resources"

The following competitions were organized throughout the week for the staff and students of the Institute namely Hindi Online Quiz, Hindi Quiz, Hindi Antakshari, Hindi Debate on "Is social media a big challenge for democracy".

Apart from this, a Hindi Quiz Competition was conducted exclusively for the school students of the staff members of the institute (Class-I to Class-XII students). Staff members, including research students, participated in all competitions in large numbers and with full enthusiasm.

Staff members participating in the competition

The concluding ceremony and prize distribution were organized on September 21, 2018. Mr. R. Krishnadas, IBS, Deputy Director-General, Doordarshan Kendra, Thiruvananthapuram presided over as the chief guest. The Chief Guest in his address justified the importance of learning Hindi as the language of the general public and distributed prizes to the winners of various competitions.

Mr. R. Krishnadas, IBS, Deputy Director, Doordarshan Kendra, Thiruvananthapuram addressing the gathering

CSIR Foundation Day

Address by chief guest Dr. V.K. Ramachandran on CSIR Foundation Day

CSIR Foundation Day was celebrated at CSIR-NIIST on September 27, 2018. The day was observed as an open day for showcasing the activities of the institute and about 400 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. V.K. Ramachandran, Vice Chairman, Kerala State Planning Board, Government of Kerala, Trivandrum, the Chief Guest for the function, delivered the CSIR Foundation Day lecture. The superannuated employees of CSIR-NIIST during 2017-18 and the employees who completed 25 years of service in CSIR were felicitated and the studentship award 2017-18 was distributed. Dr. R. Luxmi Varma, Chairperson, Academic Programme Committee proposed the vote of thanks.

NIIST Foundation Day

Release of Annual report during NIIST Foundation day

CSIR-NIIST Foundation Day was celebrated at CSIR-NIIST on October 6, 2018. The day was observed as an open day and about 350 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-NIIST Foundation day function. Shri Keshvendra Kumar IAS, Secretary, Department of Ayush and State Mission Director, National Health Mission, Government of Kerala, Thiruvananthapuram was the Chief Guest for the function. He appreciated the scientific achievements of the laboratory. The Annual Report of CSIR-NIIST for the year 2017-18 was released by the Chief Guest. Dr. T.P.D. Rajan, Convener, Academic Programme Committee, CSIR-NIIST, Thiruvananthapuram proposed the vote of thanks.

Vigilance Awareness Week

Vigilance Awareness week was observed in the Institute from October 29 to November 2, 2018. The vigilance awareness week commenced with the administration of pledge in both Hindi and English. The staff were also encouraged to take e-pledge by visiting CVC's site. A talk on "Tendering – In the vigilance perspective" was held for benefit of all staff members and students by Shri. Thomas T. Kuriakose, Controller of Stores and Purchase. Various competitions were held during the week namely elocution competition, debate on the topic "Individual or system breeds corruption?". A competition on slogan writing was held on the theme "Eradicate corruption–build a new India". The valedictory function was held on 2nd November 2018

Sri B.S. Mohammed Yasin, IPS, ADGP (Vigilance) addressing the audience

and presided over by Sri B.S. Mohammed Yasin, IPS, ADGP (Vigilance). The chief guest gave an informative speech on Anti-Corruption and vigilance in Kerala in comparison with other states. He also gave away the prizes to the winners of various competitions.

Visit of Director General, Council of Scientific & Industrial Research (CSIR)

Dr. Shekhar C Mande, Secretary, DSIR & Director General, Council of Scientific & Industrial Research (CSIR), New Delhi after taking charge on 16th October 2018, visited CSIR-NIIST on 16th -17th November 2018. He attended the Research Council meeting on 16th November 2018 to get acquainted with the research activities of NIIST. On 17th he addressed the staff and students and gave insight into the contributions of CSIR for the nation and society.

Dr. Shekhar C Mande, Secretary, DSIR & Director General, Council of Scientific & Industrial Research (CSIR) addressing the NIIST members

He appreciated the staff and students of CSIR-NIIST for actively involving in the flood relief activities when the state was facing a catastrophe. He also had a separate interactive session with Scientists, administrative staff and students to discuss regarding the challenges faced in the system.

Polymer Chemistry for Young Researchers

PCYR-18 was jointly organized by CSIR-NIIST, Trivandrum and SPSI Trivandrum chapter on 17th November 2018 and was inaugurated by the eminent Prof. Abhijit P. Deshpande, IITM, Chennai and Dr. Sudha JD convened the whole program. This conference envisaged discussing recent trends and developments in the field of synthesis, modification, and characterization of polymers, polymer blends, composites and processing of polymers, Smart polymers, conducting polymers and biopolymers, Optoelectronic properties and applications of polymers, Bio-related application of polymers, Polymer stability and degradation, Physics of polymers (theory, modelling and simulation). Through this conference, the young researchers got a unique opportunity to deliver invited lectures in front of an august audience.

Inauguration

Moreover, this conference provided an ideal platform for young scientists to present posters and discuss their work and knowledge of polymer science and technology. About 300 students were benefitted by this program.

Seventh International Conference on Solidification Science and Processing (ICSSP7)

Concluding session of ICSSP 2018

The Seventh International Conference on Solidification Science and Processing (ICSSP7) was organized jointly by the CSIR-National Institute for Interdisciplinary Science and Technology (CSIR-NIIST) and the Indian Institute of Technology Madras and held in Thiruvananthapuram during November 19–

22, 2018. ICSSP, a triennial international conference, is being organized since 2001 to allow researchers to exchange their knowledge on recent advances in the broader field of solidification. In this series, the ICSSP7 was chaired by Professor John Banhart, Technical University, Berlin, Germany. The ICSSP7 had 71 invited oral presentations by eminent researchers in the field and 67 poster presentations by young researchers from various countries.

National Conference on Emerging Trends in Science, Technology & Application of Electron Microscope (STAEM-2018)

A three-day national conference was organized jointly by CSIR-National Institute for Interdisciplinary Science and Technology, Trivandrum and Academy of Microscope Science and Technology (AMST), India during December 19 – 21, 2018. The objective of the conference was to exchange the latest state of the art and scientific information in microscopy of the advanced materials, and recent development in the field of science and technology. To provide a platform to the participants for exchanging the knowledge and for interacting with Senior Scientists of national repute so as to get acquainted with the latest scenario in the concerned field.

Inaugural session of STAEM-2018

Dioxin India 2019

CSIR- NIIST conducted a three-day "DIOXIN INDIA 2019 workshop on "Advanced Analytical Solutions for Dioxins & PCBs Monitoring" in collaboration with Agilent Technologies during 19-21st February 2019. The workshop was conducted as part of the Skill Development Programme of CSIR. The programme was specifically focussed to train analysts and engineers of regulatory agencies (Environmental & Food sector) and research institutes, to introduce the latest trends in sample preparation and analysis and to emphasis the need for scientific solid waste management for reducing dioxin emissions. Dr. A. Ajayaghosh, Director, CSIR-NIIST inaugurated the workshop. The workshop covered all aspects of dioxins monitoring such as sampling, sample preparation, sample clean up, quantification and reporting and touched upon

Dioxin India 2019 inauguration

Demonstration by resource person

the regulatory requirements. In addition, the salient outcomes of CSIR-NIIST studies on the emission of dioxins from open burning of municipal solid wastes were also presented during the workshop.

Dr. K. P. Prathish, Scientist – in charge, Dioxin Research Laboratory coordinated the workshop and was the internal resource person and organizer of the workshop. Other resource persons were Dr. Anoop Krishnan, Assistant Director, Export Inspection Agency; Shri. Abijit Pathak, Scientist, Air Lab, CPCB; Mr. Chandrasekar Kandaswamy, Scientist- GC/MS, Agilent Technologies; Mr. Prabhakaran, Application Scientist, Agilent Technologies; Ms. Angelika Kopf, Head, Sales, LC Tech, Germany and Dr. Prashant Rajankar, Programme Coordinator, Toxic Links. The major topics discussed were on Regulations in food and feed export market, air sampling, GC-MS quantification & instrumental method validation, GC-MS troubleshooting and automated sample preparation systems.

Annual meeting of Indian Academy of Biomedical Sciences

The 8th Annual meeting of IABS was celebrated from 25th to 27th February 2019 at CSIR-NIIST, Thiruvananthapuram. The conference was inaugurated by Dr. A Ajayaghosh, Director, CSIR-NIIST in the presence of Dr. Chooramani Saroj Gopal and other dignitaries. The inauguration was followed by Noorul Islam Award Session and IABS award ceremony and the awards were distributed by Dr. A. Ajayaghosh.

There were plenary lectures by Dr. Madhu Dixit, former Director of CDRI Lucknow, Dr. Adriaan Ligtenberg, Dr. Sathees Raghavan, from Indian Institute of Science, Bangalore, Dr. Jai Kalra, Professor of pathology at University of Saskatchewan, Canada and Dr. Hari S Sharma.

There were invited lectures by eminent scientists from various medical schools and research institutes in the areas pertaining to the Indian system of medicine, Epidemiology, Cancer, Natural products and nutraceuticals, the field of Diabetes, Drug discovery, CVD and Tuberculosis. There was a parallel session on the poster and oral presentations by young researchers.

Dr. K.G. Raghu, Head of APTD addressing the audience during inauguration

There were around 330 participants including the plenary speakers. We had representation from 22 states of India. There were 80 invited talks, 79 short oral presentations and 80 poster presentations during this conference. There were strong and effective discussions among the researchers which were found to be useful for updating knowledge as well as improvement of the quality of research. The conference ended with the Valedictory function on 27th February 2019.

National Science Day

The National Science Day was celebrated at CSIR-National Institute for Interdisciplinary Science and Technology (CSIR-NIIST), Trivandrum on February 28, 2019. Dr. A. Ajayaghosh, Director, CSIR-NIIST delivered the welcome address and introduced the Chief Guest of the day. Dr. T. Ramasami Former Secretary, Department of Science and Technology delivered the National Science Day Lecture. The genesis of the National Science Day is to commemorate the "Raman effect", a phenomenon of scattering of

photons discovered by celebrated Indian Scientist Sir Chandrasekhara Venkata Raman which got him Nobel Prize in 1930 for this remarkable discovery and this was the first Nobel Prize for India in the field of Science. To mark the discovery of his famous phenomenon National Science Day is celebrated in India on the day each year. During the National Science Day, Dr. T. Ramasami delivered a lecture on "Indian Science: A Perspective". Dr. T.P.D. Rajan, Convener, Academic Programme Committee proposed the vote of thanks.

Dr. T. Ramasami, Former Secretary, Department of Science and Technology delivering the National Science Day Lecture

बाढ़ से पीड़ित केरल के लोगों की मदद के लिए एनआईआईएसटी छात्र समुदाय की जोश

सदी की सबसे बड़ी और सबसे बुरी बाढ़ आपदा का अनुभव करने के बाद केरल राज्य सामान्य स्थिति में वापस आ रहा है। पूरे केरल में मई 2018 से हुई मूसलाधार बारिश के कारण सभी जलाशयों में भारी मात्रा में बारिश का पानी जमा हो गया जिसके कारण अगस्त को राज्य के 35 बांधों को खोलने पडे। भारी और अभूतपूर्व निरंतर मूसलधार बारिश से स्थिति बिगड़ गई। परिणामस्वरूप, अधिकांश नदी अधिक पानी के साथ बह गई और कुछ ही समय में निचले इलाकों में बाढ़ आ गई। मिट्टी लथपथ होने से उच्च क्षेत्र बुरी तरह प्रभावित थे और ढीली मिट्टी ट्रिगर कर राज्य के कई हिस्सों में विनाशकारी भूस्खलन हुआ।। सैकड़ों घर तबाह या क्षतिग्रस्त हो गए, कई सौ लोगों की जान चली गई और लगभग हर बुनियादी ढांचा, बिजली और पानी की आपूर्ति पूरी तरह से हिरासत में लिया गया और उखाड़ दिया गया, जिसके परिणामस्वरूप कुल अराजकता हो सकती है, लेकिन सरकारी और गैर सरकारी मशीनरी के सामंजस्यपूर्ण और सिंक्रनाइज़ तरीके से समय पर हस्तक्षेप के कारण स्थिति जिस सीमा तक संभव हो, नियंत्रण में आ गयी।

सीएसआईआर- एनआईआईएसटी परिवार तथा संपूर्ण सीएसआईआर प्रयोगशालाओं ने जरूरतमंद समय पर जिम्मेदारी, प्रतिबद्धता और समर्पण की उच्च भावना के साथ बाढ़ प्रभावित क्षेत्रों से आये एसओएस कॉल का जवाब दिया। हमारे आदरणीय निदेशक की अनुमति, समर्थन और निरंतर प्रोत्साहन के साथ इस संबंध में सामूहिक प्रयास शुरू किए गए। राज्य के विभिन्न हिस्सों में बाढ़ ग्रस्त लोगों को बचाव ऑपरेटरों से जोड़ने के उद्देश्य से संस्थान में हेल्प डेस्क की पहल प्रारंभ किया गया। हेल्प डेस्क के समक्ष कई आवश्यकताएं बताई गईं और निराश्रितों की सुविधा के लिए हर संभव सहयोग दिया गया। सदस्यों और स्वयंसेवकों को स्थिति के वास्तविक समय अलर्ट दिया गया।

छात्र संघ के सदस्यों ने तिरुवनंतपुरम के संग्रह बिंदुओं पर अधिकारियों से संपर्क किया और फीडबैक के आधार पर, आवश्यक चीजों की खरीद और आपूर्ति शुरू कर दी,जो बाढ़ ग्रस्त लोगों के समर्थन के लिए आवश्यक थी। जीवन अपेक्षित सामग्रियों को एकत्र करके प्रभावित स्थानों पर परिवहन करने के उद्देश्य से कैंपस के अंदर संग्रह बॉक्स लगाए गए थे और तिरुवनंतपुरम शहर के विभिन्न भागों में संग्रह बॉक्स लगाए गए थे अर्थात् रामचंद्रन सुपर स्टोर्स, पोथीस और बिग बाजार। एकत्रित राहत सामग्रियों को छांटकर उन्हें पैक और लेबल किए गए और प्रभावित स्थानों पर एयर ड्रॉप करने के लिए तिरुवनंतपुरम में स्थापित विभिन्न संग्रह स्थानों पर ले गये।

सड़कों की बुरी स्थिति के कारण सामानों का परिवहन सबसे बड़ी चुनौती थी। इस अवसर पर स्टाफ और प्रशासन सहायता के लिए आगे आये और लॉजिस्टिक के मुद्दे को हल किया और अलप्पुषा, कुट्टनाडु चेंगन्नूर के कुछ शिविरों में अपने निजी वाहनों में आवश्यक सामग्रियों को पहुँचाया। संस्थान के पिक-अप वैन में एमजी विश्वविद्यालय परिसर के शिविर के लिए सामान के कई लोड पहुँचाया गया। समय पर हस्तक्षेप से 1000 से अधिक लोगों को बचाव दलों के साथ जोड़ा सका और उन्हें भोजन और प्राथमिक आवश्यकताओं को प्रदान किया गया। एनआईआईएसटी कैंटीन ने करुमम और वेट्टिक्कुज़ी (तिरुवनंतपुरम) में दो शिविरों में भोजन की आपूर्ति की गयी।

सीएसआईआर परिवार के सदस्यों ने एनआईआईएसटी द्वारा समन्वित बाढ़ राहत गतिविधियों में पूरे दिल से योगदान दिया। सीएसएमसीआरआई, सीएलआरआई, सीईसीआरआई, आईएमएमटी, नीरी,आईएचबीटी,सिमैप और सीएफटीआरआई जैसे सहोदर प्रयोगशालाओं ने कपड़े, दवाइयां, खाद्य सामग्री, वाटर फिल्टर और मच्छर निरोधक जैसी सामग्रियॉ प्रदान करके मदद दी। सीएसएमसीआरआई से मोबाइल जल शोधन इकाई 10 दिनों के लिए पीने का पानी प्रदान करके बाढ़ प्रभावित क्षेत्रों में सेवा की।

उनकी सेवा का सबसे ज्यादा सराहना की गयी क्यों कि उस समय लगभग पूरे जल स्रोत दूषित थे और पेयजल एक गंभीर समस्या थी। 2 करोड़ रुपये से अधिक लागत की सामग्रियॉ प्रभावित स्थानों पर वितरण के लिए संस्थान में पहुंचे, जिसमें वाटर फिल्टर की 1000 इकाइयाँ (500 इकाइयाँ आईएमएमटी से और 500 नीरी से), मच्छर रिपेलन्ट्स की 50000 इकाइयाँ (सिमैप से), 200000 यूनिट के फूड पैकेट (राजमा, खिचड़ी, न्यूट्रीबार और चिक्की, प्रत्येक के 50000 पैकेट, आईएचबीटी से), शामिल थे। 2 मिनी लोरियां, एनआईआईएसटी के पिकअप वैन और 4 कारों में विभिन्न गंतव्यों के लिए सामग्रियों को बड़े पैमाने पर स्थानांतरण किया गया। संस्थान में प्राप्त हर एक राहत सामग्री का सफल वितरण सुनिश्चित करने के लिए सामग्री का वितरण अगले दिनों में जारी रहा। कड़ी मेहनत से कैनकेरी, रान्नी, पथनंथिट्टा, एडत्तुवा, चेरतला, रमनकरी, तकषी, निरनम, पडियूर, मतिलकम, चेंगन्नाशेरी , कोट्टयम, डप्पनक्कुन्नु,अलंगाड़, नेडुमुडी, तलवड़ी, तिरुवल्ला जैसे बाढ़ ग्रस्त क्षेत्रों तक पहुँचाकर सहायता वितरित रने में टीम सक्षम थे।

Enthusiasm of NIIST student's community to help the flood affected Kerala

The State of Kerala is springing back to normalcy after experiencing the century's biggest and worst flood disaster. The torrential rain all over Kerala since May 2018 accumulated huge quantity of rain water in all reservoirs finally forcing the opening of 35 dams in the state in August 2018. The heavy and unprecedented continuous downpour worsened the situation. As a result, most of the riverine swelled with excess water flooding low lying areas in no time. The high range areas were badly affected devastating landslides in many parts of the state. Hundreds of houses were destroyed or damaged, several hundred lives lost and almost every infrastructure, power and water supply were completely destroyed and uprooted. However, timely intervention of Government and non-Government machinery in a harmonious and synchronized manner contained the situation to the extent possible.

The CSIR-NIIST family and CSIR as a whole quickly responded to the SOS calls from the flood affected areas depicting high sense of responsibility, commitment and dedication at the neediest hour. With the permission, support and continuous encouragement from our respected Director collective efforts were initiated for flood effect mitigation support activity. A Help Desk initiative with an aim to connect the surrounded people to the rescue operators at various parts of the state was opened at the institute. Several requirements were reported before the Help Desk and all possible support were done to facilitate the destitute. The members and volunteers were given real time alerts of the ongoing situation.

Student Association members contacted the officials at the Thiruvananthapuram collection points. Based on their feedbacks and several requests posted from various parts of the state we began to procure and supply things that were essential for rending support. Collection boxes were put up inside the NIIST campus and also at various points in the Thiruvananthapuram city namely, in front of Ramachandran Super Stores, Pothys and Big Bazaar. The collected relief materials were sorted out, packed and labelled and were taken to the collection points at Thiruvananthapuram to air drop at the affected places.

Transportation of the collected goods to different affected places was the biggest challenge due to badly affected roads. The staff and the administration rose to the occasion and solved the logistics issue and transported requirement materials in their private vehicles to some of the camps at Alappuzha, Kuttanadu and Chengannur. The NIIST pick-up van transported several load of materials to the camp at MG University campus. With timely interventions it was possible to connect more than 1000 people with the rescue teams and were provided food and primary requirements. NIIST canteen provided food to two camps at Karumam and Vettukkuzhi (Thiruvananthapuram).

The members of CSIR family wholeheartedly contributed to the flood relief accomplishments coordinated by NIIST. Sister laboratories CSMCRI, CLRI, CECRI, IMMT, NEERI, IHBT, CIMAP and CFTRI offered helping hands by providing clothing, medicines, food materials, water filters and mosquito repellents. Mobile water purification unit from CSMCRI served the flood hit areas for 10 days by providing drinking water to the areas. Their service was most appreciated as the drinking water was a serious problem at the time with almost every water source contaminated. There were 1000 units of water filters (500 from IMMT and 500 from NEERI), 50000 units of mosquito repellents (CIMAP), 200000 units of food packets (Rajmah, Khichdi, nutribar and chikki each 50000; from IHBT), worth more than 2 Crore rupees reached institute for distribution to affected places. A mass transfer

of materials to different destinations was made comprising 2 mini lorries, NIIST official pickup and 4 cars. The distribution of materials continued in the following days ensuring the successful delivery of every single item of relief material that was received at the institute. With days of hard-work the team were able to get its hands reached out to areas Kainakary, Ranni, Pathanamthitta, Edathua, Cherthala, Ramankary, Thakazhy, Niranam, Padiyoor, Mathilakam, Chengannor, Changanassery, Kottayam, Kodupunnakkavu, Alangad, Nedumudy, Thalavady, Thiruvalla etc.

The final load was transported to Thrissur by means of NIIST official vehicle. The flood relief activities continued for 80 days with every NIIST member making their contribution to the activity. The money collected from NIIST and other CSIR laboratories was handed over to the Government by our respected Director. The team work reminded the spirit of togetherness and aroused the essence of humanity. The team could spread smile on more than 25000 individuals which would be the greatest success of this mission.

राहत शिविरों में वितरित करने के लिए भोजन पैक करने में व्यस्त एनआईआईएसटी टीम
Food to be distributed being packed by NIIST team

राहत सामग्री पैक करते हुये एनआईआईएसटी छात्र समुदाय
Relief materials being sorted out, packed and labelled by NIIST students

पेयजल मोबाइल यूनिट के साथ पूरी तरह से तैयार सीएसआईआर-सीएसएमसीआरआई टीम
Mobile water purification unit from CSIR-CSMCRI

मुख्यमंत्री की राहत निधि में संस्थान द्वारा समाहरण की गयी निधि के लिए चैक सौंपते हुएडॉ ए अजयघोष, निदेशक, सीएसआईआर- एनआईआईएसटी
Dr. A. Ajayaghosh, Director, CSIR-NIIST handing over the monetary contributions to Chief Minister's flood relief fund

राहत सामग्री के साथ प्रस्थान के लिए पूरी तरह से तैयार एनआईआईएसटी वाहन
Relief materials loaded NIIST vehicle ready for departure

राष्ट्रीय अंतर्विषयी विज्ञान तथा प्रौद्योगिकी संस्थान

(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद्)

तिरुवनंतपुरम

National Institute for Interdisciplinary Science & Technology

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Thiruvananthapuram