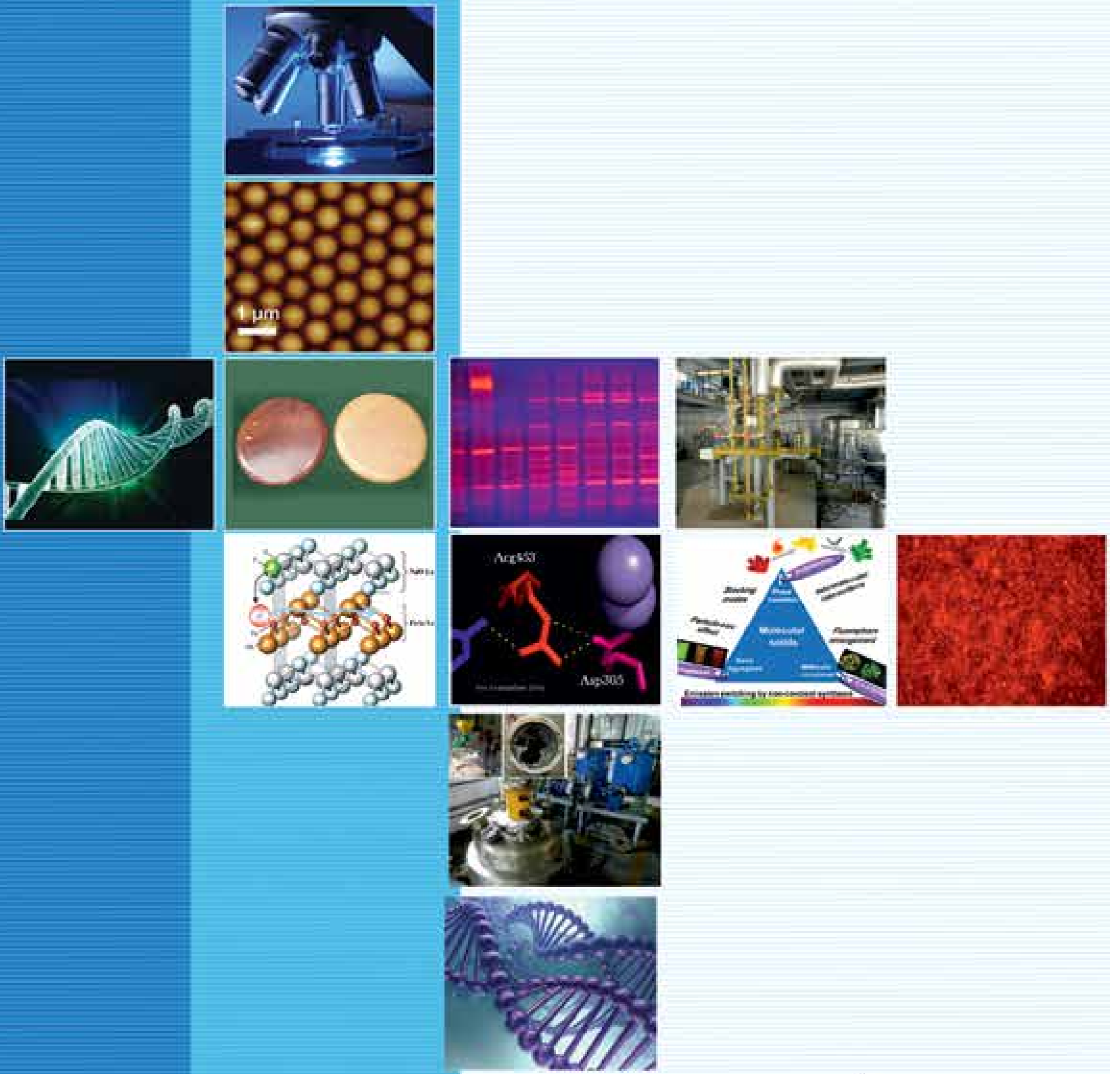

वार्षिक प्रतिवेदन 2013-2014

Annual Report
2013-2014

सी एस आई आर - राष्ट्रीय अंतर्विषयी विज्ञान तथा प्रौद्योगिकी संस्थान
CSIR - National Institute for Interdisciplinary Science & Technology
(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद्)
(Council of Scientific & Industrial Research)
तिरुवनंतपुरम / Thiruvananthapuram

Published by : The Director
National Institute for Interdisciplinary
Science & Technology, Thiruvananthapuram

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Design & Printing : Akshara Offset, Thiruvananthapuram

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CSIR - National Institute for
Interdisciplinary Science & Technology

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Foreword

It is my great pleasure and privilege to present the Annual Report for 2013-14, which highlights our scientific achievements for the year along with information on the good progress we have made in areas such as infrastructure development, external earnings, publications and patents. I am happy to note that our Institute has continued its march towards improving interdisciplinary interactions between the various Divisions of our Institute. This has enabled the Institute to take up major programs in the chemistry/materials and chemistry/biology interface and improve its interaction with various external agencies. Some of the highlights for the last year include the commissioning of the 2G Ethanol Pilot Plant, collaboration with Arya Vaidyasala, Kottakal for working on Ayurvedic products and processes and signing of the MOU with SABIC, Saudi Arabia to work on development of photochromic molecules. During the year we also organized a number of conferences and workshops including a major international conference on Advanced Functional Materials [ICAFM 2014]. As usual, several of our scientists have received awards and recognitions the most notable of which being the TWAS-Prize received by Dr. Ajayaghosh. I congratulate all of them for having brought recognition to our Institute. I also wish to thank our entire staff for their dedicated effort towards making all our achievements for this period possible.I also wish to express my sincere thanks to DG CSIR and other colleagues from Head Quarters for their continued support.

Suresh Das

Director

प्राक्कथन

वर्ष 2013-14 की वार्षिक रिपोर्ट प्रस्तुत करना मेरे लिए अत्यंत खुशी एवं सौभाग्य की बात है, जो उस वर्ष के लिए बुनियादी ढांचे के विकास, बाह्य आय, प्रकाशन तथा पेटेंट जैसे क्षेत्रों में हासिल की गयी अच्छी प्रगति के बारे में जानकारी देने के साथ-साथ हमारी वैज्ञानिक उपलब्धियों पर प्रकाश डालती है । मुझे यह नोट करने में खुशी है कि विभिन्न प्रभागों के बीच अंतर्विषयी सहभागिताओं में सुधार की दिशा में संस्थान ने अपना प्रयाण जारी रखा है। इससे रसायन विज्ञान / सामग्री तथा रसायन विज्ञान / जीव विज्ञान इंटरफ़ेस में प्रमुख कार्यक्रमों को लेने के लिए और विभिन्न बाहरी एजेंसियों के साथ अपने संपर्क में सुधार करने में संस्थान सक्षम बन गया है। पिछले साल के कुछ मुख्य आकर्षणों में 2 जी इथेनॉल प्रायोगिक संयंत्र का कमीशनिंग, आयुर्वेदिक उत्पादों और प्रक्रियाओं पर काम करने के लिए आर्यवैद्यशाला, कोट्टक्यल के साथ सहयोग, साबिक, सऊदी अरब के साथ फोटोक्रोमिक अणुओं के विकास पर काम करने के लिए समझौता ज्ञापन पर हस्ताक्षर आदि शामिल हैं। वर्ष के दौरान उन्नत कार्यात्मक सामग्री [आईसीएएमएफ- 2014] पर एक प्रमुख अंतर्राष्ट्रीय सम्मेलन सहित हमने अनेक सम्मेलनों और कार्यशालाओं का आयोजन किया। हमेशा की तरह, हमारे वैज्ञानिकों को कई पुरस्कार और मान्यताएं प्राप्त हुए, जिनमें से सबसे उल्लेखनीय डॉ. अजयघोष द्वारा प्राप्त टीडब्ल्युएएस पुरस्कार है। हमारे संस्थान के लिए मान्यता लाये उन सभी को मैं बधाई देता हूँ। इस अवधि के दौरान सभी उपलब्धियों को संभव बनाने की दिशा में अपने समर्पित प्रयास के लिए हमारे पूरे स्टाफ को मैं धन्यवाद देना चाहता हूँ। महानिदेशक, सीएसआईआर और मुख्यालय से अन्य सहयोगियों को अपने निरंतर समर्थन के लिए मैं ईमानदारी से धन्यवाद व्यक्त करना चाहता हूँ।

सुरेश दास

निदेशक

CSIR - National Institute for Interdisciplinary Science & Technology

SIGNIFICANT ACHIEVEMENTS

Annual Report 2013-14 captures the insights and reviews the tremendous new growth phase CSIR-NIIST has entered. Several major tie ups with external industrial clientele, a significantly improved average impact factor of publications along with installation and successful commissioning of major facilities instilled new vim and vigor to the Institute activities. A revamped HR training policy which gave a major thrust to the orientation and 360 degree evaluation of new scientific manpower had started paying rich dividends in the area of applied and basic research. In applied research the focus is on developing and commercializing technologies subsequently creating an innovative sustainable technology base through public private partnership generating new platforms for technology applications. This is accomplished through active and effective project management in an interdisciplinary environment. In basic research CSIR-NIIST along with its in house R&D programs is also collaborating with universities and research institutions building nascent research networks fostering new technology development. As we present the Annual Report 2013-14 the success saga is unfolded before you.

1. Business Development and Contract Research

Eighteen agreements/MOUs were signed between Institute and external clientele for the technology transfer and research collaborations. The year also witnessed earning of foreign exchequer through research agreement with Saudi Basic Industries Corporation, Riyadh, Kingdom of Saudi Arabia for a the project entitled "Synthesis and Development of Photochromic Materials" at a total cost of US$ 245,000. The aim of the project is to synthesize new organic materials showing photochromic behavior in the visible region of electromagnetic spectrum and tuning their photochromic color, stability and reversibility in solution, solid-state and polymer matrix for their use in various applications.

The Institute also joined hands with the M/s M S Swaminathan Research Foundation's Community Agro-biodiversity Centre at Puthoorvayal, Wayanad, (**MSSRF-CAbC)** for detailed scientific analysis of different medicinal plants traditionally used by the tribal population for various ailments and assisting the tribal community for conservation of endangered plants in the region and also adding value to their products. CSIR-NIIST has signed NDAs with Reliance Industries, British Petroleum (USA), Praj Industries, Pune, DSM India, Pune and Thermax India Ltd on different aspects of activities related to biomass-based biorefineries.

The commercial release of AutoCAST X1, integrating the Virtual Casting software for the simulation of solidification process of industrial casting developed by CSIR-NIIST, was made during IFEX-2013. From April 2013 to March 2014, 3DFT has transferred around 12 licenses. In addition, 3DFT now has a reseller in China which is a Taiwan-based company, called Hyperinfo. AutoCAST X1 is now available in Chinese and also has a website in Chinese (www.autocast.tw).

An improved anaerobic treatment system was developed by the Institute which works as a complete treatment system for household biodegradable wastes and yielded higher quantity of methane in the biogas. This development was licensed to M/s Carris and Pipes Pvt. Ltd., Ernakulam, Kerala and M/S. B.M. Industries, Paingattoor, Moovattupuzha, Kerala for mass production and marketing.

2. Progress in R&D Programs

Technology Business Incubation Centre in agro processing continued offering technical expertise and consultancy to entrepreneurs for product development, scale up, test marketing etc. A project for setting up of 7.5 tons per day fresh ginger and vegetable processing facility at Wyanad to produce clean/waxed ginger, cleaned vegetables and dry ginger powder etc. by value addition is in progress. Dehumidified and fluidized bed route for drying operations of agro products were standardized and are in implementation stage in various manufacturing sectors.

Iron nanoparticles (FeNPs) were synthesized utilizing aqueous *Centella asiatica* extract. These FeNPs synthesized were found to be non-cytotoxic with good cellular uptake and anti-oxidant potential. Horner-Wadsworth-Emmons reaction was successfully utilized in synthesizing β-C-glycosides using β-keto phosphonate generated from a sugar and an aglycone aldehyde. This methodology was employed in total synthesis of biologically relevant glycosphingolipid β-C-galactosyl ceramide (GalCer) and its unprecedented variant aza-β-C-GalCer. Aza-substitution of a sugar also opens a new diversity element which can be further functionalized to prepare a library of therapeutically relevant molecules.

An 80kg/d capacity second generation lignocellulosic ethanol pilot plant was commissioned on October 25, 2013, thereby making it one among the three operational biomass to ethanol plants in the country. Operations have started from November 2013 using rice straw as raw material.

The biotechnology group was successful in identifying a novel bacterial genera *Oryzibacter plantistimulans* gen. nov. sp. nov and three new bacterial species, including *Arthrobacter pokkali* sp.nov, showing potential plant growth promoting activities. The biosurfactants produced by the novel isolate of *Pseudozyma* sp. NII 08165 facilitated the bioremediation of crude oil by *Pseudomonas putida* and maximum degradation of aliphatic hydrocarbons was observed on the supplementation of 2.5 mg/l biosurfactants.

The photochemistry group synthesized various π-conjugated systems showing efficient supramolecular gelation through chain folding, π–π interactions, physical cross linking, ultrasound initiated nucleation or organization at the air-water interface. The group demonstrated the use of multi-chromophoric systems of donor-acceptor assemblies for artificial photosynthesis, dyes having panchromatic absorption for organic solar cell and bio based materials for ionic liquid crystal applications.

The team working on probes and sensors successfully designed molecular probes/electrodes for selective sensing of analytes such as Zn^{2+}, Cd^{2+} Hg^{2+}, Al^{3+}cations, NO_2^- anions, methanol vapors, catechols, ascorbic acid and for two photon and SERS based bioimaging for various applications.

Development of short reaction sequences, especially effective catalytic methods are expected to have large impact on the development of greener pharmaceutical industry. Significant discoveries of new synthetic routes and nanoparticle based MOFs for catalysis have been made such as; Rhodium catalyzed oxidative coupling of salicylaldehydes with azabicyclic olefins, Palladium/Lewis acid mediated domino reaction of pentafulvene derived diazabicyclic olefins, rhodium (III) catalyzed stereoselective C-N bond cleavage of diazabicyclic olefins, Nickel(II) complexes of tripodal 5N ligands as catalysts for alkane hydroxylation, Palladium-nanoparticle-linked organic frameworks, etc.

The Chemical Sciences and Technology division is also actively involved in modelling homogeneous catalytic reactions, particularly focusing on the development of new functional models for water splitting and CO_2 sequestration reactions. The infrastructure facilities were up-graded and established state-of the-art instrumentation facilities like Single Crystal X-ray and DNA Synthesizer.

The Material Sciences and Technology division developed a series of non-toxic intense blue and yellow inorganic pigments with high solar reflectance for energy saving applications. A mitochondria-specific visible-light sensitized europium β-diketonate complex with red emission was designed with longer lifetime, good cell permeability and faster cellular uptake and specific localization profile. AIPE-active green phosphorescent iridium(III) complex impregnated test strips for the vapor-phase detection of 2,4,6-trinitrotoluene (TNT) was developed with detection limits in nano-grams. Super hydrophilic SiO_2/PVA hybrid aerogel supports have been prepared using economically cheap sodium silicate precursors *via* gel granulation technique and was surface functionalized with three different amines for CO_2 adsorption at low temperatures.

A new $NdFeAsO_{1-x}F_x$ based superconductor was developed with remarkably high values of critical temperature and critical field by varying the fluorine content at a relatively low temperature and ambient pressure. The superconducting properties exhibited by this material, processed at a relatively low temperature, were at par with those prepared at higher temperatures or high pressures.

NIIST developed a process flow-sheet to produce electric power, liquid fertilizer and boiler solid fuel, in a common waste treatment facility for clusters of mango pulp units in mango growing areas that operate during the mango season. Economic analysis shows that the treatment plant has a break even of less than 4 years. Perchlorate (ClO_4) is the primary oxidizer of fuel in rockets, missiles and explosives. NIIST provided analytical support to Kerala State Pollution Control Board, State Groundwater Department and State Health Services Department to assess the magnitude of perchlorate contamination of ground water in Aluwa. The level of perchlorate in this area was found to have elevated very high. Studies were also conducted to develop novel and low cost adsorbents for removing perchlorate from water. A novel adsorbent was developed by organo-functionalization of indigenous bentonite clay with a cationic surfactant. The adsorbent removed around 80% of perchlorate at 50 ppm level in 10 min.

A semi-synthetic approach was tried for modifying pure violacein from the NIIST strain and violacein was modified to tetramethyl violacein. Compared to pure violacein, the tetramethyl violacein exhibited better antibacterial activity.

The demonstration plant for the bio-separation of pineapple leaf fibre was established in Maneed Pancahayat, Piravom and it was inaugurated on 25th February 2014.

3. Awards and Honours

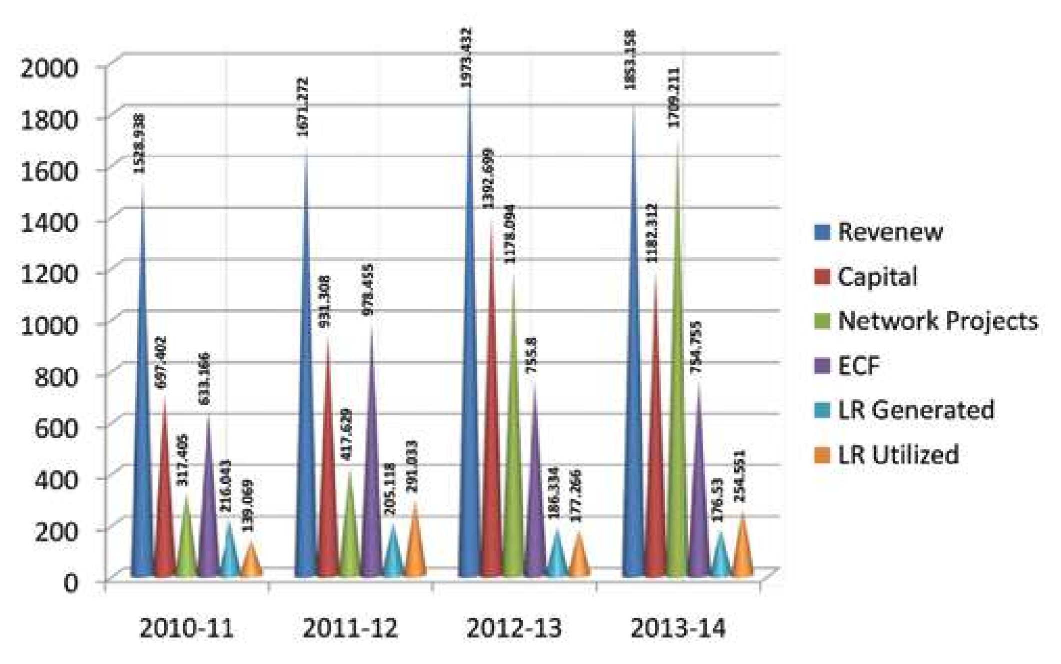
Dr. Suresh Das, Director, has been conferred the J.C. Bose National Fellowship 2013 and Sastra-CNR Rao Award for Excellence in Chemistry and Materials, 2014 for his outstanding contributions in Chemistry. Prof. A. Ajayaghosh, CSIR Outstanding Scientist, has been awarded The World Academy of Sciences (TWAS) Prize in Chemistry (2013), CRSI Sliver Medal, Honorary Fellow of Kerala Academy of Sciences (2013) and Fellow, Royal Society of Chemistry, London (2014). Prof. Ashok Pandey received the Fellow Award from the International Society for Energy and Environment Sustainability. Dr. P. Prabhakar Rao received the MRSI Medal and Dr. J.D. Sudha was awarded Fellow of Kerala Academy of Sciences (2014). Life Time Achievement Award by Indian Society for Analytical Chemistry and Sri Kishan Modi Memorial Award by Indian Ceramic Society were conferred to Dr. K.G.K. Warrier. Dr. S. Savithri was elected as the Inspiring Women Engineer/ Scientist for the year 2014 from Engineering Watch on International Women's Day. Dr. E. Bhoje Gowd and Dr. L. Ravi Shankar received the IUSSTF Research Fellowship by Indo-US Science and Technology Forum and Kerala State Young Scientist Award (2013) respectively. YIM-Boston Young Scientist Award and Distinguished Lectureship Award by Japan Chemical Society were awarded to Dr. C.H. Suresh. The Institute also received the Rajbhasha Shield and Merit Certificate as the 3rd Best Office in Implementing Official Language Policy of the Union Government during the year 2012-2013 by Dept. of Official Language, Govt. of India.

4. Other activities

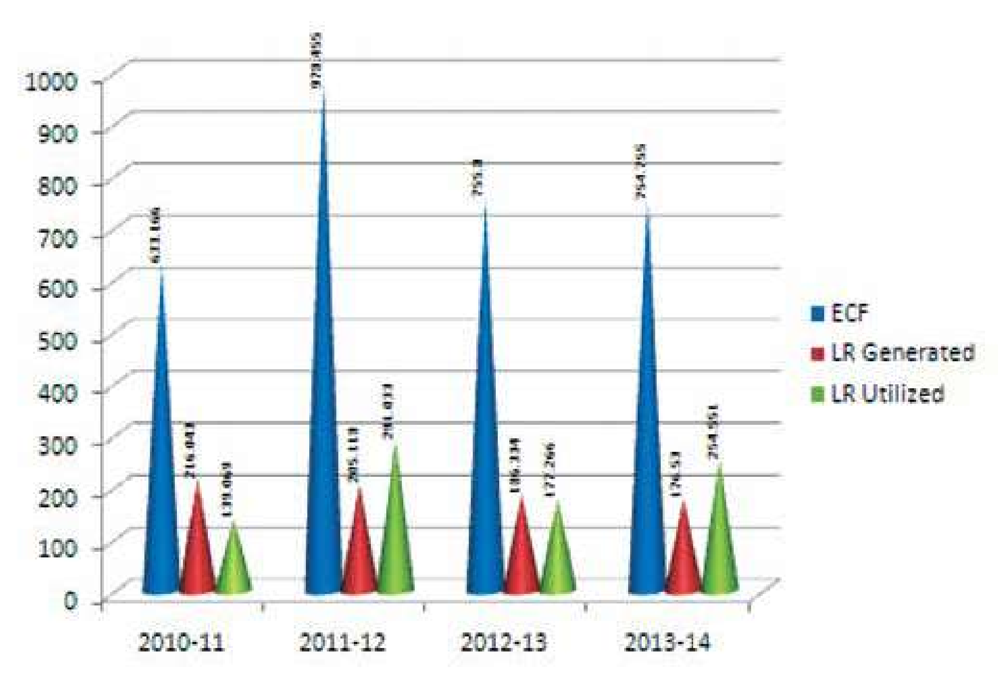
The Institute continued the sustained contribution to science and technology human resource development. Several conferences, training programmes, lecture series, workshops, and seminars were organized in the lab to develop and nourish multifaceted capabilities of the R&D task force. Seventeen students were awarded Ph D degree during the reporting period.

CSIR Foundation Day Celebrations, National Technology Day, National Science Day, NIIST Annual Day, Hindi awareness week, Vigilance awareness, World Environment day, Staff Club day, Student Association day etc were the other functions held during the year. The Institute observed open day on the occasion of foundation day celebrations of both CSIR and CSIR-NIIST. The Staff Recreation Club celebrated the Onam festival with traditional cultural events and feast.

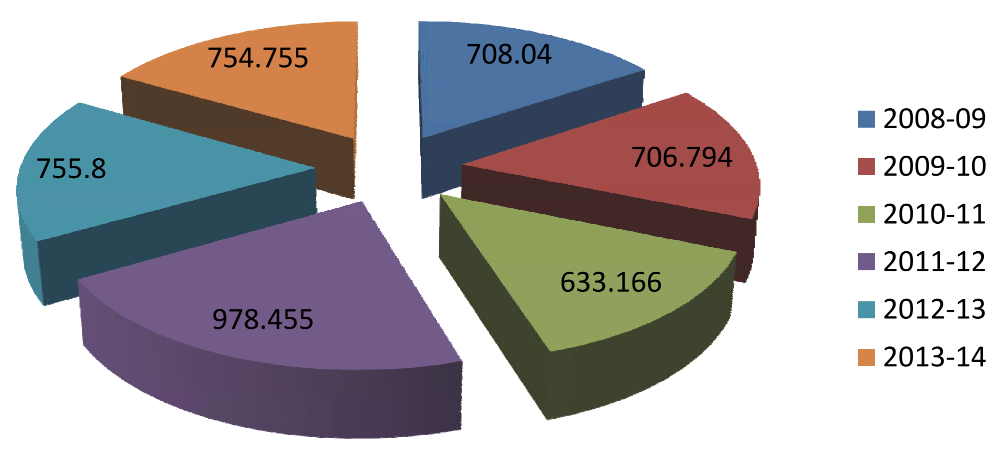
BUDGET 2010-2014 (Rs. Lakh)



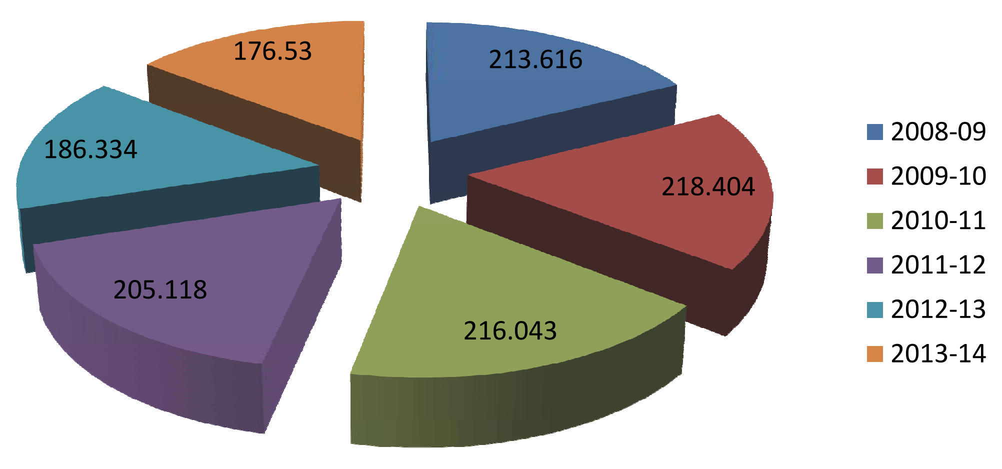
EXTERNAL CASH FLOW & LAB RESERVE (Rs. Lakh)



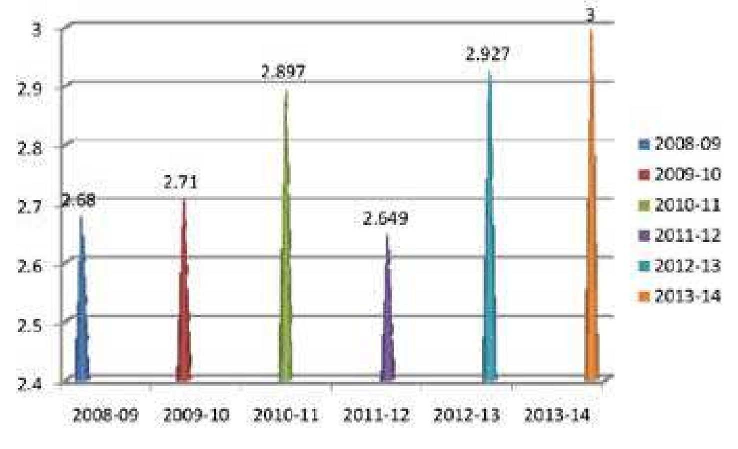
ECF (Rs. lakh)



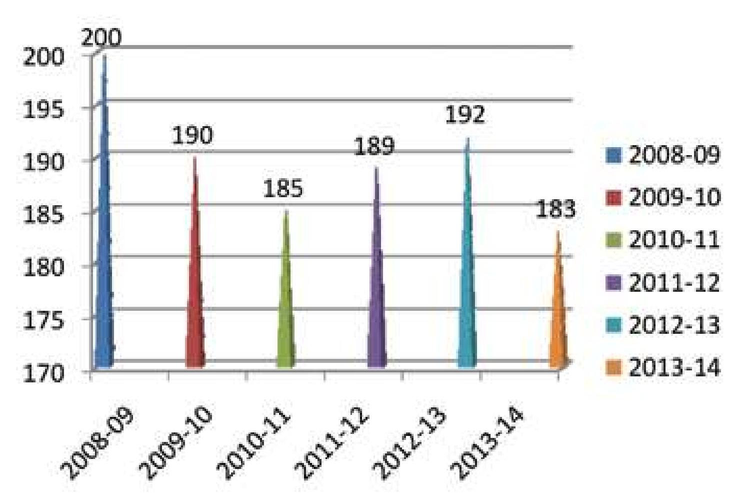
LR GENERATED (Rs. lakh)



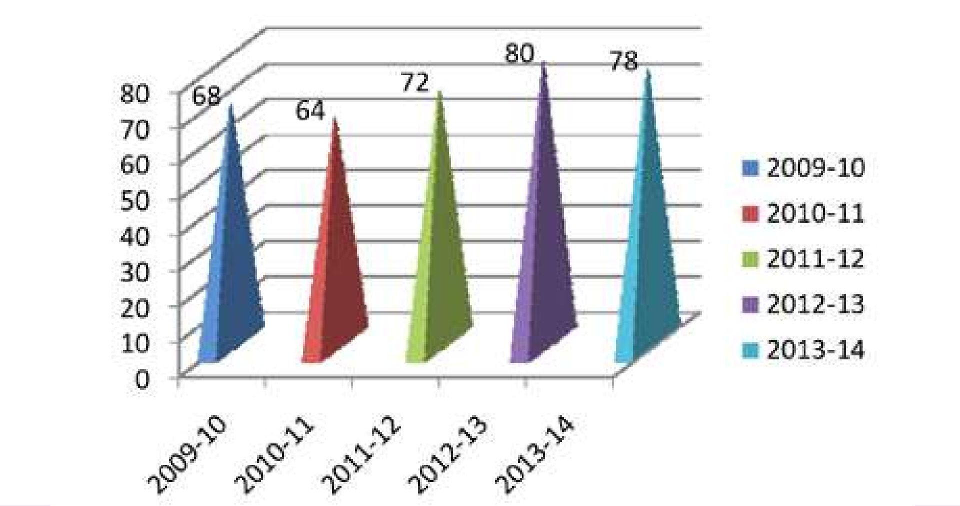
AVERAGE IMPACT FACTOR



STAFF POSITION



NO OF SCIENTISTS (GROUP IV)



हाइलाइट्स

वर्ष 2013-14 की वार्षिक रिपोर्ट सीएसआईआर-एनआईआईएसटी की अंतर्दृष्टि का चित्रण तथा प्रवेश किये विकास के नए चरण की समीक्षा करती है । बाहरी औद्योगिक ग्राहकों के साथ कई प्रमुख टाई अप् प्रमुख सुविधाओं की स्थापना व सफल कमीशनिंग तथा प्रकाशनों के काफी उन्नत औसत प्रभाव कारक ने संस्थान की गतिविधियों के लिए नई शक्ति और ताक़त प्रदान की। नई वैज्ञानिक जनशक्ति के ओरिएंटेशन और उनके 360 डिग्री मूल्यांकन को प्रमुख जोर देनेवाली पुर्नोत्थान मानव संसाधन प्रशिक्षण नीति ने एप्लाइड और बुनियादी अनुसंधान के क्षेत्र में उच्च लाभ प्रदान करना शुरू कर दिया था । अनुप्रयुक्त अनुसंधान के क्षेत्र में प्रौद्योगिकियों के विकास और उनके व्यवसायीकरण तथा बाद में प्रौद्योगिकी अनुप्रयोगों के लिए नये प्लेटफॉर्म पैदा करने के लिए सार्वजनिक निजी भागीदारी के माध्यम से एक अभिनव स्थायी प्रौद्योगिकी आधार के सृजन पर ध्यान केंद्रित है। यह, एक अंतर्विषयी वातावरण में सक्रिय और प्रभावी परियोजना प्रबंधन के माध्यम से पूरा है। बुनियादी अनुसंधान में सीएसआईआर-एनआईआईएसटी ने अपने इन-हाउस अनुसंधान एवं विकास कार्यक्रमों के साथ नई प्रौद्योगिकियों के विकास को बढ़ावा देने के लिए उदीयमान अनुसंधान नेटवर्क के निर्माण में विश्वविद्यालयों और अनुसंधान संस्थानों के साथ सहयोग कर रहा है। हम वर्ष 2013-14 की वार्षिक रिपोर्ट के माध्यम से सफलता की गाथा आपके सामने प्रस्तुत करते हैं।

1. व्यवसाय विकास और अनुबंध अनुसंधान

प्रौद्योगिकी हस्तांतरण और अनुसंधान सहयोग के लिए संस्थान और बाह्य ग्राहकों के बीच अठारह करारों / समझौता ज्ञापनों पर हस्ताक्षर किए गए । 245,000 अमेरिकी डॉलर की कुल लागत पर सऊदी बेसिक इंडस्ट्रीज कारपोरेशन, रियाद, किंगडम ऑफ़ सऊदी अरबिया के साथ " फोटोक्रोमिक सामग्री के विकास तथा संश्लेषण " नामक परियोजना के लिए अनुसंधान समझौते के माध्यम से वर्ष के दौरान विदेशी धनार्जन प्राप्त हुआ । परियोजना का उद्देश्य इलेक्ट्रोमैग्नेटिक वर्णक्रम के दृश्य क्षेत्र में फोटोक्रोमिक व्यवहार दिखानेवाले नए कार्बनिक पदार्थों के

संश्लेषण और विभिन्न अनुप्रयोगों में उनके उपयोग के लिए विलयन, ठोस अवस्था तथा पॉलिमर मैट्रिक्स में उनके फोटोक्रोमिक रंग, स्थिरता और रेवर्सिबिलिटी का समस्वरण है ।

संस्थान ने परंपरागत रूप से विभिन्न बीमारियों के लिए आदिवासी लोगों द्वारा इस्तेमाल किये विभिन्न औषधीय पौधों के विस्तृत वैज्ञानिक विश्लेषण तथा इस क्षेत्र के संकटग्रस्त प्रजाति पौधों के संरक्षण में जनजातीय समुदाय की सहायता और उनके उत्पादों के मूल्य संवर्धन के लिए पुथूरवयल, वायनाड, (एमएसएसआरएफ-सीएबीसी) के मेसेर्स एम.एस स्वामीनाथन रिसर्च फाउंडेशन के सामुदायिक कृषि जैव विविधता केंद्र के साथ हाथ मिलाया ।

सीएसआईआर-एनआईआईएसटी ने बायोमास आधारित जैव रिफाइनरियों से संबंधित गतिविधियों के विभिन्न पहलुओं पर रिलायंस इंडस्ट्रीज, ब्रिटिश पेट्रोलियम (यूएसए), प्राज इंडस्ट्रीज, पुणे, डीएसएम इंडिया, पुणे और थर्मेक्स इंडिया लिमिटेड के साथ एनडीए पर हस्ताक्षर किया है।

आईएफईएक्स-2013 के दौरान औद्योगिक कास्टिंग की संपिंडन प्रक्रिया के अनुकरण के लिए सीएसआईआर-एनआईआईएसटी द्वारा विकसित वर्चुअल कास्टिंग सॉफ्टवेयर को एकीकृत करके विकसित ऑटोकास्ट X1 का वाणिज्यिक रिलीज किया गया। अप्रैल 2013 से मार्च 2014 तक 3 डीएफटी ने करीब 12 लाइसेंसों को हस्तांतरित कर दिया है । इसके अलावा, 3 डीएफटी को अब चीन में हाइपरइन्फो नामक एक पुनर्विक्रेता है, जो एक ताइवान आधारित कंपनी है। ऑटोकास्ट X1 अब चीनी में उपलब्ध है और चीनी में एक वेबसाइट भी है (www.autocast.tw) ।

संस्थान द्वारा एक उन्नत अवायवीय उपचार प्रणाली विकसित की गयी जो घर के जैव अवक्रमणीय कचरे के लिए एक पूर्ण उपचार प्रणाली के रूप में काम करती है और बायोगैस में मीथेन की उच्च मात्रा भी प्राप्त हुई । इस विकास को मेसेर्स कैरिस एंड पाइप्स प्राइवेट, एर्नाकुलम, केरल और मेसेर्स बी.एम. इंडस्ट्रीस, पैंगट्टूर, मूवाट्टुपुषा को बड़े पैमाने पर उत्पादन और विपणन के लिए लाइसेंस किया गया ।

2. अनुसंधान एवं विकास कार्यक्रमों में प्रगति

कृषि प्रसंस्करण में प्रौद्योगिकी व्यापार ऊष्मायन केंद्र ने उत्पाद विकास, स्केल अप् और परीक्षण विपणन के लिए उद्यमियों को तकनीकी विशेषज्ञता और परामर्श देने का कार्य जारी रखा । मूल्य संवर्धन द्वारा स्वच्छ/ लच्छेदार अदरक, साफ सब्जियों और सूखे अदरक पाउडर आदि का उत्पादन के लिए वयनाड में प्रतिदिन 7.5 टन ताजा अदरक और सब्जियों की प्रसंस्करण सुविधा की स्थापना के लिए परियोजना कार्य प्रगति पर है । कृषि उत्पादों के ड्रइंग ऑपरेशन के लिए निराद्रीकृत और द्रवीकृत बेड रूट का मानकीकरण किया गया और विभिन्न विनिर्माण क्षेत्रों में ये कार्यान्वयन चरण में हैं। जलीय सन्तेल्ला असिएटिका के निकाल के इस्तेमाल से लोहे नैनोकणें (FeNPs) का संश्लेषण किया गया। ये संश्लेषित FeNPs को अच्छे सेलुलर तेज और एंटीऑक्सीडेंट क्षमता के साथ गैर-साइटोटोक्सिक पाया गया है। एक चीनी और एक ऐग्लाइकॉन एल्डिहाइड से उत्पन्न β-कीटो फॉस्फोनेट का उपयोग करके β-सी ग्लाइकोसाइड के संश्लेषण में होर्नर- वड्सवर्थ- एमोंस प्रतिक्रिया का सफलतापूर्वक उपयोग किया गया । इस पद्धति का जैविक रूप से प्रासंगिक ग्लाइकोस्पिंगोलिपिड β-सी-गैलक्टोसिल सिरामिड (गलसर)

और उसके अप्रत्याशित भिन्न रूप AZA-β-C-GalCer के कुल संश्लेषण में नियोजित किया गया। एक चीनी का Aza-प्रतिस्थापन भी आगे एक नया विविधता तत्व खोलता है, जो उपचारात्मक प्रासंगिक अणुओं के एक समुच्चय तैयार करने के लिए क्रियाशील किया जा सकता है ।

25 अक्तूबर, 2013 को दूसरी पीढ़ी के लिग्नोसेल्लुलोसिक बायोमास से इथेनॉल उत्पादन के लिए प्रतिदिन 80 कि.ग्रा क्षमतावाला एक प्रायोगिक संयंत्र चालू किया गया, जिससे यह बायोमास का इथेनॉल रूपांतरण के लिए देश में परिचालित तीन संयंत्रों से एक बन गया । कच्चे माल के रूप में चावल के भूसे का उपयोग करते हुए नवंबर 2013 से संचालन शुरू कर दिया है ।

पौधों की संभावित वृद्धि को बढ़ावा देने की गतिविधियों दिखानेवाले नूतन बैक्टीरियल वंश ओरीज़िबक्टेर प्लांटीस्टिम्युलंस वंश .एनओवी. स्पीशीज. एनओवी और अथ्रीबैक्टेर पोक्काली स्पीशीज. एनओवी सहित तीन नए बैक्टीरियल प्रजातियों की पहचान में बायो-तकनॉलजी समूह सफल हो गया था । स्यूडोजाइमा स्पीशीज एनआईआई 08165 के नूतन वियुक्त से उत्पन्न जैवसर्फेक्टेंटों ने स्यूडोमोनास पुटीड़ा द्वारा कच्चे तेल के डीग्रेडेशन को सुगम बनाया और 2.5 मिलीग्राम / लीटर जैवसर्फेक्टेंटों के अनुपूरण पर एलिफैटिक हाइड्रोकार्बन के अधिकतम अवक्रमण दर्शाया गया था ।

प्रकाश रसायनविज्ञान समूह ने हवा-पानी इंटरफेस में चैन फोल्डिंग, π-π अन्योन्यक्रिया, भौतिक क्रॉसलिंकिंग, अल्ट्रासाउंड समारंभित न्यूक्लिएशन या व्यवस्था के माध्यम से कुशल सुप्राआणविक जलेशन दिखानेवाले विभिन्न π संयुग्मित प्रणालियों का संश्लेषण किया । इस समूह ने कृत्रिम प्रकाश संश्लेषण के लिए दाता- स्वीकर्ता समुच्चयों की बहु वर्णमूलक प्रणाली, कार्बनिक सौर सेल के लिए पैनक्रोमैटिक अवशोषण युक्त रंजकों तथा आयनिक लिक्विड क्रिस्टल अनुप्रयोगों के लिए जैव आधारित सामग्री के उपयोगों का प्रदर्शन किया। प्रोब्स और संसरों पर कार्य करनेवाले समूह ने Zn^{2+}, Cd^{2+}, Hg^{2+}, Al^{3+} धनायन, NO_2 ऋणायन, मेथनॉल वाष्प, कैटिकोल, एस्कॉर्बिक एसिड जैसे ऐनालाइट के चयनात्मक संवेदन के लिए तथा विभिन्न अनुप्रयोगों के लिए दो फोटोन और एसईआरएस आधारित जैवइमेजिंग के लिए आणविक प्रोब्स/ इलेक्ट्रोड्स का सफलतापूर्वक डिजाइन किया।

शॉर्ट अभिक्रिया दृश्यों का विकास, विशेष रूप से प्रभावी उत्प्रेरक तरीके, हरियाली दवा उद्योग के विकास पर भारी प्रभाव डालने की संभावना है। नए सिंथेटिक मार्गों और कटैलिसीस के लिए नैनोकण आधारित एमओएफ की दिशा में महत्वपूर्ण खोज की गयी जैसे; ऐजाबाइसाइक्लिक ओलिफिन्स के साथ सैलिसिलऐल्डिहाइडों के रोडियम उत्प्रेरित ऑक्सीडेटिव युग्मन, पेन्टाफुल्वेन व्युत्पन्न डाइऐजाबाइसाइक्लिक ओलिफिन्स के पैलेडियम / लुईस एसिड मध्यस्थता डोमिनो अभिक्रिया, डाइऐजाबाइसाइक्लिक ओलिफिन्स के रोडियम (III) उत्प्रेरित स्टीरियो चयनात्मक सी-एन बांड विपाटन, ऐल्केन हाइड्रॉक्सिलीकरण के लिए उत्प्रेरक के रूप में त्रिपादीय 5 एन लिगन्डों के निकैल(II) कॉम्प्लेक्सेस, पैलेडियम नैनोकण-लिंक्ड कार्बनिक व्यवस्थाएं इत्यादि।

रसायन विज्ञान और प्रौद्योगिकी विभाग सजातीय उत्प्रेरक अभिक्रियाओं के मॉडलिंग में, विशेष रूप से पानी के बंटवारे और कार्बन डाइ ऑक्साइड पृथक्करण प्रतिक्रियाओं के लिए नए कार्यात्मक मॉडल के विकास पर सक्रिय रूप से कार्य कर रहा है । सिंगल क्रिस्टल एक्स-रे और डीएनए सिंथेसाइज़र जैसे अत्याधुनिक इंस्ट्रूमेंटेशन सुविधाओं

की स्थापना के साथ बुनियादी सुविधाओं का उन्नयन किया गया ।

पदार्थ विज्ञान तथा प्रौद्योगिकी प्रभाग ने ऊर्जा बचत अनुप्रयोगों के लिए उच्च सौर परावर्तकता के साथ गैर विषैले तीव्र नीले और पीले रंग के अकार्बनिक पिगमेंट्स की एक श्रृंखला विकसित की है। दीर्घावधि, अच्छी कोशिका पारगम्यता और तेजी सेलुलर तेज और विशिष्ट स्थानीयकरण प्रोफाइल युक्त तथा लाल उत्सर्जन के साथ एक माइटोकॉन्ड्रिया-विशिष्ट दृश्य प्रकाश संवेदनशील युरोपियम β-डाइकीटोनेट कॉम्प्लेक्स का डिजाइन किया गया । नैनो ग्राम तक की संसूचन सीमा के साथ 2,4,6-ट्राइनाइट्रोटॉलूइन (टीएनटी) के वाष्प-अवस्था अनुसंधान के लिए एआईपीई सक्रिय हरी स्फुरदीप्त इरिडियम (III) कॉम्प्लेक्स से संसेचित परीक्षण स्ट्रिप्स विकसित किया गया । आर्थिक रूप से सस्ते सोडियम सिलिकेट पूर्ववर्तियों का उपयोग करके जेल कणीकरण तकनीक के माध्यम से सुपर हाइड्रोफिलिक SiO_2 / पीवीए संकर एयरोजेल समर्थकों को तैयार किया गया है और कम तापमान में कार्बन डाइ ऑक्साइड अवशोषण के लिए तीन अलग-अलग ऐमीन के साथ इन्हें सतह क्रियाशील किया गया।

अपेक्षाकृत कम तापमान और परिवेश दबाव में, फ्लोरीन सामग्री के बदलाव से, क्रांतिक तापमान और क्रांतिक क्षेत्र के उल्लेखनीय उच्च मूल्यों के साथ एक नया $NdFeAsO_{1-X}F_X$ आधारित अतिचालक विकसित किया गया । अपेक्षाकृत कम तापमान में संसाधित इस सामग्री द्वारा प्रदर्शित अतिचालकता गुण, उच्च तापमान या उच्च दबाव पर तैयार सामग्रियों के बराबर थे।

एनआईआईएसटी ने आम की खेती के क्षेत्रों में केवल मौसम के दौरान संचालित आम लुगदी इकाइयों के समूहों के लिए एक सामान्य अपशिष्ट उपचार सुविधा में इलेक्ट्रिक पावर, तरल उर्वरक और बॉयलर ठोस ईंधन के उत्पादन करने के लिए एक प्रक्रिया फ्लो शीट विकसित की है। आर्थिक विश्लेषण से यह पता चलता है कि कम से कम 4 सालों में उपचार संयंत्र का ब्रेक - ईवन प्राप्त है । रॉकेट, मिसाइल और विस्फोटकों में परक्लोरेट (ClO_4) ईंधन का प्राथमिक ऑक्सीकारक है। एनआईआईएसटी ने आलुवा में भूजल के परक्लोरेट संदूषण की भयावहता का आकलन करने के लिए केरल राज्य प्रदूषण नियंत्रण बोर्ड, राज्य भूजल विभाग और राज्य स्वास्थ्य सेवा विभाग के लिए विश्लेषणात्मक समर्थन प्रदान किया है । इस क्षेत्र में परक्लोरेट का स्तर बहुत उच्च पाया गया। पानी से परक्लोरेट को दूर करने के लिए नूतन और कम लागत अवशोषकों को विकसित करने के लिए अध्ययन जारी किया गया। एक घनायनी सर्फेक्टेंट के साथ स्वदेशी बेन्टोनाइट मिट्टी की कार्ब-क्रियाशीलता के द्वारा एक नूतन अवशोषक का विकास किया गया। अवशोषक ने 10 मिनट में 50 पीपीएम के स्तर पर परक्लोरेट के 80 प्रतिशत के आसपास हटा दिया।

एनआईआईएसटी के स्ट्रेन से शुद्ध वायोलासीन को संशोधित करने के लिए एक अर्द्ध सिंथेटिक दृष्टिकोण की कोशिश की गई और वायोलासीन को टेट्रामीथेल वायोलासीन में संशोधित किया गया। शुद्ध वायोलासीन की तुलना में, टेट्रामीथेल वायोलासीन ने बेहतर जीवाणुरोधी गतिविधि का प्रदर्शन किया।

अनानास पत्ती फाइबर की जैविक-जुदाई के लिए मनीड पंचायत, पिरवम में प्रदर्शन संयंत्र स्थापित किया गया और 25 फरवरी 2014 को इसका उद्घाटन किया गया ।

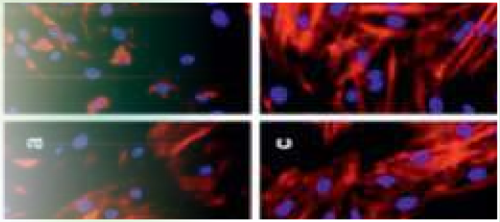
3. पुरस्कार और सम्मान

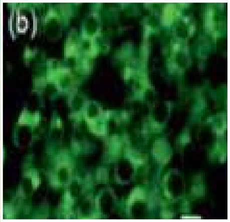
डॉ. सुरेश दास, निदेशक, को रसायन विज्ञान में अपने उत्कृष्ट योगदान के लिए जेसी बोस नेशनल फैलोशिप 2013 तथा रसायन विज्ञान और सामग्री में उत्कृष्टता के लिए शास्त्र-सीएनआर राव पुरस्कार 2014 से सम्मानित किया गया है। प्रो ए अजयघोष, सीएसआईआर उत्कृष्ट वैज्ञानिक को रसायन विज्ञान में विश्व विज्ञान अकादमी (टीडब्ल्युएएस) पुरस्कार, सीआरएसआई रजत पदक (2013) केरल विज्ञान अकादमी के मानद फैलो (2013) और रसायन विज्ञान रॉयल सोसाइटी लंदन (2014) के फैलो से सम्मानित किया गया है। प्रो अशोक पाण्डेय को ऊर्जा, पर्यावरण और सस्टेनेबिलिटी की इंटरनेशनल सोसायटी की तरफ़ से फैलो पुरस्कार से सम्मानित किया गया है। डॉ. पी प्रभाकर राव को एमआरएसआई पदक तथा डॉ जे.डी. सुधा को केरल अकादमी ऑफ साइंसेज की फैलो (2014) पुरस्कार से सम्मानित किया गया है। डॉ के जी के वार्यर को भारतीय सिरेमिक सोसायटी से श्री किशन मोदी मेमोरियल पुरस्कार और भारतीय एनालिटिकल कैमिस्ट्री सोसायटी द्वारा लाइफ टाइम अचीवमेंट अवार्ड से सम्मानित किया गया है। डॉ. एस सावित्री को अंतर्राष्ट्रीय महिला दिवस के अवसर पर इंजीनियरिंग वाच से वर्ष 2014 की प्रेरणादायक महिला अभियंता / वैज्ञानिक घोषित करके सम्मानित किया गया है । डॉ ई भोजे गौउड और डॉ एल रविशंकर को क्रमश: भारत-अमेरिका विज्ञान एवं प्रौद्योगिकी फोरम रिसर्च फेलोशिप (आईयूएसएसटीएफ) और केरल राज्य युवा वैज्ञानिक पुरस्कार (2013) से सम्मानित किया गया है। डॉ. सी एच सुरेश को वाईआईएम -बोस्टन युवा वैज्ञानिक पुरस्कार और जापान केमिकल सोसायटी के प्रतिष्ठित लेक्चररशिप पुरस्कार से सम्मानित किया गया है। संस्थान को भारत सरकार के राजभाषा विभाग से वर्ष 2012-2013 के दौरान केंद्र सरकार के कार्यालयों में राजभाषा नीति के कार्यान्वयन के लिए तीसरा सर्वश्रेष्ठ कार्यालय घोषित किया गया और राजभाषा शील्ड और योग्यता प्रमाण पत्र प्राप्त हुए।

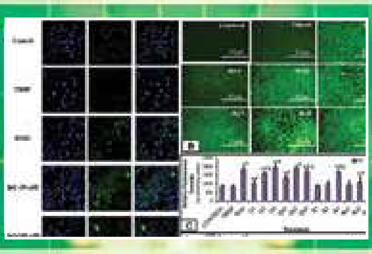
4. अन्य गतिविधियों

संस्थान ने विज्ञान, प्रौद्योगिकी और मानव संसाधन विकास के क्षेत्र में अपना निरंतर योगदान जारी रखा। अनुसंधान एवं विकास कार्य बल की बहुमुखी क्षमताओं के विकास और पोषण के सिलसिले में संस्थान में कई सम्मेलन, प्रशिक्षण कार्यक्रम, व्याख्यान श्रृंखला, कार्यशाला, और सेमिनार का आयोजन किया गया। समीक्षाधीन अवधि के दौरान सत्रह छात्रों को पीएचडी डिग्री से सम्मानित किया गया है।

सीएसआईआर स्थापना दिवस समारोह, राष्ट्रीय प्रौद्योगिकी दिवस, राष्ट्रीय विज्ञान दिवस, एनआईआईएसटी वार्षिक दिवस, हिन्दी दिवस/ सप्ताह, सतर्कता जागरूकता सप्ताह, विश्व पर्यावरण दिवस, स्टाफ क्लब दिवस, छात्र संघ दिवस आदि वर्ष के दौरान आयोजित अन्य समारोह थें। सीएसआईआर और सीएसआईआर एनआईआईएसटी स्थापना दिवस, दोनों समारोहों के अवसर पर







AGROPROCESSING & NATURAL PRODUCTS DIVISION

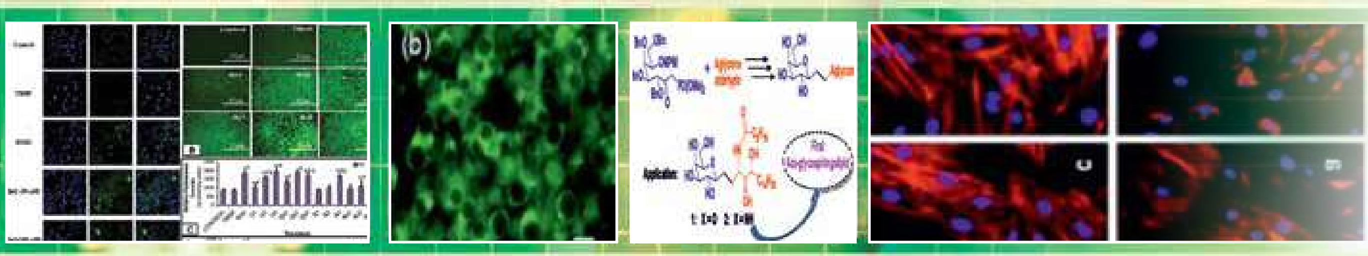
Agroprocessing and natural products division activities emphasizes on the development of technologies in the area of oil seeds, spices and agricultural produce of the region. The multidisciplinary team comprises of Chemical Engineers, Food technologists, Microbiologists, Biologists and Chemists. Excellent analytical and pilot plant facilities steer the programmes undertaken by the division. A technology business incubator is operational under the division and it has taken up several programmes which were beneficial to the MSME's in the country.

Besides its technology related activities, the Biology – Chemistry interface programmes are also contributing significantly in the natural products chemistry and biological areas. The programmes initiated with the Kottakkal Aryavaidyasala are in progress.

The division has developed several linkages with various agencies during this period. They include Spices Board, Cochin, DBT, DST and KSCSTE. The division was successful in getting projects worth Rs. 1.59 Crores from non CSIR sources and generated an external cash flow of Rs 77 lakhs during this period.

Highlights

- Dehumidified and fluidized bed drying of agro products were standardized and are in implementation stage in various manufacturing sectors.
- A project for setting up of 7.5 tons per day fresh ginger and vegetable processing facility at Wyanad to produce clean/waxed ginger, cleaned vegetables and dry ginger powder etc. for value addition is in progress
- Horner-Wadsworth-Emmons reaction was successfully utilized in synthesizing β-C-glycosides using β-keto phosphonate generated from a sugar and an aglycone aldehyde.
- A new derivative of Bis indolyl methanes (Biaryl BIM-B12) showed significant growth inhibitory effects in breast cancer (MCF-7) cells.
- The iron nanoparticles (FeNPs) synthesized using aqueous *Centella asiatica* extract proved to be non-cytotoxic with good cellular uptake and antioxidant potential.
- The flavoured coconut oil (CNO) by incorporation of pepper essential oil showed good thermal stability and oxidative stability.



कृषि प्रसंस्करण तथा प्राकृतिक उत्पाद प्रभाग

कृषि प्रसंस्करण तथा प्राकृतिक उत्पाद प्रभाग की गतिविधियॉ तिलहन, मसाले और इस क्षेत्र के कृषि उपजों के प्रौद्योगिकी विकास पर जोर देती है। अंतर्विषयी टीम में केमिकल इंजीनियर्स, खाद्य प्रौद्योगिकीविदों, सूक्ष्मजीवविज्ञानियों, जीवविज्ञानियों और केमिस्ट्स शामिल हैं। उत्कृष्ट विश्लेषणात्मक और पायलट संयंत्र सुविधाएं प्रभाग द्वारा जारी कार्यक्रमों को आगे चलाती हैं। प्रभाग के अंतर्गत एक प्रौद्योगिकी व्यापार इनक्यूबेटर कार्य कर रहा है और इसके द्वारा देश में एमएसएमई के लिए फायदेमंद कई कार्यक्रम ले लिये गये हैं।

अपनी प्रौद्योगिकी से संबंधित गतिविधियों के अलावा, प्राकृतिक उत्पाद रसायन विज्ञान तथा जीव विज्ञान के क्षेत्रों में भी जीवविज्ञान - रसायन विज्ञान इंटरफ़ेस कार्यक्रम द्वारा काफी योगदान दे रहे हैं। कोट्टक्कल आर्य वैद्यशाला के साथ प्रारंभ किये कार्यक्रम भी प्रगती पर हैं। प्रभाग ने इस अवधि के दौरान विभिन्न एजेंसियों के साथ कई लिंकेज विकसित किये हैं। इनमें स्पाइसेस बोर्ड, कोचीन, डीबीटी, डीएसटी और केएससीएसटीई शामिल हैं। प्रभाग द्वारा इस अवधि के दौरान गैर सीएसआईआर स्रोतों से 1.59 करोड़ रुपये मूल्य की परियोजनाओं को प्राप्त कराने में और 77 लाख रुपए के बाह्य नकदी प्रवाह उत्पन्न करने में सफल हुआ था।

मुख्य विशेषताएं

- कृषि उत्पादों के ड्रइंग ऑपरेशन के लिए निराद्रीकृत और द्रवीकृत बेड रूट का मानकीकरण किया गया था और विभिन्न विनिर्माण क्षेत्रों में ये कार्यान्वयन चरण में हैं।
- मूल्य संवर्धन द्वारा स्वच्छ/ लच्छेदार अदरक, साफ सब्जियों और सूखे अदरक पाउडर आदि का उत्पादन के लिए वयनाड में प्रतिदिन 7.5 टन ताजा अदरक और सब्जियों की प्रसंस्करण सुविधा की स्थापना के लिए परियोजना कार्य प्रगति पर है ।
- एक चीनी और एक ऐग्लाइकॉन एल्डिहाइड से उत्पन्न β-कीटो फॉस्फोनेट का उपयोग करके β-सी ग्लाइकोसाइड के संश्लेषण में होर्नर- वड्सवर्थ- एमोंस प्रतिक्रिया का सफलतापूर्वक उपयोग किया गया है ।
- बीआईएस इन्डोलील मेथैन्स (बयेरील बीआईएम-बी 12) के एक नये व्युत्पन्न ने स्तन कैंसर कोशिकाओं में (एमसीएफ 7) महत्वपूर्ण वृद्धि निरोधात्मक प्रभाव दिखाया है।
- जलीय *सन्तेल्ला असिएटिका* के निकाल के इस्तेमाल से संश्लेषित लोहे नैनोकणें (FeNPs) अच्छे सेलुलर तेज और एंटीऑक्सीडेंट क्षमता युक्त गैर-साइटोटॉक्सिक साबित हुये ।
- काली मिर्च के वाष्पशील तेल के समावेश से निर्मित सुगंधित नारियल तेल (CNO) ने अच्छी थर्मल स्थिरता और ओक्सिडेटिव स्थिरता दिखायी ।

Technology Business Incubation Centre in Agroprocessing

The objectives of the project was to create a Technology Business Incubation Centre in agro processing wherein specialized infrastructure facilities, offering technical expertise and consultancy to entrepreneurs for product development, scale up, test marketing etc are made available. M/s Hafed, Radaur, Haryana, was the 1st incubatee of TBIC. NIIST offered the technical expertise in modernization of the existing 14 TPD fresh turmeric processing facility. The existing process which was cumbersome and inefficient in terms of time and energy consumption was modified based on the pilot scale experiments conducted at NIIST TBIC facility. The advantages of the modified process are drastic reduction in the process duration, substantial reduction in energy consumption, improved product quality in terms of colour, product free from aflatoxins and meet FSSAI standards, saving manpower cost and reducing the drudgery of the people employed at the factory. CSIR NIIST also extends technical support in other activities such as the design and detailed engineering, project documentation and scheduling, assistance in identification and inspection of machineries, etc. The modernized plant is expected to be commissioned in 2014.

As part of the programme the following studies were also undertaken for other incubates during the year:

- Technical expertise offered for developing a modified cost effective process for drying of white onions for value addition (M/s Prasans Solutions, Cochin)
- Process development studies for the recovery of HCA from *Garcinia cambogia* and granulation of curcuminoids (M/s Flora Naturals,Thrissur)
- Development of some formulated products from Ayurveda based on new generation process techniques (M/s K V G Ayurveda Medical College, Karnataka)
- Product development studies for new entrepreneurs for flavoured functional food / health care products (M/s UCER India, Kottayam)

New Initiatives to boost agriculture productivity through maximizing pre and post-harvest yields

The project objective is to develop commercially viable technologies in the processing of various agro produces for shelf life enhancement and application of dehumidified, fluid bed and ultrasonic drying method for shelf life extension of selected food crops. Different agro produces like turmeric, ginger and jack fruit were dried using dehumidified and fluidized bed route. The drying operations were standardized by studying the drying kinetics, effect on physico-chemical changes and cost evaluation for processing. The technologies developed through the programme are in implementation stage in various manufacturing sectors. (FBD drying in the proposed unit of Hafed turmeric plant at Haryana and dehumidified drying in the ginger processing unit at Wyanadu, Kerala).

A study on optimizing the material utilization in Ayurvedic industry by replacing plant roots by benign herbal parts and by developing new bio active applications for herbal spent material

The project focuses on a need based research to address some of the key issues for effective material utilization and value addition in the area of Ayurvedic processing sector. The technology development for the isolation of extracts, active principles and functional food products from selected single herb spent materials (such as cumin, pepper, turmeric etc) generated from industry have been taken as one task. The process development studies and optimization of process parameters were completed and the scale up studies are in progress. The activities for the chemical fingerprinting and biological screening of extracts and active fractions from various parts (such as root, bark, fruit, leaves) of *Aegle marmelose* tree also are ongoing to establish the possibility of replacement of plant root with alternative part of the same plant. The classical formulations were also developed by replacing root by substitution with other parts and the activities of the formulations were also been studied using *in vitro* models.

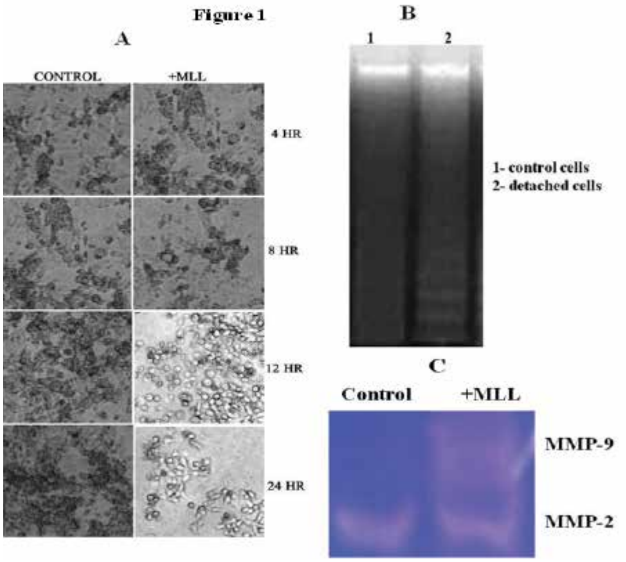
Setting up of fresh ginger / vegetable processing facility at Wyanad

A project for setting up of a 7.5 tons per day fresh ginger and vegetable processing facility has been approved by Govt of Kerala under 12th Year plan with MRCMPU (MILMA) as implementing agency to produce clean/waxed ginger, cleaned vegetables and dry ginger powder etc. by value addition. A tripartite agreement has been signed and the project is in implementation stage. The role of CSIR NIIST is to provide technology, detailed engineering, drawing the specifications for plant machinery, identification of machineries, extending technical expertise in various stages of project execution, assistance in erection and commissioning of the unit, provide training to technical personnel in plant operations, QC etc. The civil work for the unit is in progress and the initiatives taken for tendering of the plant machineries.

Purified Mulberry leaf lectin (MLL) induces detachment induced cell death (anoikis) in breast cancer cells

Lectins are proteins/glycoproteins, with specific carbohydrate specificity, purified from various plants and other organisms. It is well documented that lectins have antitumor effects. A cytotoxic lectin from Mulberry (*Morus alba*, L) was purified using two step chromatographic procedures. The purified lectin induced cell cycle arrest and apoptosis in human breast cancer (MCF-7) cells. Cell–cell and cell–ECM interactions provide critical signaling information that control cell survival. Apoptosis induced by prevention of cell adhesion by inadequate or inappropriate cell–matrix contacts is termed anoikis.

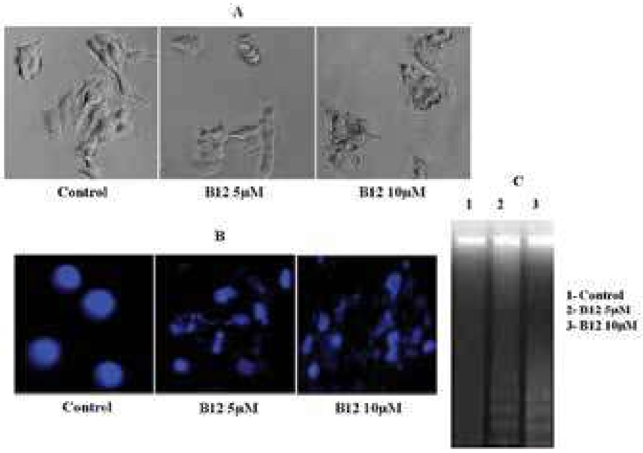
The effects of MLL on detachment induced cell death in MCF-7 cells were studied. MCF-7 cells cultured on dishes were treated with 10 μg/ml of MLL for 4, 8, 12 and 24 hrs and observed for the morphology. On treatment with MLL, the cells started detaching from the plates by 12 hrs. Most of the cells got detached from the plates by 24 hrs (Figure A). The detached cells didn't attach to the plates when separately seeded. Total DNA was isolated from the detached cells and run on agarose gel. The results in Figure B indicated DNA fragmentation which confirmed the detachment induced cell death. Matrix metalloproteinases (MMPs) are the enzymes responsible for the breakdown of cell ECM interactions and the effect of this enzyme under MLL treated conditions were checked. There was a significant increase in the production of MMP-9, but the MMP-2 level expression remained same as that of control. Increase in MMP-9 may be responsible for the detachment of cells while treating with MLL. Further studies to confirm this are in progress.

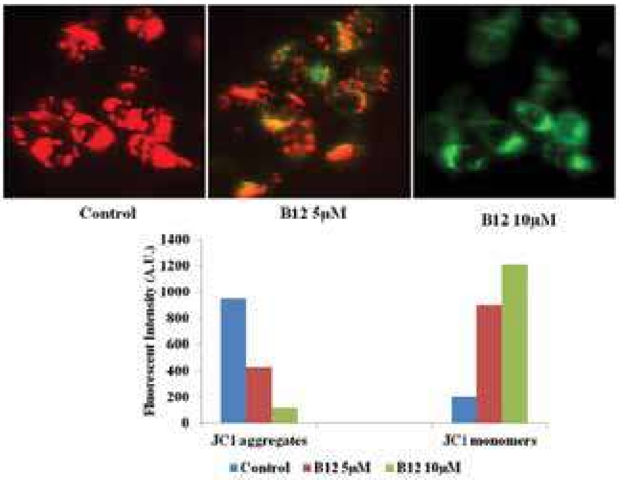


Biaryl BIM (B12) induces apoptosis in breast cancer cells through alteration in mitochonrial membrane potential

Bis indolyl methanes (BIMs) are the metabolite of indole 3-carbinol (I3C), the phytochemical present in cruciferous vegetables. These class of compounds have number of biological applications as anticancer and immunomodulatory effects. BIMs and their substituted derivatives have differential effects on cancer cells. The cell death induced by these compounds lead to the modulation of an array of genes and proteins, which included cyclin D1, cyclin dependent kinases, phosphor RBP and many more.

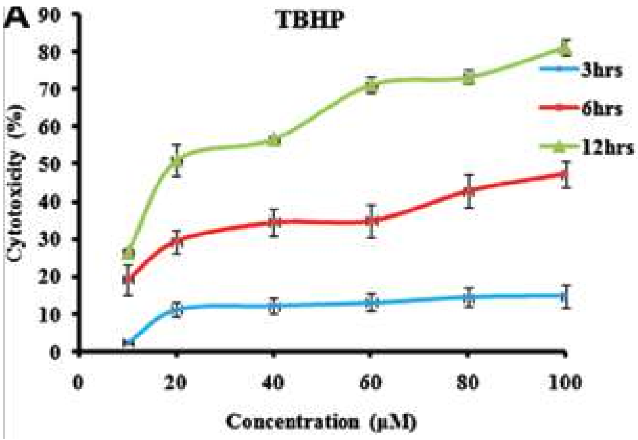
A new derivative of BIM (Biaryl BIM-B12) synthesized, which showed significant growth inhibitory effects in breast cancer (MCF-7) cells. The IC_{50} value was found to be 12 μM. B12 induced significant morphological changes like rounding up of cells in a concentration dependent manner (Figure A). B12 treated cells showed significant fragmentation of DNA shown by agarose gel electrophoresis (Figure B) and DAPI staining (Figure C). It was that B12 treatment caused loss in mitochondrial membrane potential as indicated by JC1 staining. This indicates the apoptosis may be through the mitochondrial pathway and a further test need to be done for confirmation.

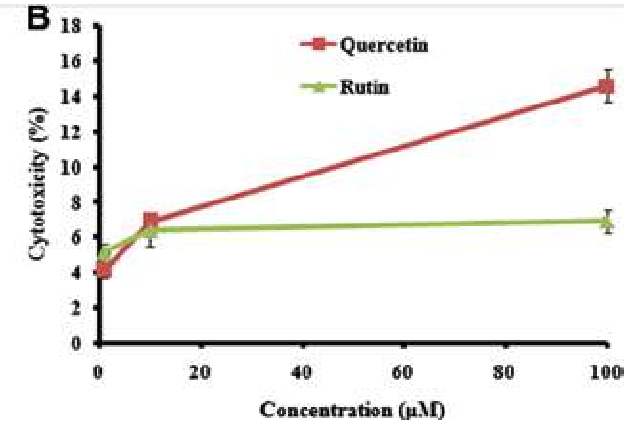




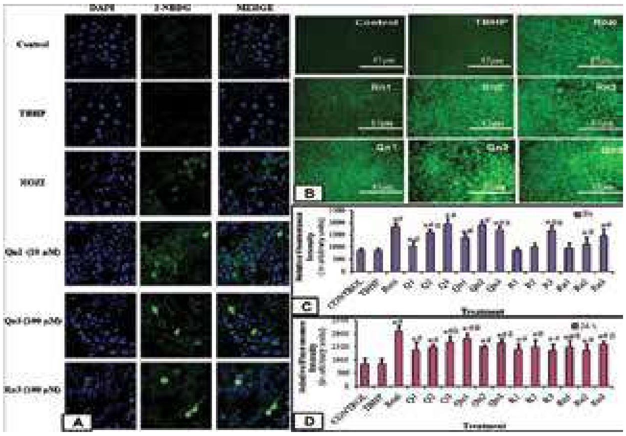
Rutin and Quercetin enhance glucose uptake in L6 myotubes under oxidative stress

The incidence of diabetes is rapidly increasing and by 2030 an expected 366 million individuals are projected to be affected [*WHO report*]. Scientific evidence suggests a strong link between the oxidative stress induced pathways and onset of diabetes and its complications. To suppress the oxidative stress mediated damage in diabetic pathophysiology, a special focus has been shifted towards naturally occurring antioxidants present in food. The present study is a continuation of the previous investigation on the improvement of glucose uptake in L6 myotubes under oxidative stress challenged by tertiary butyl hydrogen peroxide (TBHP). The results demonstrated that reactive oxygen species generated by TBHP decreased markedly in the L6 cells on preincubation with flavonoids in a dose dependent manner on oxidative challenge. These flavonoids were found to prevent lipid peroxidation in L6 myoblast. The flavonoid's role in increasing glucose uptake in L6 myotubes on chronic and acute pre-treatment in the presence of oxidative stress was further confirmed using high resolution confocal microscopy. Increased glucose uptake in L6 myotubes was found to be attributed by GLUT 4 translocation, the most downstream factor in the insulin signalling cascade, which increased two to three fold on chronic pretreatment of Quercetin (10 μM) and Rutin (100 μM).



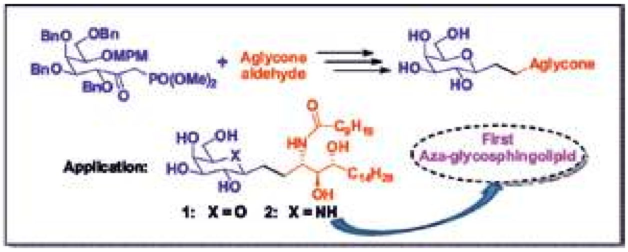


Cytotoxicity of TBHP, quercetin & rutin in cultured L6 myoblast. Effect of TBHP (A), quercetin and rutin (24 h) (B), on cell viability was evaluated, based on concentration as well as period of incubation. The results are represented in terms of means ± SD of three determinations.



GLUT4 translocation on flavonoid pretreatment. (A) High resolution confocal images (40X) of L6 myotubes pretreated with flavonoids (B) Immunofluorescence in different group of cells at low magnification. (C) Fluorescence intensity analysis of immunofluorescence by BD Image Data Explorer software in L6 myotubes.

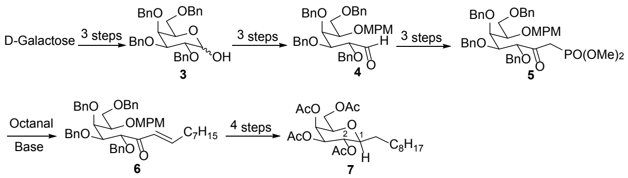
Total synthesis of the structural analogues of the natural product galactosyl ceramide



Glycosphingolipids (GSLs) are essential components of cellular membranes which play a critical role in a variety of biochemical functions. The carbohydrate portion is present in the outer leaflet of the plasma membrane serving as a receptor for various pathogens. An important initial event behind HIV infection is interaction of cell surface expressed β-GalCer with V3 loop region of HIV gp120. This and other findings enabled exploration of β-GalCer analogues as potential inhibitors for HIV infection. A careful scrutiny of the reported β-GalCer analogues, led to design a novel piperidine aza-sugar coupled to phytosphingosine derived ceramide. This novel design prompted to expeditiously set the goal towards development of a methodology for synthesis of aza-β-C-GalCer. In this pursuit, a general strategy was designed towards synthesis of β-C-glycosides in a convergent manner utilizing Horner-Wadsworth-Emmons (HWE) reaction of β-keto phosphonate, derived from D-galactose, and aglycone aldehyde. In the present work, the HWE strategy was applied towards total synthesis of β-C-galactosyl ceramide (β-C-GalCer) **1** and its unprecedented variant aza-β-C-GalCer **2** from a common intermediate derived from HWE reaction using phytosphingosine-1-al as the aglycone component.

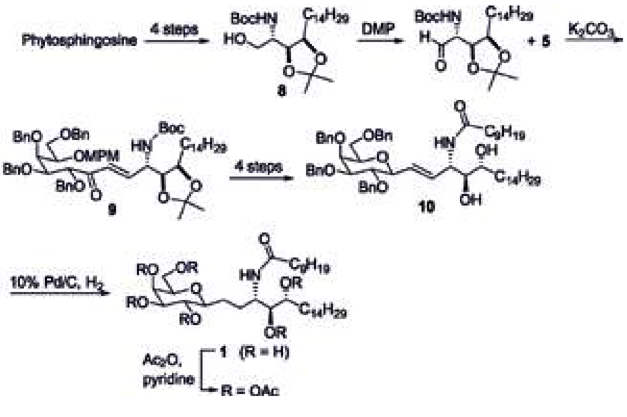
Retrosynthetic analysis for β-C-glycosides

Synthesis of HWE precursor β-keto phosphonate **5** (Scheme 1) commenced from lactol **3** that was prepared in three steps from D-galactose. Witting reaction of lactol **3** produced the desired alkene which was protected with MPM group followed by oxidative cleavage led to aldehyde **4**. Nucleophilic addition, generated from dimethyl methylphosphonate and *n*-BuLi, to aldehyde afforded the 2° alcohol which was subsequently oxidized using Dess-Martin periodinane giving rise to galactosyl β-keto phosphonate **5**. In an attempt to develop a generalized HWE methodology for β-C-glycoside, β-keto phosphonate **5** was subjected to HWE conditions with octanal to afford the HWE product **6**. The HWE product was then converted in three steps to produce β-C-glycoside **7**.



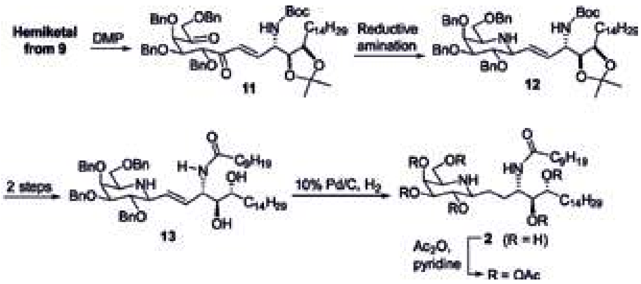
Scheme 1. Synthesis of β-C-glycoside 7 from d-galactose

Successful synthesis of β-C-glycoside **7** from keto-phosphonate **5** and octanal utilizing HWE reaction led to the generalized methodology towards total synthesis of biologically relevant structures β-C-GalCer and its unprecedented variant aza-β-C-GalCer from a common intermediate. In a convergent approach, firstly, the ceramide portion of the molecule was synthesized from commercially available phytosphingosine (Scheme 2). Primary alcohol **8** was oxidized with Dess-Martin periodinane in presence of excess $NaHCO_3$, the resulting crude phytosphingosine-1-al was dried *in vacuo* and then reacted with keto phosphonate **5** under HWE conditions. After successful synthesis of HWE adduct **9**, the advanced intermediate **10** was synthesized in 4 steps. Finally, debenzylation using 10% Pd/C under H_2 afforded β-C-GalCer **1** in a quantitative yield which was subjected to global acetylation affording peracetylated β-C-GalCer.



Scheme 2. Synthesis of β-C-GalCer 1

Synthesis of aza-β-C-GalCer was envisaged by utilizing reductive amination conditions from the HWE product derived for synthesis of β-C-GalCer **1**. As a result the hemiketal product produced from deprotection of compound **9** was oxidized with Dess-Martin periodinane using excess $NaHCO_3$ which afforded diketone **11** (Scheme 3). Standard double reductive amination conditions was utilized for facile cyclization to afford piperidine aza-D-sugar **12**. Deprotection step and amidation with *p*-nitrophenyl decanoate in presence of K_2CO_3 in DCM:DMF (5:2) affording piperidine aza-sugar linked ceramide **13**. Surprisingly, during the later amidation conditions, only the sphingosine amine was affected which was desired leaving the piperidine aza-sugar unaltered, perhaps, due to steric hindrance. The indifference of 2° amine of piperidine aza-sugar towards amide bond formation was further substantiated by a previous report for N-benzoylation utilizing Grignard reagent for deprotonation. Finally, global debenzylation with 10% Pd/C under H_2 afforded aza-β-C-GalCer **2** in a quantitative yield which was treated with Ac_2O/pyridine to produce peracetylated aza-β-C-GalCer.



Scheme 3. Synthesis of aza-β-C-GalCer 2

The Horner-Wadsworth-Emmons reaction was successfully utilized in synthesizing β-C-glycosides using β-keto phosphonate generated from a sugar and an aglycone aldehyde. This methodology was employed in total synthesis of biologically relevant glycosphingolipid β-C-galactosyl ceramide (GalCer) and its unprecedented variant aza–β-C-GalCer. Aza-substitution of a sugar also opens a new diversity element which can be further functionalized to prepare a library of therapeutically relevant molecules.

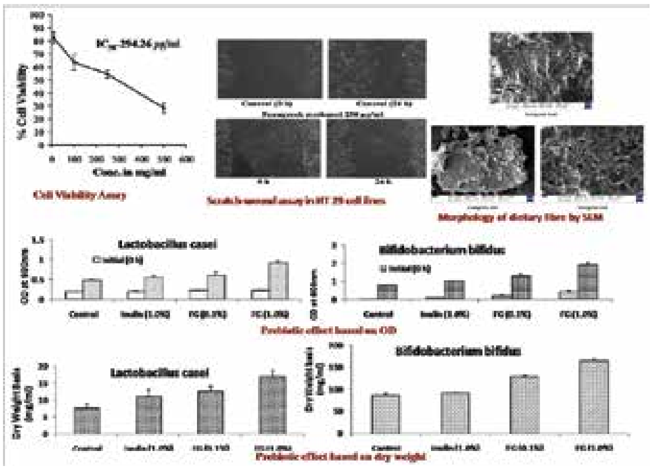
Antioxidant and prebiotic potential of fenugreek seeds in modulating colorectal cancer

Diet devoid of dietary fiber is one of the key reasons for the development of colon cancer and fenugreek seed is an excellent source of fiber. It is also reported that the major part of plant bioactives are bound to the fiber. Considering these factors, the present study was undertaken to study the potential of fenugreek seeds (*Trigonella foenum-graceum*) as a source of bioactive compounds and prebiotic dietary fiber in the management of colorectal cancer.

The seeds were sequentially extracted with hexane, ethyl acetate, and methanol. Dietary fiber was extracted from the seeds using standard protocols and evaluated for its prebiotic efficacy. The antioxidant activity were assessed in terms of TPC, TFC, CUPRAC, FRAP, metal chelating activity and its ability to scavenge DPPH and NO radicals. The polyphenols present in extracts were identified by HPLC. MTT and scratch-wound assay were performed in HT 29 cell lines to analyze the anticancer potential of the extracts.

From various antioxidant assays it was found that the methanol extract was more active and efficiently scavenged free radicals, especially NO (IC_{50}-56.54 µg/ml). HPLC profiling proved that the methanol extract was rich in poly phenols like syringic acid, p-coumaric acid and ferulic acid. The methanol extract was toxic to HT 29 cell lines (IC_{50}-294.26 µg/ml) and reduced the area of migration up to 72.26% at 250 µg/ml as compared to the control.

It was also found that fenugreek seeds are very good source of dietary fiber with a soluble dietary fiber (SDF) content of 44.1±4.8 g/100g dry seeds. The morphology of dietary fiber isolated from the seeds was determined by SEM and its prebiotic efficacy was evaluated using *Lactobacillus casei* and *Bifidobacterium bifidus* species. It was found that the SDF isolated from fenugreek seeds effectively promoted the growth of probiotic species selected for the study as compared to the negative control as well as the positive controls (inulin and oligo fructo saccharides) used in the study. The short chain fatty produced during fermentation was quantified by gas chromatography. Therefore, it may be concluded that fenugreek seeds are good source of antioxidant dietary fiber which can lower the risk of developing colon cancer and can maintain a healthy digestive system.



Spent cumin- A potential source of bioactive phytochemicals

Cumin cyminum is a herbaceous annual plant which belongs to the umbelliferae family. Cumin is widely used in traditional and Ayurvedic health care systems due to its putative health promoting benefits. Spent cumin residue from the processing of ayurvedic decoctions are traditionally considered as an environmental problem. These spent cumin seeds were chosen for the current study based on the commercial potential as it undergoes minimum thermal processing during preparation and there by ascertaining the retention of bio actives after processing. The experiments were planned to obtain a comparison between fresh (FC) and spent cumin (SC) seeds for its antioxidant and antidiabetic potential. FC and SC seeds of same batch were supplied by Kottaykal Aryavaidyasala, Kerala. Powdered seeds were defatted with hexane and extracted using ethyl acetate and methanol.

The TPC and TFC are higher for FC when compared to SC extracts. Phenolic content is higher for the methanol extract of FC. The flavanoid content is higher for the ethyl acetate extract of FC. Among the two extracts of SC, methanol extract showed higher phenolic and flavanoid content. The phenolic acids in the extracts of FC and SC were determined by HPLC. Thirteen standard polyphenolic compounds initially analysed -(1) gallic acid, (2) catechol, (3) chlorogenic acid, (4) caffeic acid, (5) syringic acid, (6) p-coumaric acid, (7) ferulic acid, (8) ellagic acid, (9) myercetin, (10) cinnamic acid, (11) quercetin, (12) kaemferol and (13) apigenin. Six polyphenols were identified in the ethyl acetate extract (5, 6, 8, 9, 10 and 11) and five polyphenols were identified from methanol extract (3, 4, 5, 6 and 7) of FC. In case of SC, seven polyphenols were identified in the ethyl acetate extract and methanol extract (5, 6, 7, 8, 9, 10 and 11). The reducing potential of the ethyl acetate and methanolic fractions of FC and SC showed that the ethyl acetate fraction of FC was more active in reducing copper ion and methanol extract of FC showed maximum activity in reducing ferrous ion. A reasonable activity was shown by the methanol fraction of FC (IC_{50}-26.33µg/ml) in the NO radical scavenging assay. For DPPH assay, the methanol extract of SC showed highest activity. Only the methanol extract of FC showed considerable metal chelating activity.

The extracts ability to inhibit α-amylase and α-glucosidase - two important enzymes in carbohydrate metabolism was analyzed. The methanol extract of SC showed more activity against α-amylase (337.22 µg/ml). In case of α-glucosidase, methanol extract of FC exhibited higher activity. The antiglycation assay showed that the ethyl acetate extract of both FC and SC have no activity. However the methanol extracts of both FC and SC exhibited antiglyaction potential. Glucose uptake by the cells was analyzed by flow cytometry. The data analysis showed 34, 25.3, 32, 30.7 and 26.3% of 2-NBDG uptake in cells treated with rosiglitazone, FC-100 µg, FC-250 µg, SC- 10 µg and SC- 100 µg respectively. The histogram representing the glucose uptake is shown in the figure.

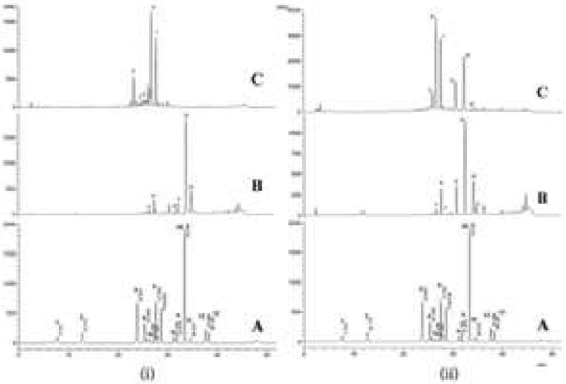


Figure 1(i). HPLC chromatogram (280 nm) of (A) authentic standards (B) ethyl acetate extract of FC; (C) methanol extract of FC **(ii)** (A) authentic standards (B) ethyl acetate extract of SC; (C) methanol extract of SC

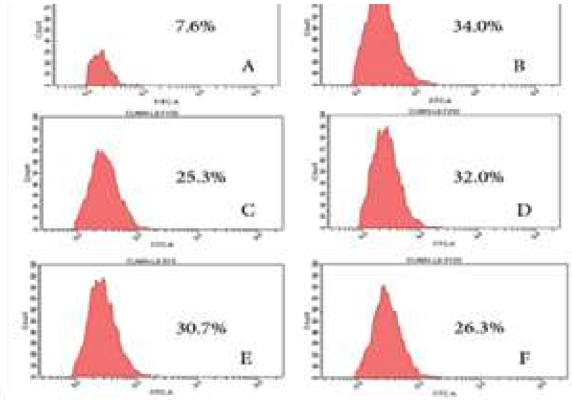


Figure 2. Flow cytometry analysis of 2-NBDG uptake. FACS analysis of 2-NBDG uptake in differentiated L6 cells by plotting cell count against FITC. The groups contained untreated cells (A-Blank), Rosiglitazone (B-Positive control, 100 nM), cells treated with methanol extract of fresh (C,D,- F-100 and 250 µg/ml) and spent (E,F- S-10 and 100 µg/ml) cumin

Thus results from the study proved that SC residue from the processing of ayurvedic decoctions can be targeted as sources for obtaining high phenolic products with antioxidant and antidiabetic activity. As some encouraging results are obtained from this study, further studies are required to optimize the effective usage of raw materials from ayurvedic industries for the betterment of human health.

Physico-chemical change and heat stability of coconut oil flavoured by pepper essential oil

Oils and fats, apart from providing nutrition, are known to play functional roles during product preparation contributing to the palatability of processed foods. Spices are ingredients that could be used for the production of flavoured oils. They also play a role in extending the shelf life of the flavoured oils. The study aims to develop flavoured oil from coconut oil (CNO) by incorporation of pepper essential oil at two different concentrations namely 0.1 % (CNO_{P0}) and 1% (CNO_{P1}). The physico-chemical properties and fatty acid composition of oils were evaluated on storage for 55 days at 60°C which corresponds to 6 months at room temperature. The thermal stability was studied at 180°C for 1hr. Pure CNO (CNO_C) as control and CNO with 200ppm TBHQ (CNO_T) was kept as the positive control. Among the oils studied CNO_{P0} was found to be the best with FFA 0.92%, peroxides (PV) 4.92meq/kg and para-anisidiene value (p-av) 0.043 when compared with the control. The flavoured oils need no further addition of synthetic antioxidant as the study indicated good oxidative stability of CNO_{P1} when compared with the TBHQ added oil. The sensory analysis of the product was evaluated for colour, taste and overall acceptability. As pepper essential oil is reported to possess lot of health benefits, flavoured oil also can be considered as functional oil.

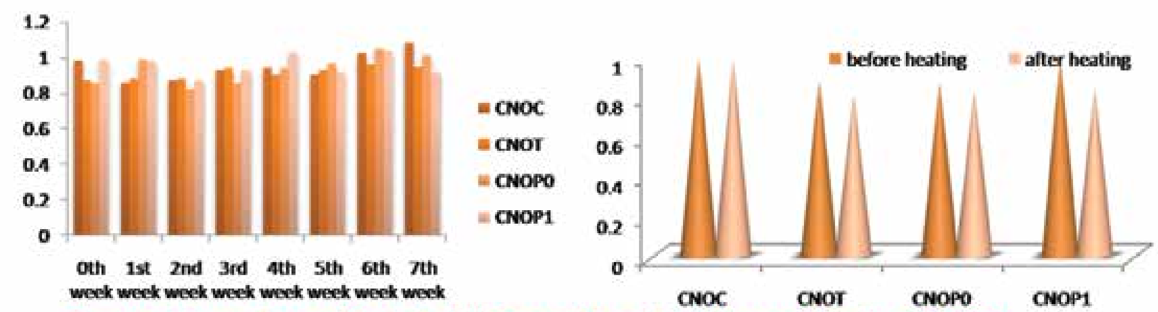


Figure 1: % Free fatty acid of oils during accelerated storage and heating at 180 °C

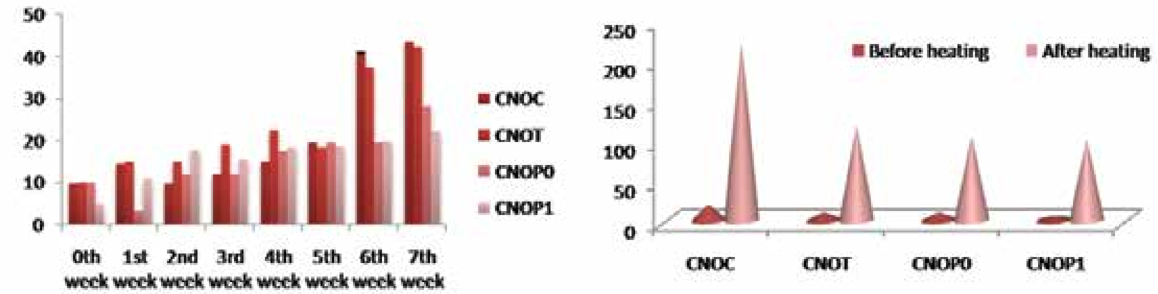


Figure 2: Peroxide value of oils during accelerated storage and heating at 180 °C

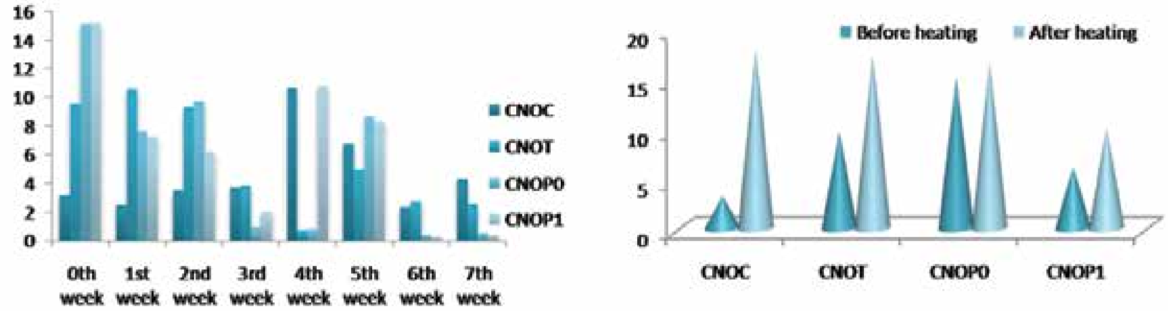


Figure : p-Anisidine value of oils during accelerated storage and heating at 180 °C

Symplocos cochinchinensis attenuates streptozotocin-diabetes induced patho-physiological alterations in rats

Hyperglycemia associated secondary complications has been studied in streptozotocin induced diabetic rat model. The beneficial effect hydroethanol extract of *Symplocos cochinchinensis* (SCE) in the above animal model was explored. The experimental groups consisted of normal control (NC), diabetic control (DC), DC+metformin 100mg/kg-1bwd, DC+SCE 250 and DC+SCE 500. SCEs and metformin were administered daily for 21 days and sacrificed on day 22. Oral glucose tolerance test, plasma insulin, % HbA1c, urea, creatinine, aspartate aminotransferase, alanine aminotransferase, albumin, total protein etc. were analysed. Aldose reductase (AR) activity in the eye lens was also checked. On day 21, DC rats showed significantly abnormal glucose response, HOMA-IR, % HbA1c, decreased activity of antioxidant enzymes and GSH, elevated AR activity, hepatic and renal oxidative stress markers like malondialdehyde, protein carbonyls compared to NC. DC rats also exhibited increased level of plasma urea and creatinine. Treatment with SCE protected from the deleterious alterations of biochemical parameters in a dose dependent manner including histopathological alterations in pancreas. SCE 500 exhibited 46.28% of glucose lowering effect and decreased HOMA-IR , % HbA1c, lens AR activity, and hepatic, renal oxidative stress and function markers compared to DC group. Considerable amount of liver and muscle glycogen was replenished by SCE treatment in diabetic animals. The activity of SCE is very much promising for further exploration.

Benificial effect of *Boerhaavia diffusa* L. against angiotensin II induced hypertrophy in H9c2 cardiomyoblast cells with special emphasis on mitochondria.

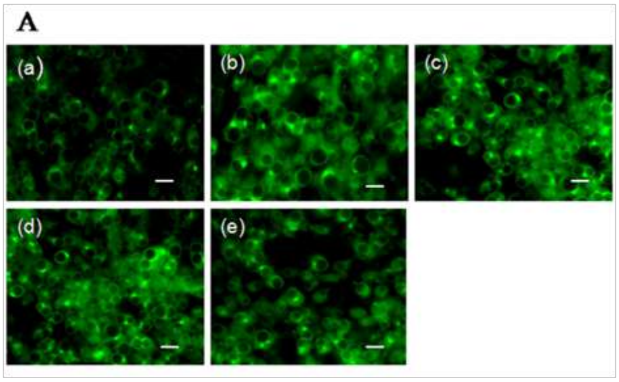
Mitochondrial dysfunction plays a critical role in the development of cardiac hypertrophy and heart failure. So mitochondria are emerging as one of the important druggable targets in the management of cardiac hypertrophy and other associated complications. The study has been conducted to see the effects of ethanolic extract of *Boerhaavia diffusa* (BDE) against mitochondrial dysfunction in angiotensin II (Ang II) induced hypertrophy in H9c2 cardiomyoblasts. H9c2 cells challenged with Ang II exhibited pathological hypertrophic responses and mitochondrial dysfunction which was evident from increment in cell volume, protein content, LDH leakage, increased intracellular ROS production, mitochondrial superoxide generation, alteration in mitochondrial transmembrane potential ($\Delta\Psi m$), opening of mitochondrial permeability transition pore (mPTP) and mitochondrial swelling. In addition, activities of mitochondrial respiratory chain complexes (I-IV), aconitase, NADPH oxidase, thioredoxin reductase, oxygen consumption rate, and calcium homeostasis were evaluated. Treatment with BDE significantly prevented the generation of intracellular ROS and mitochondrial superoxide radicals and protected the mitochondria by preventing dissipation of $\Delta\Psi m$, opening of mPTP, mitochondrial swelling and enhanced the activities of respiratory chain complexes and oxygen consumption rate in H9c2 cells. Activities of aconitase and thioredoxin reductase, which lowered (33.77±0.68% & 45.81±0.71% respectively) due to hypertrophy, were increased in BDE treated cells ($P \leq 0.05$). Moreover, BDE also reduced the intracellular calcium overload in Ang II treated cells. Overall results revealed the protective effects of *B. diffusa* against mitochondrial dysfunction in hypertrophy in H9c2 cells and the present findings may shed new light on the therapeutic potential of *B. diffusa* in addition to its nutraceutical potentials

Aerva lanata (L.) Juss. ex Schult is potent nutraceutical against secondary complications of diabetes

Nutraceuticals are derived from natural products and provide health benefits beyond their basic nutrition by modulating a number of biochemical pathways. The aim of the present study was to explore the nutraceutical potential of *Aerva lanata* for its therapeutic potential in streptozotocin (STZ) diabetic rats. Treatment with 70% ethanolic extract (ALE) at 500 mg/kg b.w/day for 21 days significantly improved the fasting blood glucose, insulin level, HbA1c and glycogen content in liver and muscle compared to diabetic control. The extract also showed significant decrease in blood glucose by 47.29% towards the end of 2h in oral glucose tolerance test on day 21. The presence of flavonoids, tannins and terpenes (alpha amyrin, betulin and beta sitosterol) along with micronutrients like potassium, magnesium, calcium and zinc could be partly responsible for its therapeutic potential.

An *in vitro* study reveals nutraceutical potential of punicic acid relevant to diabetes *via* enhanced glut-4 expression, adiponectin secretion and antioxidant potential

In the present study punicic acid (PA) a major bioactive found in pomegranate seed was subjected for biological characterisation with respect to peroxisome proliferator-activated receptor gamma (PPARγ) agonist property in *in vitro* system. The adipogenic potential of various concentrations (5, 10 and 30 μM) of PA was evaluated by studying triglyceride accumulation and glycerol-3-phosphate dehydrogenase (GPDH) activity in adipocytes which was found to be increased moderately compared with the positive control rosiglitazone (RG). Glucose uptake activity, and prevention of reactive oxygen species (ROS) generation in adipocytes with PA were also evaluated. It was found that PA increased adiponectin secretion and up regulated glut-4 expression and translocation in adipocytes. Molecular modeling study revealed high binding affinity of PA to the PPARγ ligand binding domain with a free energy of -5.91.



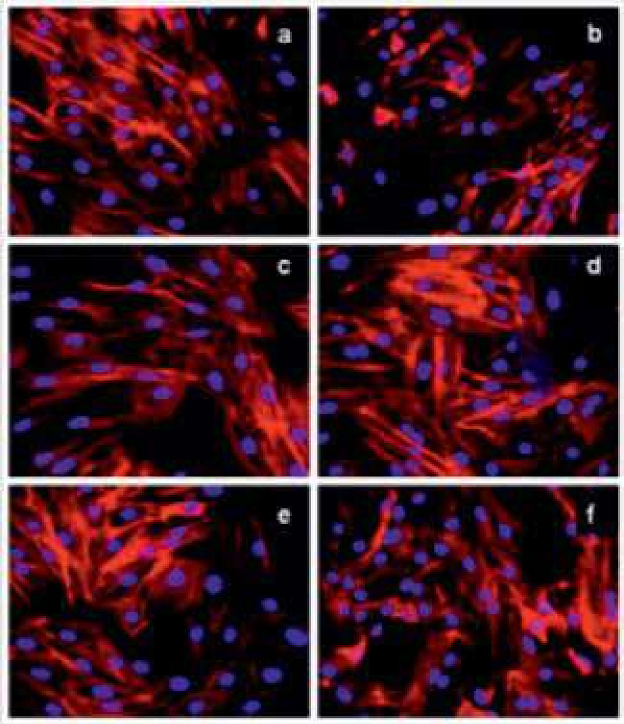
Effect of punicic acid on insulin stimulated glut-4 expression and translocation in 3T3-L1 adipocytes (a)- control; (b)- punicic acid 5 μM; (c)- punicic acid 10 μM; (d)- punicic acid 30 μM; (e)- rosiglitazone 100 nM

Curcumin improves hypoxia induced dysfunctions in 3T3 L1 adipocytes by down regulating oxidative stress, inflammation, and mitochondrial alterations

Excessive expansion of adipose tissue in obesity leads to hypoxia. It is mainly responsible for inflammation, insulin resistance and other obesity related complications. There is a high demand for anti-obese phytoceuticals to control and manage this complications. How hypoxia affects the physiological functions of 3T3 L1 adipocytes was investigated and also evaluated protective role of curcumin on hypoxia induced alterations. Results revealed that hypoxia significantly altered all the vital parameters like HIF1α expression, lactate and glycerol release, ROS production, lipid and protein oxidation, reduction in antioxidant enzymes (superoxide dismutase and catalase) status, secretion of inflammatory markers (TNF α,IL 6, IL 1β,& IFN γ) and mitochondrial functions (mitochondrial mass, membrane potential, permeability transition pore integrity, superoxide generation). Curcumin significantly protected adipocytes from adverse effects of hypoxia in a dose dependent manner.

Phloretin attenuates arsenic trioxide-induced toxicity in H9c2 cardiomyoblasts *via* modulating the innate antioxidant system and calcium homeostasis

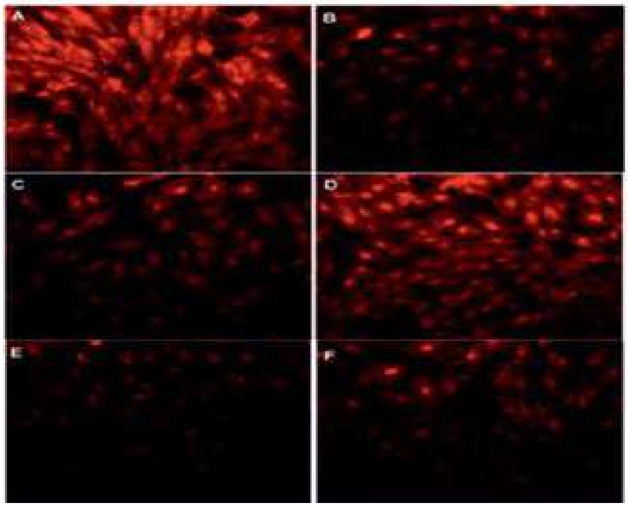
Arsenic trioxide (ATO) is a very effective drug for the treatment of acute promyelocytic leukemia but it leads to cardiotoxicity mediated through alterations in various cardiac ion channels and by increasing the intracellular calcium level and reactive oxygen species (ROS). The present study aims to study the effect of phloretin, a bioactive flavonoid found in apple, on ATO induced toxicity in H9c2 cardiomyoblasts. The cells exposed with ATO (5 μM) exhibited increased level of ROS along with reduced activity of innate antioxidant enzymes. Cytoskeletal alterations were also observed in addition to change in the expression of troponin, desmin, IGF1 and caveolin 3. Phloretin at 2.5 and 5 μM concentrations prevented the alteration in antioxidant status, intracellular calcium level, cytoskeleton and gene expression induced by ATO in H9c2 cells. Unexpectedly, phloretin at higher concentration (10 μM) in presence of ATO led to potentiation of toxic effect of ATO.



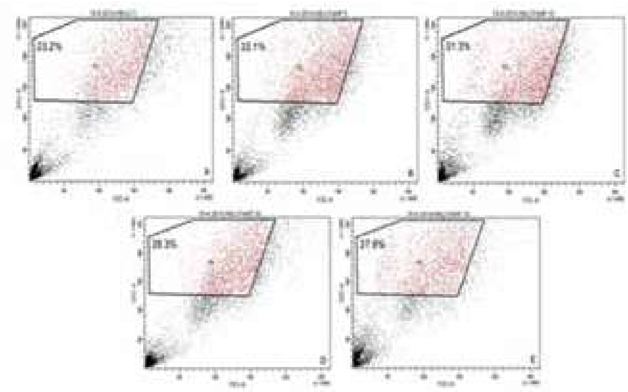
Alteration in integrity of cytoskeleton with ATO Fluorescent microscopic images of H9c2 cells stained with phalloidin. a: control cells; b: cells treated with ATO; c, e: cells treated with 2.5 and 10 μM phloretin respectively; d, f: cells treated with 2.5 and 10 phloretin and 5 μM ATO respectively.

Green synthesis of iron nanoparticles (FeNPs) using *Centella asiatica* and evaluation of antioxidant and cytoprotective potentials by *in vitro* methods

The present study was carried out to synthesize, characterize and evaluate the antioxidant, cellular uptake and cytoprotective potential of FeNPs. Conventional methods for synthesis of nanoparticles generate several byproducts which are toxic to ecosystems. So, there is a need to develop a low-cost, ecofriendly method for nanoparticle synthesis. In the present study, the FeNPs were synthesized utilizing aqueous *Centella asiatica* extract. FeNPs of size 97 nm and PDI value of 0.51 was synthesized successfully. TEM and SEM studies confirmed the spherical nature of FeNPs. 50-250μg of FeNPs effectively scavenged reactive oxygen species including DPPH, ABTS and superoxide anions with an IC_{50} value of 145.99±0.869, 145.98±1.18, 122.5±0.353 respectively. The TRP of FeNPs was also found to be high when compared to their macro counterparts. Since *in vitro* antioxidant assays demonstrated good radical scavenging activities for FeNPs, they were taken up for cell culture studies utilizing H9c2 cell line to examine their cellular uptake and cytotoxicity. Absence of cytotoxicity of FeNPs was evident from MTT assay and flow cytometric observations revealed their cellular uptake. Moreover, DHE incorporation in the cells exposed to higher concentrations of FeNP showed less generation of super oxide anions and were comparable to control. Overall, the FeNPs synthesized using aqueous *Centella asiatica* extract proved to be non-cytotoxic with good cellular uptake and antioxidant potential. These preliminary observations provide a new insight into the benefits of FeNPs in contrast to Fe, especially in oxidative stress - induced diseases, particularly cardiovascular diseases. More investigations are required to delineate the molecular mechanisms underlying the antioxidant potential of FeNP and the *in vivo* relevance of the findings.



Confocal images of H9c2 cells demonstrating red fluorescence of ethidium. A.Antimycin(10μM) B. Control C.FeNP(5μM) D. FeNP (10μM) E. FeNP(20μM) F. FeNP(30μM).

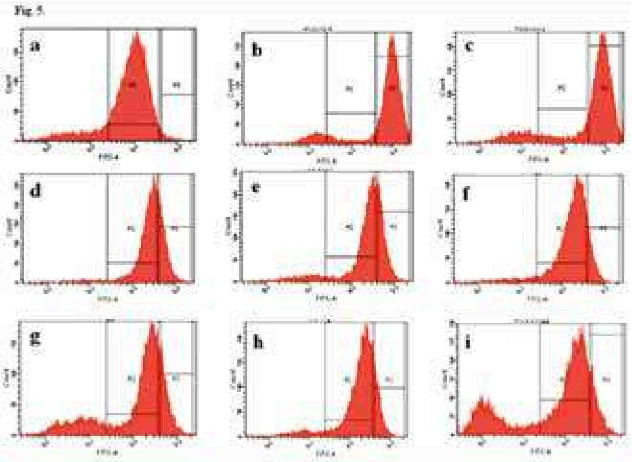


Flowcytometric data showing FeNP uptake by side scatter analysis. Representative dot plots of A. control cells without treatment B. FeNP (5μM) C. FeNP (10μM) D. FeNP (20μM) E. FeNP (30μM). Population P1 represents the region of increased cellular gra nularity due to nanoparticle uptake in B, C, D and E when compared to A

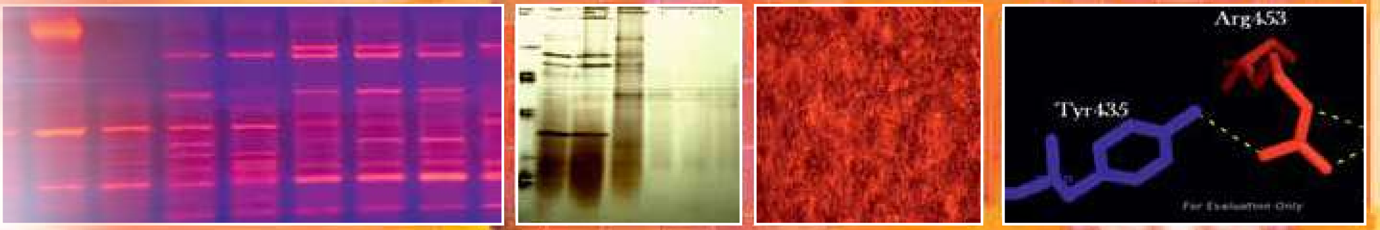
Beneficial properties of selenium incorporated guar gum nanoparticle against ischemia reperfusion in cardiomyoblast (H9c2)

In the present study, selenium incorporated guar gum nanoparticle, prepared by nanoprecipitation, was screened for antioxidant potential (metal chelation, total reducing power and hydroxyl radical scavenging activity) and evaluated against cell line based cardiac ischemia-reperfusion model with special emphasis on oxidative stress and mitochondrial parameters. Cell based cardiac ischemia model was employed using H9c2 cell lines.

Selenium, guar gum and selenium incorporated guar gum nanoparticle were evaluated for its protective property against ischemia reperfusion for comparative evaluation. The study revealed that selenium incorporated guar gum nanoparticle was the best to protect the cells from ischemia reperfusion compared to selenium and guar gum nanoparticle. The potent antioxidant capability shown by the sample in *in vitro* assays may be the biochemical basis of its better biological activity. Further, the nanodimension of the particle may be the additional factor for its improved therapeutic property.



Flow cytometric analysis of intracellular ROS generation in different groups. (a) control cells; (b) ischemic cells; (c) ischemia reperfusion (d, e) cells treated with 5nM and 25 nM Se (f, g) cells treated with 60 μg and 300 μg of GGN and (h, i) cells treated with 5 nM and 25 nM SGG.

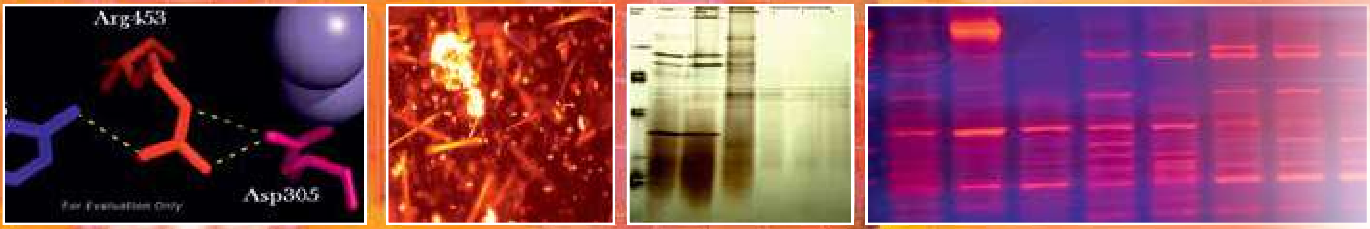


BIOTECHNOLOGY DIVISION

The Biotechnology Division undertakes R&D and industrial consultancy in the frontier areas of biotechnology which include (a) bioprocess and product development, (b) energy and environment, and (c) health and genomics. These activities are well aligned with the priority sectors of CSIR such as Affordable Health Care, Energy and Environment. Under the energy sector, the main focus is on the production of bioethanol from lignocellulose feedstocks. Noval microbes are being isolated from the Western Ghats in Kerala and deposited in the NII Culture Collection under the environmental biodiversity programme. A summary of the achievements during the reporting period is given below.

Highlights:

- 2G Ethanol Pilot Plant commissioned: This is India's first multi-feedstocks, multiple mode pretreatment capable 80kg/d capacity pilot plant.
- A major international project (Indo-Australia) on integrated biorefineries involving five partners each from India and Australia, has been undertaken. The project aims at developing integrated technologies for economically sustainable bio-based energy.
- A novel protein expression system developed for the expression of heterologous proteins in filamentous fungal host.
- The biosurfactants produced by the novel isolate of *Pseudozyma* sp facilitated the degradation of crude oil by *Pseudomonas putida* than the culture alone, which showed its potential in biosurfactants-assisted bioremediation.
- Identified one novel bacterial genera *Oryzibacter plantistimulans* gen. nov. sp. nov and three new bacterial species, including *Arthrobacter pokkali* sp.nov, showing potential plant growth promoting activities.



जैव प्रौद्योगिकी प्रभाग

जैव प्रौद्योगिकी प्रभाग द्वारा जैव प्रौद्योगिकी के अग्रणी क्षेत्रों में अनुसंधान एवं विकास तथा औद्योगिक परामर्श का कार्य कर रहा है, जिनके अंतर्गत (क) बायोप्रोसैस और उत्पाद विकास, (ख) ऊर्जा और पर्यावरण, और (ग) स्वास्थ्य और जीनोमिक्स शामिल हैं। उपर्युक्त गतिविधियॉं सीएसआईआर के प्राथमिकता प्राप्त क्षेत्रों जैसे सस्ती स्वास्थ्य देखभाल, ऊर्जा और पर्यावरण के साथ अच्छी तरह से गठबंधन कर रही हैं। ऊर्जा के क्षेत्र के अंतर्गत, मुख्य ध्यान लिग्नोसेल्लुलोसिक फीडस्टॉक से जैव इथेनॉल के उत्पादन पर है। पर्यावरण जैव विविधता कार्यक्रम के तहत केरल के पश्चिमी घाट से नूतन रोगाणुओं को अलग करके एनआईआई संवर्धन संग्रह में जमा किया जा रहा है। समीक्षाधीन अवधि के दौरान प्राप्त उपलब्धियों का एक सारांश नीचे दिया जाता है।

मुख्य विशेषताएं

- 2 जी इथेनॉल पायलट संयंत्र कमीशन किया गया : यह भारत का पहला बहु फीडस्टॉक, बहुविध मोड पूर्वोपचार सक्षम और 80 किलोग्राम / डी क्षमतावाला पायलट संयंत्र है।
- भारत और ऑस्ट्रेलिया, प्रत्येक राष्ट्र से पांच साथियों को शामिल करके एकीकृत जैव- रिफाइनरियों पर एक प्रमुख अंतरराष्ट्रीय परियोजना (भारत-ऑस्ट्रेलिया) शुरू की गयी है। परियोजना का उद्देश्य आर्थिक रूप से स्थायी जैव आधारित ऊर्जा के लिए एकीकृत प्रौद्योगिकी विकास है।
- तांतुक कवक होस्ट में विषमजात प्रोटीन की अभिव्यक्ति के लिए एक नूतन प्रोटीन अभिव्यक्ति प्रणाली विकसित की गयी।
- *स्यूडोजाइमा* स्पीशीज के नूतन वियुक्त से उत्पन्न जैवसर्फेक्टेंटों ने अकेले संवर्धन की तुलना में *स्यूडोमोनास पुटीड़ा* द्वारा कच्चे तेल के डीग्रेडेशन को सुगम बनाया और इसने जैवसर्फेक्टेंट सहायता प्राप्त जैव उपचार की अपनी शक्यता दर्शायी।
- पौधों की संभावित वृद्धि को बढ़ावा देने की गतिविधियों दिखानेवाले नूतन बैक्टीरियल वंश *ओरीज़िबक्टेर प्लांटीस्टिम्युलंस* वंश .एनओवी. स्पीशीज. एनओवी और अथ्रीबैक्टेर पोक्काली स्पीशीज. एनओवी सहित तीन नए बैक्टीरियल प्रजातियों की पहचान की गयी।

BIO-PROCESSES AND PRODUCTS DEVELOPMENT

Industrial enzymes

Recombinant expression of L-asparaginase II from *Escherichia* sp. and property improvements through amino acid substitutions: L-asparaginase is an enzyme that catalyzes the hydrolysis of L-asparagine into L-aspartate and ammonia in two steps *via* a beta-acyl-enzyme intermediate. In the present study, the L-asparaginase II gene was isolated from *E. coli* and cloned and over-expressed from BL21DE3 cells. The property improvement of the protein was achieved through site- directed mutagenesis. The mutated purified protein was studied for properties such as thermal tolerance and stability. The mutations based on alteration of the surface charge proved promising and compared to the wild enzyme and positively charged control mutant, K139A and K139D showed tolerance towards 70°C and 20 % more activity retention on thermal stability at 50 °C. The surface electrostatic potential maps of both wild and mutant proteins were analysed using PyMOL, and alanine and asparatate substitution at position 139 resulted in localized negative charge density surrounding the residue than the positive potential in wild protein (Fig 1). The hydrogen bonds formed by all these mutants were checked in PyMOL and swiss PDB viewer and since there are no additional hydrogen bonds formed in any of the improved mutants, it could be concluded that it was the surface charge interaction, which contributed to the stability of the mutants. The study concluded the stabilization of surface charge-charge interactions could contribute to overall stability of the protein (Fig 2). Hence in future, the addition of positive single mutations in a cumulative manner in a single gene can be done for developing an improved enzyme with stabilized surface charge interactions.

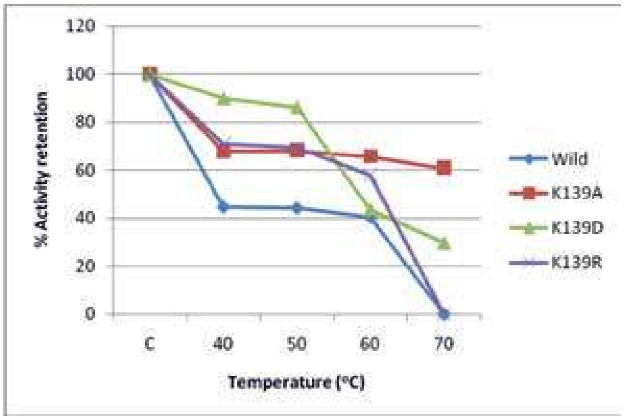


Fig.1 : Thermal tolerance of mutants at position 139 : themperature stability of wild and mutant proteins incubated at 40 - 70 °C for 10 minutes and residual activity retention compared to untreated control (C- 100%).

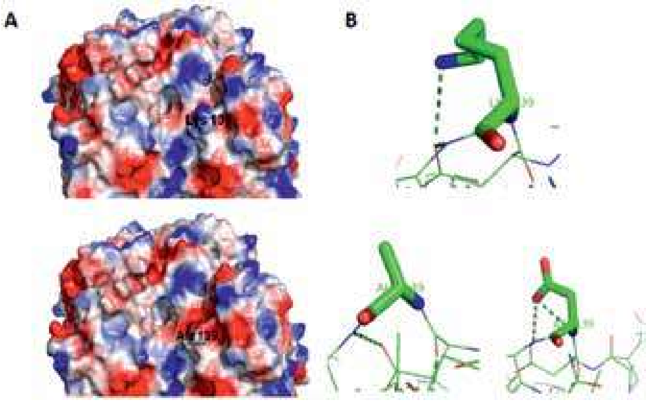


Fig.2: Structural representation of wild type and selected mutants. A) Surface electrostatic potential map of wild type enzyme (Lys 139) and mutant (Ala 139), view of mutational sites. Positive, negative and neutral values of electrostatic potentials are represented by shades of blue, red and white color respectively. B) Structural representation of the hydrogen bonds in mutation sites of Lys 139 (wild type enzyme), Ala 139 and Asp 139 (mutants). All the figures were constructed using PyMOL

Surface display of *Bacillus* phytase on yeast: Application in preparation of functional foods and production of pharmacologically relevant myoinositol phosphates: Present study aimed the cloning and expression of beta propeller phytase from *Bacillus amyloliquifaciens* on the surface of yeast system. Phytase C gene was successfully isolated from *B. amyloliquifaciens* and cloned in TA vector. Expression cassette containing phytase gene and anchor proteins were designed (Fig 3). Genes encoding cell wall anchor proteins Flo1p and CWP2p were PCR amplified from genomic DNA of *Saccharomyces cerevaceae* and fused with phytase C gene (Fig 4). CWp2P –phyC fusion was cloned in to yeast expression vector pKLAC1 downstream to alpha mating factor secretory signal, confirmed clone plasmid was linearized, and electroporated in to *Kluyveromyces lactis* GG799 cells. Recombinant yeast cells harboring expression cassette which was integrated in to its genomic DNA was identified by PCR (Fig 5). Since, in subsequent expression studies, intact recombinant cells exhibited negligible phytase activity, immuno blotting would be carried out to determine the surface display and studies will be continued with the other anchor FLO1p.

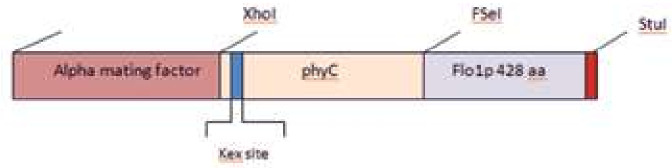
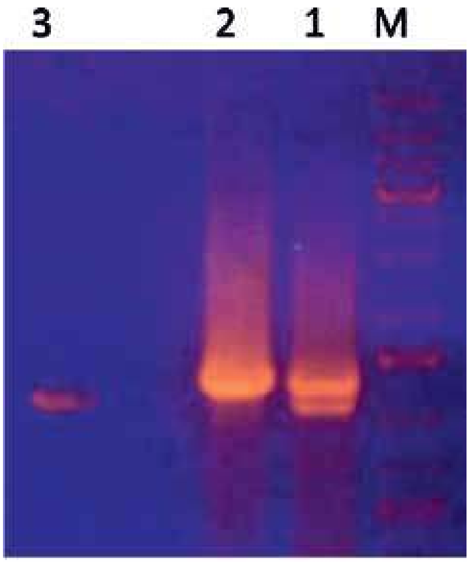
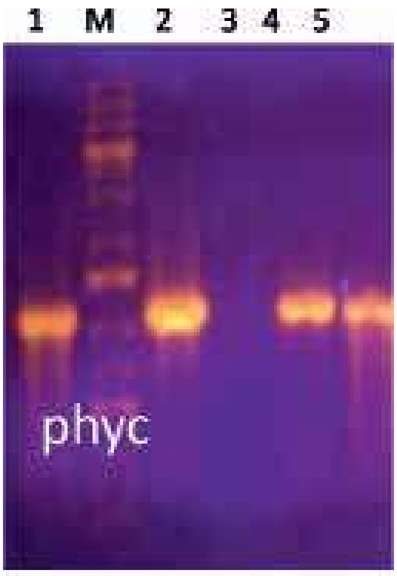


Fig.3 Design of fusion construct phyc-Flo1p



M – 1kb gene ruler plus DNA ladder
Lanes1 and 2- Amplicons (phyc-cwp2p) from ligation mix
Lanes 3- phyc amplicon

Fig. 4 Amplification of fusion construct from ligation mix



Lane 1,2,4 &5-PCR from clones
Lane 3-PCR with K. lactis
Lane M- DNA ladder

Fig.5 Colony PCR from yeast transformants

Arginine 453 contributes to the substrate specificity of aminopeptidase P from *Stretomyces lavendulae:* To understand the structure-function relationships of aminopeptidase P (APP) of *Streptomyces lavendulae*, a conserved arginine residue was replaced with lysine (R453K) by site-directed mutagenesis. The overexpressed wild and mutant enzymes were of nearly 60 kDa and purified by nickel affinity chromatography. Kinetic analysis of R453K variant using Gly-Pro-*p*NA as the substrate revealed an increase in Km with a decrease in Vmax, leading to overall decrease in the catalytic efficiency, indicating that the guanidinium group of arginine plays an important role in substrate binding in APP. The constructed three dimensional models for the catalytic domains of wild and mutant enzyme revealed an interaction in Arginine 453 of native enzyme through hydrogen bonding with the adjacent residues making a substrate binding cavity whereas Lysine 453 did not participate in any hydrogen bonding (Fig 6). Hence, Arg453 in APP of *S. lavenduale* must be playing a critical role in the hydrolysis of the substrate.

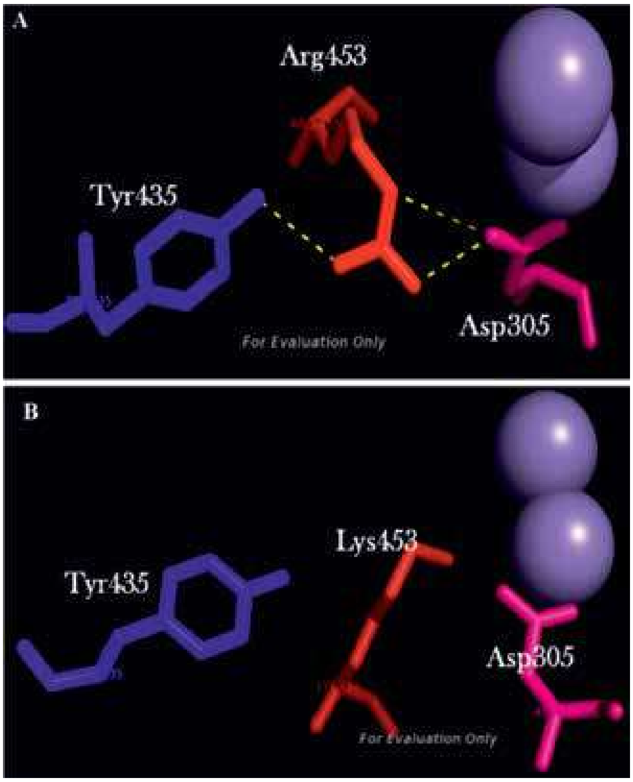


Fig. 6 Comparison of the orientation of the hydrogen bond network in the active site of APP formed by Asp305, Arg453 and Tyr435. (A) The guanidinium group of Arg453 interacting with the carboxylate of Asp305 and the hydroxyl group of Tyr435 in the wild-type APP (B) the modeled structure displaying the relative position of R453K, showing the absence of hydrogen bond interactions with two neighboring residues. The hydrogen bonding interactions are shown as dashed yellow lines

Molecular cloning, expression, characterization and production of novel xylanases: Two xylanase genes (*Xyn*D and *Xyn*A) from *Bacillus pumilus* MTCC 5015 were isolated. The industrially relevant xylanase gene (*Xyn*A) was further cloned and expressed in *Kluyveromyces lactis*. Recombinant enzyme purified from the culture supernatant of multiple integrant was partially purified and characterized for industrial properties. Comparison of waste paper deinking as well as bleaching efficiency of recombinant *Xyn*A was compared with that of commercial enzyme and xylanase preparation from native organism (Fig 7). The end-products of xylan hydrolysis by the action of recombinant xylanase on beech wood xylan were xylobiose, xylotriose and xylose. These results showed that this was an endo-xylanase. Xylanase A was effectively expressed from *K. lactis* and the enzyme was efficient in biological deinking. Biochemical characteristics revealed that this enzyme could be highly useful for industrial applications where stable xylanases were indispensable. Studies involving media engineering for the production of xylanase using *B. pumilus* using response surface methodology resulted five-fold increase in the production of the enzyme.

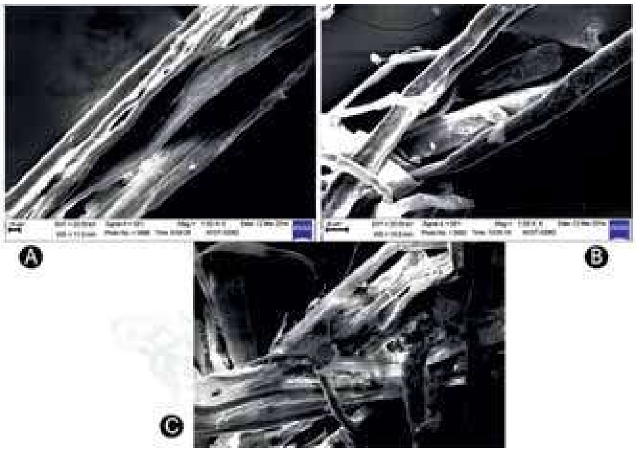
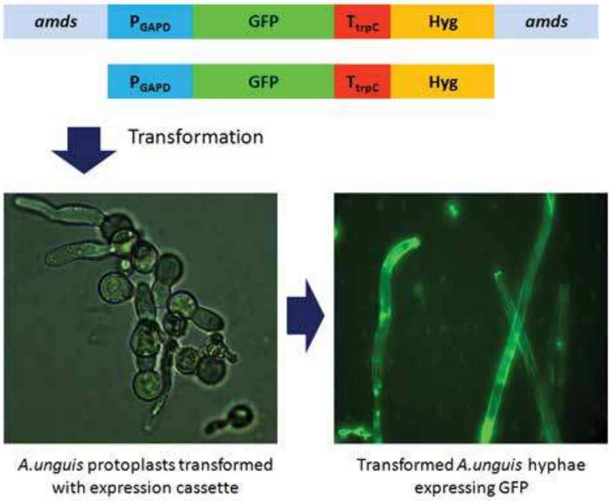


Fig. 7: Micrograph images of carton microfibrils (A) Control (B) Xylanase (wild) (C) Xylanase (recombinant)

Development of a heterologous protein expression system in filamentous fungus:

A protein expression system was developed for the expression of heterologous proteins in filamentous fungal host.



Green fluorescent protein gene was introduced downstream of glyceraldehyde phosphate dehydrogenase (GAPD) promoter and terminated using a bifunctional indole-3-glycerol phosphate synthase/ phosphoribosylanthranilate isomerase (trpC) terminator sequence from *Aspergillus nidulans*. This cassette was also coupled to hygromycin resistance gene as a marker and linkers derived from acetamidase (amds) gene for selection and targeting respectively. Linearized cassette was introduced into *Aspergillus unguis* to evaluate the efficacy of the newly developed expression cassette. The system developed was successful in expressing green fluorescent protein in the filamentous fungal host indicating that the GFP expression system developed at the NIIST-Centre for Biofuels is functional and can be further fine tuned for expression of other heterologous proteins and their secretion.

Stereo selective production of chiral alcohol using novel microbial oxidoreductase:

The study involves the production of ethyl (S)-4-chloro-3-hydroxy butyrate and (S)-(-)-1-(1-napthyl) ethanol through biotransformation using appropriate ketones. Screening of 169 soil isolates were done, out of which four cultures showed positive growth in ethyl 4-chloroacetoacetate plates. Further screening resulted in a strain, which showed highest conversion of ECHB to and Ethyl S-4-chloro-3-hydroxybutyrate among the positive organisms. The strain was identified as *Candida tropicalis*.

Production of chitinolytic enzymes from microbial cultures isolated from coastal environment samples: The optimization of process parameters for fermentative production of chitinase enzyme was carried out using single parameter optimization method and statistical optimization method using multiple parameters employing *Streptomyces* sp. The highest production achieved using the optimum condition was 105 U/ml. The purification of chitinase enzyme by ammonium sulfate precipitation, ion exchange chromatography and gel permeation chromatography showed that the molecular mass of the enzyme was estimated to be about 80 kDa by SDS-PAGE (Fig 8).

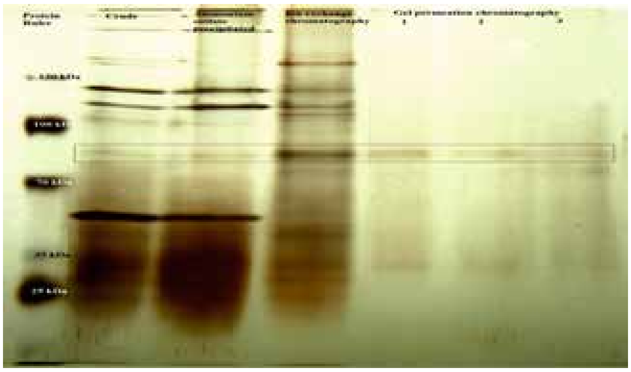


Fig 8 SDS-PAGE analysis of chitinase enzyme

Characterisation of chitinase enzyme with respect to the effect of pH, temperature, salinity, addition of metal ions, solvents and denaturing agents showed optimal pH 6.0 and temperature as 50°C, respectively. The enzyme showed high stability in the acidic pH range of 2.0-6.0 and temperature stability of up to 50°C. Mg^{2+} and Ca^{2+}, toluene and surfactants belonging to the Tween series stimulated the chitinase activity. This enzyme exhibited antifungal activity against phytopathogens such as *C. gleosporoides, F. oxysporum, P. expansum and P. alphanidermatum*, revealing a potential biocontrol application in agriculture.

Biopolymers and Biosurfactants

Microbial consortium for biopolymer/plastic degradation: Compatibility of a Microbial consortium containing six different newly isolated strains was tested for plastic/e-plastic degradation. The selected cultures had either acidic protease, lipase/esterase or depolymerase activity. Maximum degradation attained for PVC film was 11% and for ASM01 14%. Similarly, from more than 400 pure cultures screened, 21 formed clearing zones in PLA, PHB biopolymer plates. Complete degradation of PHB film (50 mg) was attained in 15 days, which for PLA was 44% in 15 days (Fig 9).

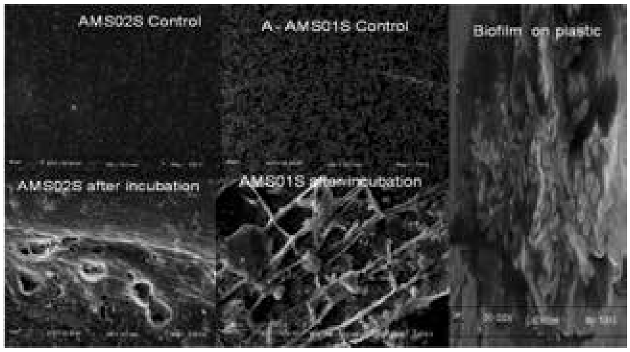
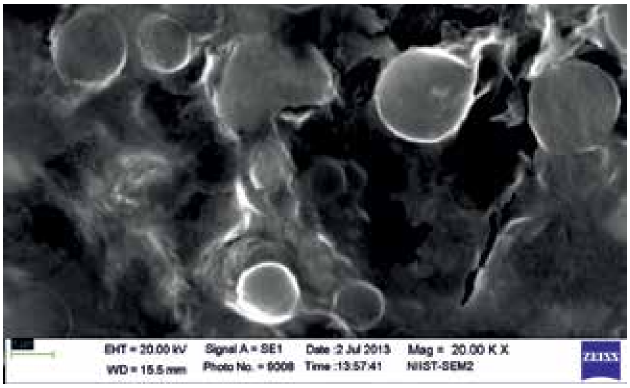
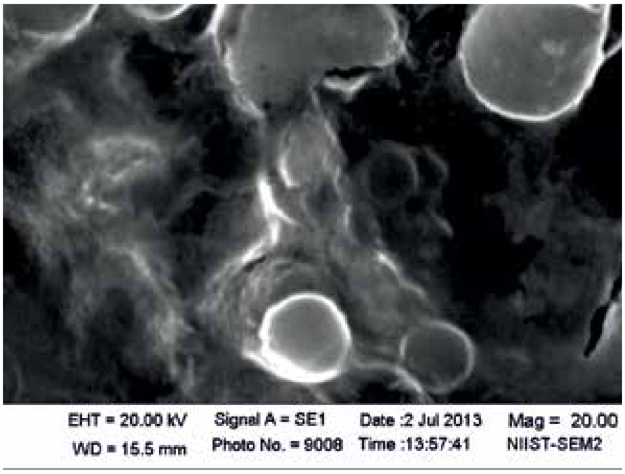


Fig 9. Microbial Degradation of e-Plastic. AMS 01 (HIPS with decabromodiphenyl oxide or ether and antimony trioxide). AMS02 (HIPS with decabromodiphenyl ethane and antimony trioxide)

Colloidal properties of biopolymer (PLA and PHB) nanoparticles for biomedical applications: To characterize the physico-chemical and biological stability of nano-devices suitable for biomedical applications, poly-lactic acid (PLA) nano-particles (NPs) of 112-128nm size and poly-hydroxy butyrate (PHB) of 15-28 nm were prepared by standardizing the suitable method for each (Fig 10). Morphology of NPs was studied by scanning and transmission electron microscopy and temperature stability by thermo-gravimetric analysis. Their stability in gastrointestinal, saliva stimulant fluids and tolerance against 0.5 M NaCl were analyzed. PHB NPs remained stable in all the fluids, while the PLA NPs showed the beginning of disintegration in intestinal fluid after 24 h treatment. Apart from the mere polyethylene glycol (PEG) surface coated NPs, PLA-PEG-PLA triblock copolymer (MW ~ 7,366) was also chemically synthesised and characterized. Cytotoxicity of all forms of nano-particles was tested by MTT assay and by annexin pi staining.



PLA



Phb

Fig 10 Nano-particles (NPs) of poly-lactic acid (PLA) and poly-hydroxy butyrate (PHB)

Potential applications of *Pseudozyma* biosurfactants for biosurfactants assisted bioremediation: *Pseudozyma* sp. NII 08165 was used to produce biosurfactants, mannosylerythritol lipids and some other unknown glycolipids, which exhibited good surface activity. The aim of this study was to evaluate whether *Pseudozyma* biosurfactants could facilitate the bioremediation of crude oil by a hydrocarbon degrading strain. For this, a model hydrocarbon degrading strain *Pseudomonas putida* MTCC 1194 strain was used and *Pseudozyma* biosurfactants was supplemented at different concentration along with *P putida* to B.H. medium containing crude oil as sole carbon source. Results showed that the supplementation of *Pseudozyma* biosurfactants facilitated the degradation of crude oil than that of *P. putida* alone. Maximum degradation of aliphatic hydrocarbons was observed on the supplementation of 2.5 mg/l along with *P. putida*. *Pseudozyma* sp. NII 08165 was capable of degrading other hydrocarbon such as diesel and kerosene. Studies using *Pseudozyma* culture broth containing biosurfactants showed improved efficiency in the degradation of crude oil (Fig 11).

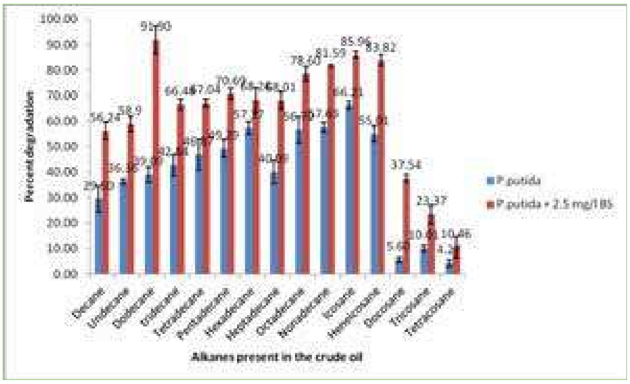


Fig 11. Degradation of alkanes by P. putida and P. putida with supplementation of 2.5 mg/l biosurfactants

BIOFUELS AND BIOREFINERIES

Centre for Biofuels and Biofuels Research-Commissioning of the bioethanol pilot plant: Centre for Biofuels R&D aims to address different unit operations involved in lignocellulose to ethanol conversion. An 80kg/d capacity second generation lignocellulosic ethanol pilot plant was commissioned on October 25, 2013. This is one among the three operational biomass to ethanol plants in the country. Operations have started from November 2013 using rice straw as raw material. R & D is aimed at developing bioethanol from cellulose derived glucose (C6 sugar) and production of high value chemicals from hemicellulose derived pentose (C5) sugars- xylose and arabinose.

Biomass hydrolyzing enzymes: Centre has developed solid-state fermentation processes for the production cellulase enzyme. The enzyme was produced using a filamentous fungus – *Penicillum janthinellum*. The process has been evaluated successfully up to 1kg level in tray fermentation. The enzyme is highly efficient in hydrolysis of pretreated biomass, and the Centre is now developing cocktails based on this enzyme for lignocellulose saccharification. Cocktails developed using β –glucosidase (BGL) enzyme addition into the cellulase preparation enhances the efficiency of biomass hydrolysis. The addition of 240U of BGL into cellulase preparation increased the sugar yield from 257 mg/g to 426 mg/g in 48h (1.65 fold/65% increase) on saccharification of biomass. Bench marking of the enzyme with leading commercial enzyme preparation for biomass hydrolysis showed that the NIIST enzyme cocktail has equal or better performance for the hydrolysis of certain biomass feedstocks.

Biomass hydrolysis using solid acid catalyst: A solid acid catalyst developed by IICT, Hyderabad was evaluated for the hydrolysis of alkali pretreated rice straw and cotton stalk with sugar yields of 262 mg/g and 219 mg/g, respectively (Fig 12). Fermentation of the catalytic hydrolyzate was demonstrated with *Saccharomyces cerevisiae* for the production of alcohol, which showed 53% efficiency, indicating the potential to use the catalytic hydrolyzate for fermentation.

Fig 12 A-Catalytic biomass hydrolysis being performed in acid digestion bombs, B-mixture of biomass and catalyst

Algal biorefinery

Cultivation of microalgae in dairy effluent for oil production and removal of organic pollution load: *Chlorococcum* sp RAP-13, was evaluated for growth and oil production in dairy effluent (DE) under mixotrophic and heterotrophic modes. The alga grew better and accumulated more lipids under heterotrophic cultivation. Supplementation of biodiesel industry waste glycerol (BDWG) to DE enhanced the biomass production as well as lipid accumulation. While the biomass yield was 0.8g/L for mixotrophic cultivation, it was 1.48 and 1.94 g/l, respectively when cultivated with 4% or 6% BDWG. The cells accumulated 31% lipid when grown in mixotrophic mode; heterotrophic cultivation with 4 or 6% BDWG resulted in a lipid accumulation of 39 and 42% respectively. Saturated fatty acids production was elevated in the DE, and the major fatty acid components of the algal oil were palmitic (16:0), oleic (18:1), stearic (18:0) linoleic (18:2) and linolenic (18:3) acids. DE quality improved with reduction in COD and BOD after algal cultivation.

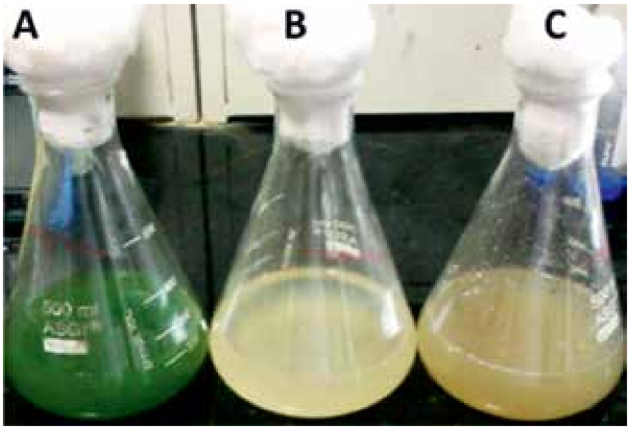
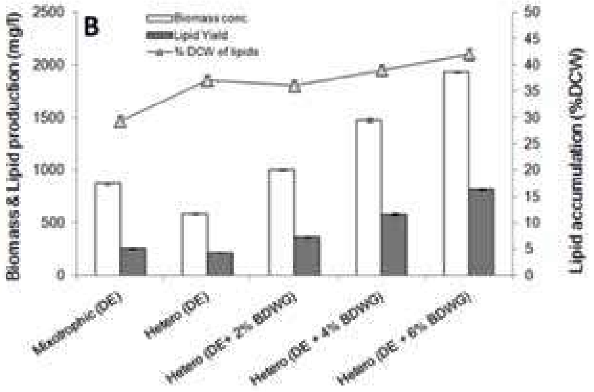
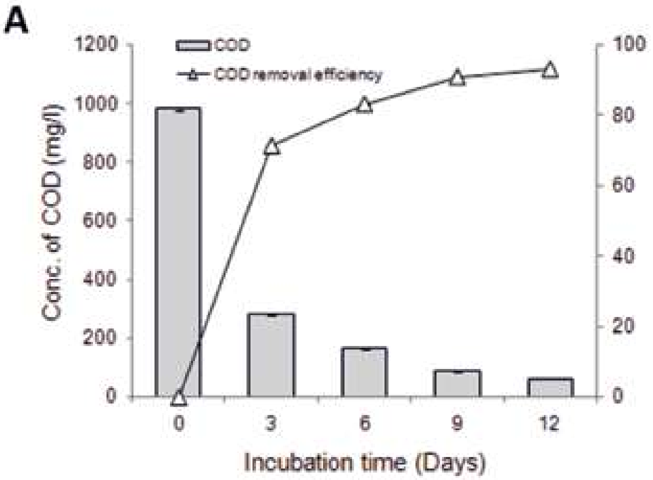


Fig 13. A-Phototrophic, B-mixotrophic and C-heterotrophic growth of Chlorococcum sp RAP-13 in Dairy effluent





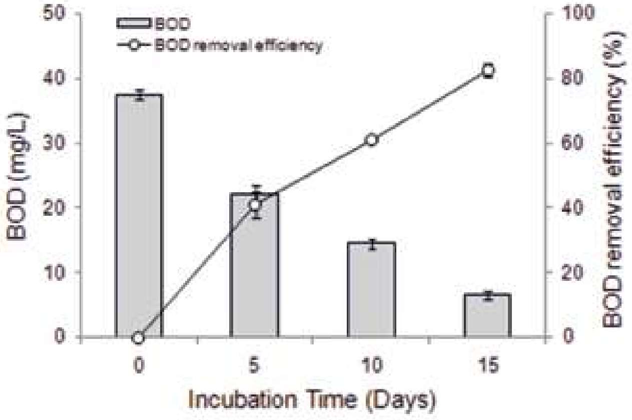


Fig 14 Growth and activity of Chlorococcum sp RAP-13 in diary effluent

Biochemical and molecular investigation on stress mediated lipid accumulation and biomass productivity in microalgae: This study aims to address the biochemical and molecular causes for increased lipid content in microalgae. Basic biochemical parameters under nitrogen deprived condition showed that total carbohydrate was not much altered in *Scenedesmus* in nitrogen rich or deprived condition. However, there was enhanced lipid accumulation in nitrogen deprived condition and the enhancement was around 2.21-fold (Fig 15).

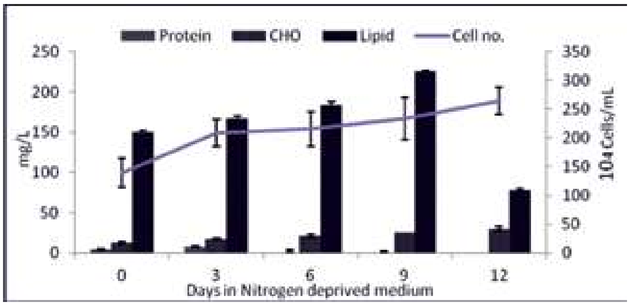


Fig 15 Growth and lipid accumulation by Scenedesmus in nitrogen deprived condition

Scenedesmus cells transferred to nitrogen-free medium showed that there was increased lipid droplet in 9th day nitrogen starved cells (Fig 16).

Fig 16 Nilered stained Scenedesmus cells in Nitrogen deprived condition

It was observed that the lipid yield was enhanced in nitrogen-depleted condition (226 mg/L) when compared to nitrogen rich condition (99.33 mg/L). The increment of about 2.27-fold lipid increase was observed in nitrogen depleted condition.There was not much difference observed for carbohydrate, which ranged from 12.67 ± 1.53 to 29.83 ± 2.36 mg/L in nitrogen depleted condition. However, there was drastic change in protein level, in nitrogen-rich condition (27.00 ± 0.50 mg/L) when compared to nitrogen depleted condition (1.33 ± 0.76 mg/L). The total lipid profile as checked by thin layer chromatography along with TAG and FAME standard reveled that there was more accumulation of TAG in nitrogen depleted condition.

Alternative strategies for pretreatment of lignocellulosic biomass for bioethanol production

Ultrasound assisted hydrothermal pretreatment of chili post harvest residue for bioethanol production: A novel ultrasound-assisted hydrothermal pretreatment was developed, which could effectively remove hemicelluloses and lignin and improved the reducing sugar yield from chili post harvest residue. Operational parameters for pretreatment were studied and optimized. Under optimal pretreatment conditions, 0.436 g of reducing sugar was produced per gram of pretreated biomass. The conditions of pretreatment were 25% w/w of biomass loading, 10 min of sonication time and 45 min of pretreatment time at 121°C (Table 1). The study revealed that major fermentation inhibitors like furfural and hydroxymethyl furfural were absent in all the samples. Organic acids like citric acid, succinic acid and propionic acid were absent indicating that the hydrolyzate could be used for fermentation without any detoxification.

One of the most important advantages of this pretreatment is that the pretreated biomass can be used for hydrolysis without any washing, neutralization and drying and the hydrolyzate is devoid of major fermentation inhibitors hence a detoxification step can be eliminated.

Table 1: Compositional analysis data of native and USAHTP CPHR

Components	Total (%)	
	Native	USAHTP CPHR
Cellulose	38.76	47.76
Hemicelluloses	14.62	11.11
Total lignin	27.55	19.87

Studies on the structural changes of native and pretreated biomass investigated by X-ray diffraction (XRD) showed there was an increase in the crystallinity index of the pretreated sample. The results indicated that ultrasound-assisted hydrothermal pretreated chili post-harvest residue could be used as a potential feed stock for bioethanol production.

Surfactant-assisted hydrothermal pretreatment of chili post harvest residue for bioethanol production: A novel surfactant-assisted hydrothermal pretreatment was developed which could effectively remove hemicelluloses and lignin and improved the reducing sugar yield from chili post harvest residue. Under optimal operational parameters for the pretreatment 0.445 g of reducing sugar was produced per gram of pretreated biomass (Fig 17). The conditions of pretreatment were 30% w/w of biomass loading, surfactant concentration of 1% (w/w) and 45 min of pretreatment time at 121°C. The study revealed that major fermentation inhibitors like furfural and hydroxymethylfurfural were absent in all the samples. Organic acids like citric acid, succinic acid, formic acid and propionic acid were absent indicating that the hydrolyzate could be used for fermentation without any detoxification.

One of the most important advantages of this pretreatment is that the pretreated biomass can be used for hydrolysis without any washing, neutralization and drying and the hydrolyzate is devoid of major fermentation inhibitors hence a detoxification step can be eliminated.

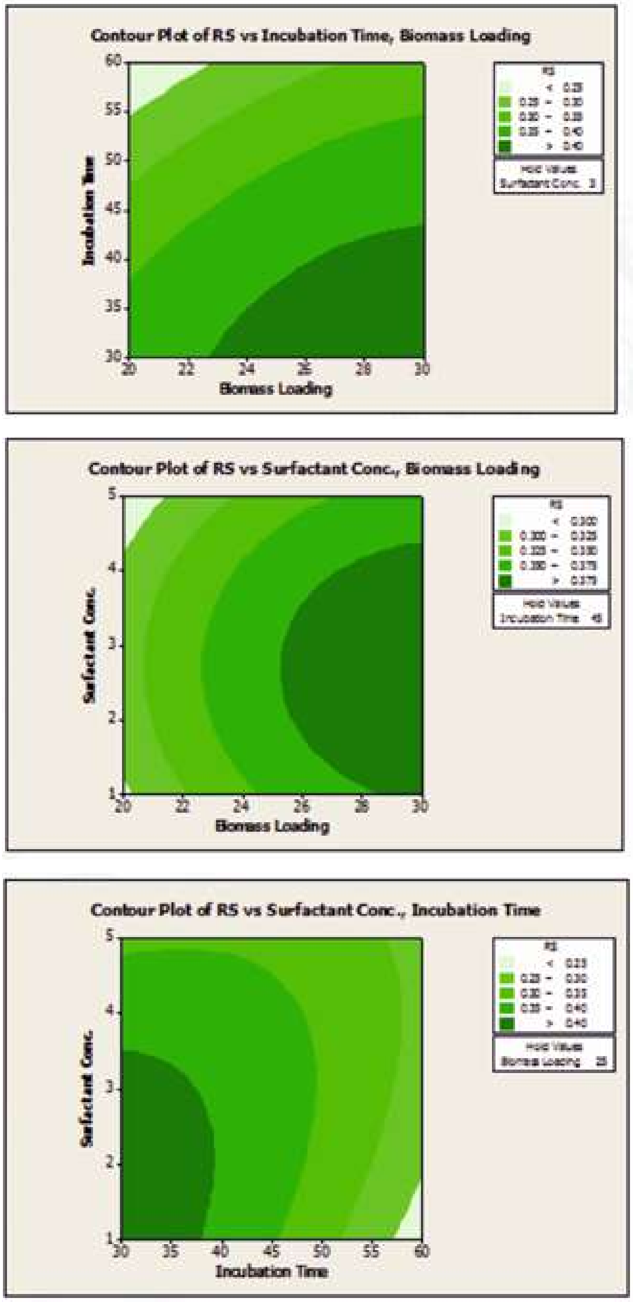
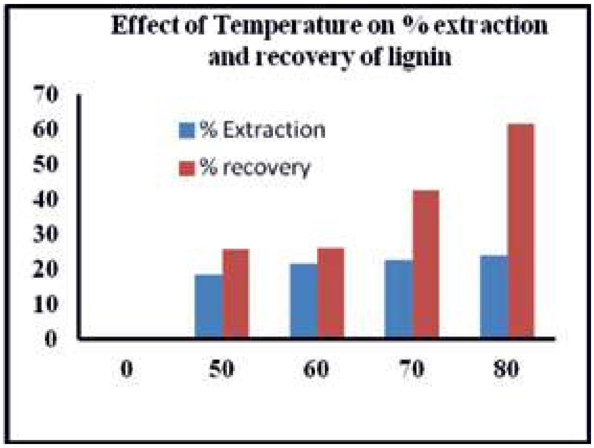


Fig 17 Optimization of surfactant-assisted hydrothermal pretreatment of chili post-harvest residue

Hydrotrope-assisted pretreatment of lignocellulosic biomass and adsorptive removal of fermentation inhibitors formed during pretreatment: Hydrotropic solutions are aqueous salt solutions, which improve the solubility of slightly soluble substances (*e.g.*, lignin) in comparison with pure water at the same temperature. Studies were carried out on the delignification of rice straw using 30% solution of sodium cumene sulfonate (NaCS). Results showed that with the increase in the temperature of the treatment, there was enhancement in the removal as well as the recovery of lignin (Fig 18a). Characterization of the lignin using IR and UV spectra suggested to be similar with reported data (Fig 18b).



Temperature, in degree celusis

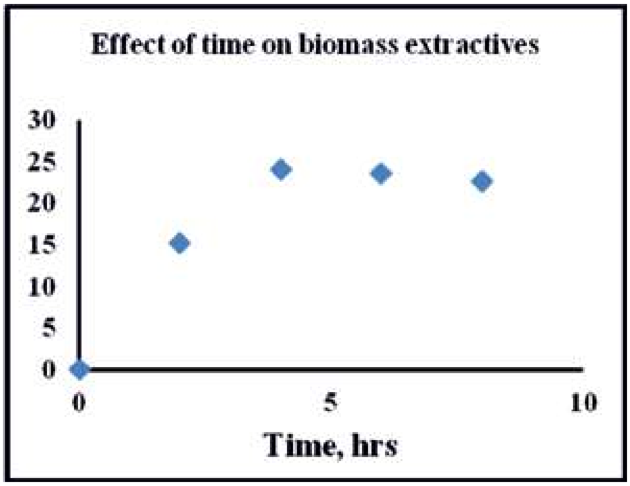


Fig 18a Delignification of Rice straw using 30% solution of Sodium Cumene Sulfonate (NaCS)

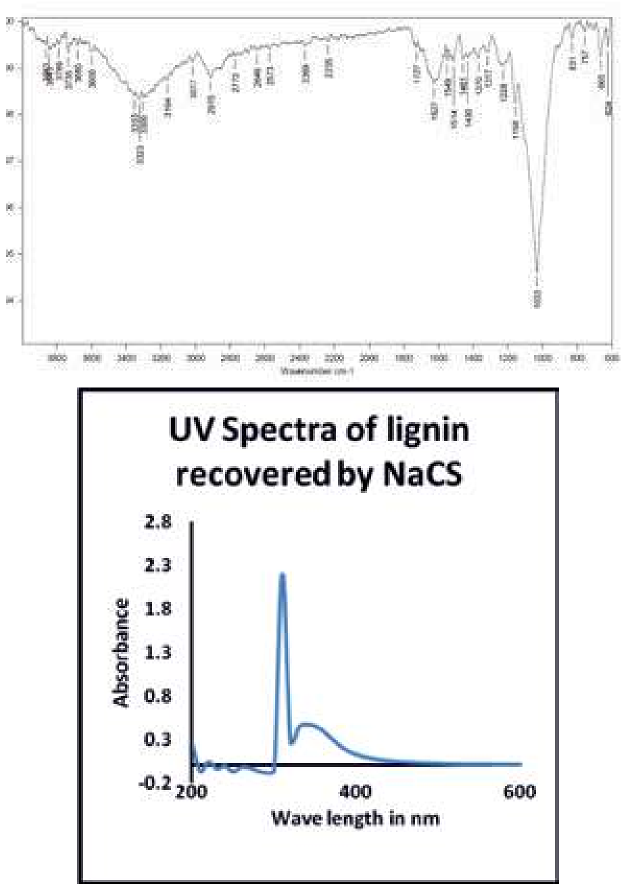


Fig 18b Characterization of lignin recovered from Sodium Cumene sulfonate (NaCS)

Sorghum stover-based biorefinery for fuels and chemicals - biomass pretreatment: Pretreatment studies on sorghum were carried out. Out of different acids tried, dilute sulphuric acid was found to be the best. Three different statistical models were studied where acid concentration, solid loading, residence time and pretreatment temperature were optimised. With optimized pretreatment conditions as 0.37% (v/v) sulphuric acid, 16% (w/w) solid loading, pretreatment temperature at 150°C for 15 minutes, followed by enzymatic saccharification, about 66 % conversion of sorghum biomass to free reducing sugars were achieved. Various alternative pretreatment studies using microwave, percolation and sonication showed that even though the sugar yield was less compared to high pressure reactor (HPR) pretreatment, the inhibitor formation was less. High pressure reactor pretreatment in presence of SDS showed best sugar yield among the tested methods.

Table 2. Comparison of various pretreatment methods for soghum stover

Method	Pretreatment Conditions	Sugar yield	Inhibitors (g/L)	Hemicellulose removal (in liquor)	Cellulose Removal (in liquor)
HPR	Acid conc - 0.37 % SL – 16 % Time – 15 min Temp – 150 C	**408 mg/g**	Acetic – 4.32 Formic – 2.46 HMF – 0.66	28.63 %	0.67 %
Sonication	Acid conc – 4.5 % SL – 10 % Time – 45 min Power – 30 % Frequency – 80 KHz	**314 mg/g**	Acetic acid – 4.9	14.33 %	2.28 %
Microwave	Acid conc - 0.37 % SL – 16 % Time – 3 min Power – 550 Watts	**249 mg/g**	Succinic – 1.32 Oxalic – 0.02	43.22 %	13.09 %
Percolation	Acid conc - 6 % SL – 2.7 % Time – 2 hr Temp – 85 to 90 C	**170 mg/g**	Succinic–0.001 Formic – 0.003	36.48 %	10.36 %
Surfactant (SDS) + HPR	Acid conc - 0.37 % SL – 16 % Time – 15 min Temp – 150 C SDS– (0.5 %)	**435 mg/g**	Acetic acid – 0.55 Formic acid-0.038 HMF – 0.097	34.08 %	2.48 %

HEALTH AND GENOMICS

Probiotics and Nutraceuticals

Folate fortification of skim milk by a probiotic *Lactococcus lactis* subsp. *lactis* and evaluation of its stability in fermented milk on cold storage: In order to enhance folate levels in fermented foods, a folate producing probiotic lactic acid bacterium isolated from cow's milk and identified as *Lactococcus lactis* subsp. *lactis* by 16S rRNA sequencing was used to fortify skim milk. Optimization of medium additives such as folate precursors, prebiotics and reducing agents along with suitable culture conditions enhanced folate levels in skim milk. Optimization resulted in a fourfold increase in the extracellular folate (61.02 ±1.3µg/L) and after deconjugation the total folate detected was 129.53± 1.2µg/L. The effect of refrigerated storage on the viability of *L. lactis*, pH, titratable acidity (TA) in terms of percentage lactic acid and finally on the stability of folate was determined. Only a slight variation in pH (4.74±0.02 to 4.415±0.007) and acidity (0.28±0.028 to 0.48±0.014%) was noted during folate fermentation (Fig 19). During storage, only less than a log unit reduction was noted in the viable count of the probiotic after 15 days and about 90% of the produced folate was retained in an active state.

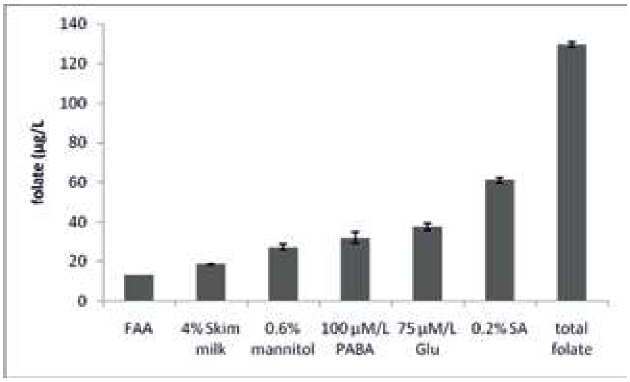


Fig. 19 Folate levels quantified at optimized condition [FAA – Folic acid assay medium, Glu – glutamate, SA – Sodium ascorbate, Total folate corresponds to extra and intracellular folate]

Control of spoilage fungi by protective lactic acid bacteria displaying probiotic properties: Lactic acid bacteria (LAB) belong to *Lactococcus*, *Lactobacillus*, *Enterococcus* and *Pediococcus* were isolated and the spectrum of antifungal activity was verified against *Fusarium oxysporum* (KACC 42109), *Aspergillus niger* (KACC 42589), *Fusarium moniliforme* (KACC 08141), *Penicillium chrysogenum* (NII 08137) and the yeast *Candida albicans* (MTCC 3017). Three isolates, identified as *Pediococcus pentosaceus* (TG2), *Lactobacillus casei* (DY2) and *Lactococcus* (BSN) were selected further and their antifungal compounds were identified by ESI-MS and HPLC analysis as a range of carboxylic acids along with some unidentified, higher molecular weight compounds (Fig 20). An attempt to check out the shelf life extension of wheat bread without fungal spoilage was performed by fermenting the dough with the *Lactococcus* isolate. Apart from growth in low pH and tolerance to bile salts, probiotic potential of these three isolates was further substantiated by *in vitro* screening methods that include transit tolerance to the conditions in the upper human gastrointestinal tract and bacterial adhesion capacity to human intestinal cell lines.

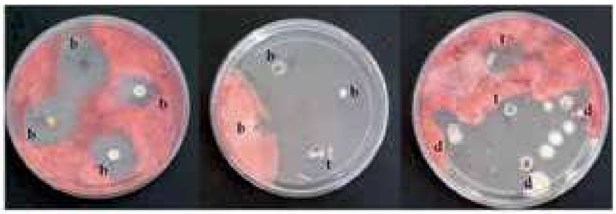


Fig. 20 Antifungal activity of preparatory TLC purified fractions against F. oxysporum. Activity of different fractions from BSN (b), TG2 (t) and DY2 (d)

Exopolysaccharides (EPS) for nutraceutical aplication from lactic acid bacteria: Lactic acid bacteria capable of producing exopolysaccharides were obtained. Shake flask production of EPS from two isolates, a *Lactobacillus plantarum* and a *Weissella cibaria* were optimized. EPS was extracted and purified for monosaccharide analysis, mol wt determination, thermo gravimetric analysis, FT IR analysis, etc. The maximum yield of purified EPS was 7.74 g/L from *Weissella* sp using sucrose as carbon source (Fig 21). EPS from *L. plantarum was* found to have more antioxidant activity and by using the 0.2% Weissella EPS, there was a considerable decrease in the syneresis in wheat starch.

Fig 21 Purified EPS from Weissella sp

Polyunsaturated fatty acids from fungal sources: This study aims to screen novel fungal strains from Western Ghats regions of Kerala for the production of poly unsaturated fatty acids (PUFA). Primary screening of isolated strains were done by nile red screening method and nineteen lipid producing cultures were isolated (Figs 22, 23). The fatty acid profiling of these positive strains were analyzed for gamma linolenic acid (GLA) and docosahexaenoic acid (DHA). Process optimization for enhanced production as well as down-stream processing is going on.

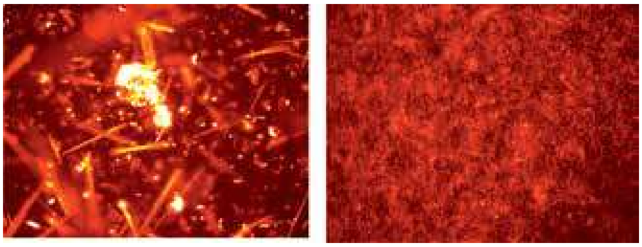


Fig 22 Primary screening of fugal cultures for lipid

Fig 23 Diversity of fungal cultures producing PUFA

Plant-Microbe Interaction

PGPR tools for improving crop productivity in stressed agricultural systems: This work aimed on the isolation of ACC deaminase producing PGPR from different stressed soils especially from coastal agricultural rhizosphere soils of Kerala and mangroves, which are saline acidic soils. Screened around 380 bacterial isolates from the above mentioned ecosystems and found that 65 isolates exhibited good growth on ½ Burk's minimal medium containing 0.5% sodium chloride and 3mM

ACC as the sole nitrogen source indicating the presence of ACC-deaminase activity. These isolates were quantified for ACC-deaminase activity. The results showed enzyme activity for only 32 isolates, ranging from 30-2μM α-ketobutyrate h^{-1} mg protein^{-1} in the culture filtrates. Furthermore these, thirty two ACC-deaminase producing bacteria were characterized based on 16S rRNA gene sequencing. Based on the 16S rRNA analysis, the isolates were found to belong to the following genera of *Burkholderia*, *Rhizobium*, *Acinetobacter*, *Mangrovibacter, Methylobacterium*, *Asticcacaulis*, *Arthrobacter*, *Roseateles, Novosphingobium*, *Sphingomonas*, *Microbacterium*, *Herbaspirillum*, *Pseudomonas*, *Labrys*, *Labrenzia* and *Marinobacter*. The first reports of taxa having ACC deaminase activity and plant association are *Asticcacaulis*, *Mangrovibacter*, *Labrys*, *Labrenzia* and *Marinobacter*. These results showed that the current screening methodology yielded good diversity of ACC deaminase producing strains. In addition, two potential novel strains were identified based on the polyphasic taxonomy (genotypic, phenotypic and chemotaxonomic) analysis, which were named as *Arthrobacter pokkali* sp.nov and a novel genera *Oryzibacter plantistimulans* gen. nov. sp. nov.

Novel pokkali rice associated *Sphingomonas* with plant beneficial activities isolated from pokkali rice fields: Nine novel *Sphingomonas* isolates were identified from the rhizosphere soil of pokkali rice plants. The sampling was done during the period of August-September (2013) from Chellanam and Kumbalangi pokkali rice fields of Ernakulam district, Kerala. All the *Sphingomonas* isolates showed plant beneficial functions such as auxin plant hormone production, growth in ACC amended medium. A polyphasic approach was carried out to characterize these nine yellow-pigmented strains associated with pokkali rhizosphere soils. All these nine strains were very closely related, with 99-100% 16s rRNA gene sequence similarity, suggesting that all these isolates represented a single species. 16s rRNA gene sequence analysis identified *Sphingomonas pituitosa* as the closest relative with 98.5% similarity to the novel identified isolates and *Sphingomonas trueperi, Sphingomonas azotifigens* as other closest relatives. Even though, these isolates showed 99-100% similarity among themselves, the phylogenetic tree devised from the 16s rRNA gene sequences structured to form two different tightly related clusters (Cluster I – 3aNB17 and L3B27; Cluster II – 3CLB12, 3CNB20, 3CNB30, 3CNB27, 3CNBAF), both closely relating with the four already identified Sphingomonas isolates (Fig 24). Based on this, further genomic differentiation was done for all the nine isolates with Rep PCR - $(GTG)_5$ primers. The banding patterns obtained from these fingerprinting primers showed a very good intra-species diversity among the very similar nine novel isolates. These intra-species diversity was reflected from three different banding patterns obtained which is clearly visible from the fingerprinting gel profile (Fig 25).

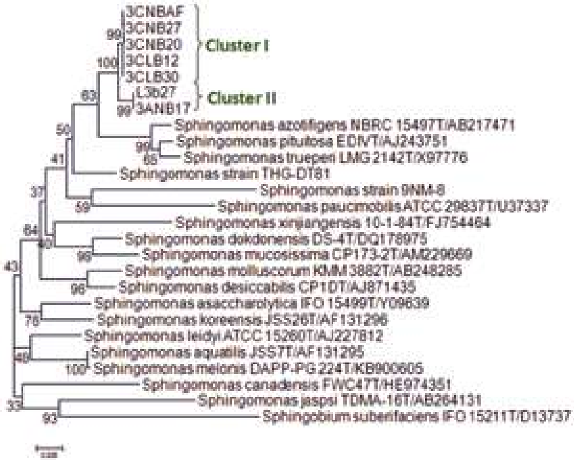
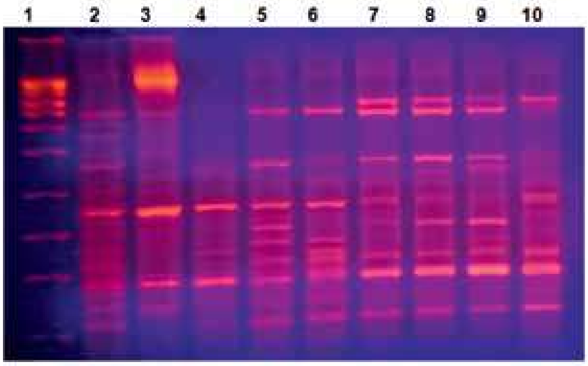


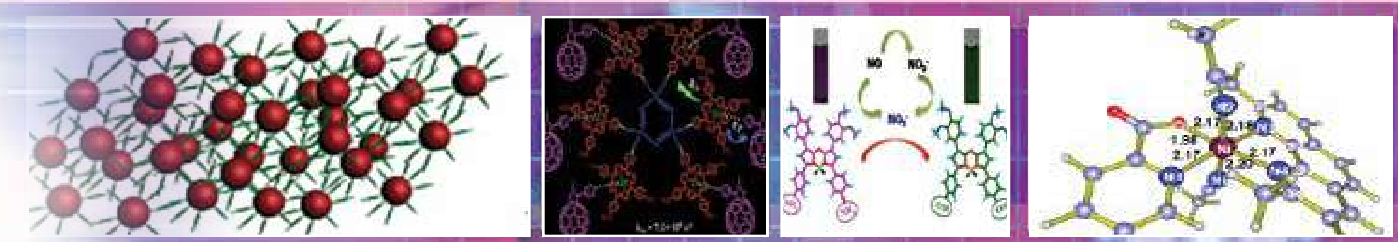
Fig 24 Neighbour-joining phylogenetic tree based on 16S rRNA gene sequences of Sphingomnasa strains and members of related generae. Numbers at nodes indicate bootstrap values (%). Bar, 0.05 substitutions per nucleotide position



1-1 kb DNA ladder, 2-L3B27, 3-LIA4, 4-LID23, 5-3aNB17, 6-3CLB12, 7-3CNB20, 8-3CNB30, 9-3CNB27, 10-3CNBAF

Fig 25 Genomic finger printing using rep-PCR showing intra-species diversity among Sphingomonas isolates

NII Culture Collection: The NII-Microbial culture Collection and Gene Bank (NIICC), a national facility established in 2008 is a modern facility situated at the National Institute for Interdisciplinary Science and Technology (NIIST), Trivandrum. It is an affiliate member of the World Federation for Culture Collections (WFCC) and is registered with the World Data Centre for Microorganisms (WDCM, registration number 961).The main objectives of this national facility are to act as a depository especially for marine actinomycetes, agricultural and industrial important microbes, novel taxa. Presently, the NIICC holds collectively over one thousand cultures, including Actinomycetes, Bacteria, Fungi and Yeasts. Generally, cultures are preserved by 20% glycerol stocks, either in ultra-deep freezer (-80°C) or in liquid nitrogen container (-196°C). NII also holds a dedicated in- lab DNA Sequencing facility; eight capillary DNA sequence machine (model 3500 ABI), mainly used in research programs relating to microbial diversity, ecology and taxonomy. The facility also provides DNA sequencing services for students and scientists of NIIST.



CHEMICAL SCIENCES AND TECHNOLOGY DIVISION

The main research focus of the Chemical Sciences and Technology Division (CSTD) during the year 2013-2014 has been on the following themes; (i) self-assembly of oligomers and polymers (ii) artificial photosynthesis and organic electronics, (iii) probes and sensors, (iv) organic catalysis and synthetic methodologies, (v) probes and sensitizers for biology (vi) bioactive natural products (vii) computational chemistry and (viii) x-ray crystallography. The Division has also ongoing research activities under the 12th Five Year Plan in interdisciplinary areas with an aim to capitalize on the existing knowledge base. Under these programs, functional advanced materials are being developed to meet the challenges in affordable health, energy, imaging and diagnostic applications and strategic sector.

During this period, the Division has been enriched by the joining of one new scientist Dr. Karunakaran Venugopal who has expertise in ultrafast spectroscopy. As in the earlier years, the members of the Division have been quite successful in publishing 74 papers in high impact journals with an average impact factor of 4.1. Given below are some of the research highlights of the Division during the year 2013-2014, along with brief abstracts of the results published in various international peer reviewed journals.

Highlights

- Synthesized various **π**-conjugated systems showing efficient supramolecular gelation through chain folding, **π–π** interactions, physical crosslinking, ultrasound initiated nucleation or organization at the air-water interface.
- Demonstrated the use of multi-chromophoric systems of donor-acceptor assemblies for artificial photosynthesis, dyes having panchromatic absorption for organic solar cell and bio based materials for ionic liquid crystal applications.
- Designed molecular probes/electrodes for selective sensing of analytes such as Zn^{2+}, Cd^{2+} Hg^{2+}, Al^{3+}cations, NO_2^- anions, methanol vapors, catechols, ascorbic acid and for two photon and SERS based bioimaging.
- Isolation of bioactive natural products for therapeutics, development of new synthetic methodologies and nanoparticle based MOFs for catalysis.
- Theoretical approaches for design of new molecular receptors, ligands, catalysts and to study hydrogen, halogen and dihydrogen bond formation.
- Developed neutral and metalloporphyrins for photodynamic therapy and biosensing applications
- Established state-of the-art instrumentation facilities like Single Crystal X-ray, and DNA Synthesizer.
- MOU signed with M/s SABIC, Kingdom of Saudi Arabia and Vinvish, Trivandrum for industrial collaboration.

रसायन विज्ञान तथा प्रौद्योगिकी विभाग

वर्ष 2013-2014 के दौरान रसायन विज्ञान तथा प्रौद्योगिकी प्रभाग (सीएसटीडी) के मुख्य अनुसंधान ध्यान निम्न थीम पर केंद्रित किया गया है; (I) स्वल्पलक और पॉलिमर के स्वत: समुच्चयन (ii) कृत्रिम प्रकाश संश्लेषण और कार्बनिक इलेक्ट्रॉनिक्स, (iii) प्रोब्स तथा सेंसर, (iv) जैविक कटैलिसीस और सिंथेटिक तरीके (v) जीव विज्ञान के लिए प्रोब्स और सेंसिटर्स (vi) बायोएक्टिव प्राकृतिक उत्पादों (vii) कम्प्यूटेशनल रसायन शास्त्र और (viii) एक्स-रे क्रिस्टलोग्राफी। प्रभाग को मौजूदा ज्ञान के आधार पर फायदा उठाने के उद्देश्य के साथ 12 वीं पंचवर्षीय योजना के तहत अंतर्विषयी क्षेत्रों में अनुसंधान गतिविधियॉं हैं। इन कार्यक्रमों के तहत सस्ती स्वास्थ्य, ऊर्जा, इमेजिंग और नैदानिक अनुप्रयोगों और सामरिक क्षेत्र की चुनौतियों को पूरा करने के लिए कार्यात्मक उन्नत सामग्री का विकास किया जा रहा है।

इस अवधि के दौरान अल्ट्रातेज स्पेक्ट्रोस्कोपी में विशेषज्ञता प्राप्त नया वैज्ञानिक डॉ. करुणाकरन वेणुगोपाल के शामिल होने से प्रभाग समृद्ध हो गया है। पहले के वर्षों जैसे प्रभाग के सदस्य 4.1 औसत प्रभाव कारक के साथ उच्च इंपैक्ट पत्रिकाओं में 74 शोध पत्रों के प्रकाशन में काफी सफल रहे हैं। विभिन्न अंतरराष्ट्रीय सहकर्मी समीक्षित पत्रिकाओं में प्रकाशित परिणामों के संक्षिप्त सार के साथ-साथ वर्ष 2013-2014 के दौरान प्रभाग के अनुसंधान की मुख्य विशेषताओं में से कुछ नीचे प्रस्तुत किये जाते हैं।

मुख्य विशेषताएं

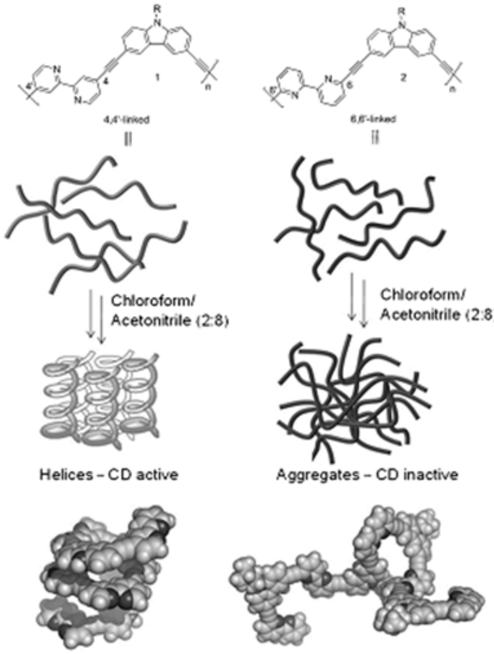
- हवा-पानी इंटरफेस में चेन फोल्डिंग, $\pi-\pi$ अन्योन्यक्रिया, भौतिक क्रॉसलिंकिंग, अल्ट्रासाउंड समारंभित न्यूक्लिएशन या व्यवस्था के माध्यम से कुशल सुप्राआणविक जलेशन दिखानेवाले विभिन्न π संयुग्मित प्रणालियों को संश्लेषित किया गया।
- कृत्रिम प्रकाश संश्लेषण के लिए दाता- स्वीकर्ता समुच्चयों की बहु वर्णमूलक प्रणाली, कार्बनिक सौर सेल के लिए पैनक्रोमैटिक अवशोषण युक्त रंजकों तथा आयनिक लिक्विड क्रिस्टल अनुप्रयोगों के लिए जैव आधारित सामग्री के उपयोगों का प्रदर्शन किया गया।
- Zn2+, Cd2+, Hg2+, Al3+ धनायन, NO2 ऋणायन, मेथनॉल वाष्प, कैटिकोल, एस्कॉर्बिक एसिड जैसे ऐनालाइट के चयनात्मक संवेदन के लिए तथा दो फोटोन और एसईआरएस आधारित जैवइमेजिंग के लिए आणविक प्रोब्स/ इलेक्ट्रोड्स का डिजाइन किया गया ।
- चिकित्सा के लिए बायोएक्टिव प्राकृतिक उत्पादों का अलगाव और कटैलिसीस के लिए नये सिंथेटिक तरीके और नैनो कण आधारित एमओएफ का विकास।
- नए आणविक रिसेप्टर्स, लिगन्ड्स, उत्प्रेरक के डिजाइन के लिए सैद्धांतिक दृष्टिकोण और हाइड्रोजन, हलोजन और डाइहाइड्रोजन बांड गठन का अध्ययन।
- प्रकाशगतिशील चिकित्सा और जैव-संवेदन अनुप्रयोगों के लिए न्यूट्रल और मेटलोपॉर्फिरिन विकसित किया गया ।
- सिंगल क्रिस्टल एक्स-रे, डीएनए सिंथेसाइज़र जैसे अत्याधुनिक इंस्ट्रूमेंटेशन सुविधाएं स्थापित की गयीं ।
- औद्योगिक सहयोग के लिए मेसेर्स साबिक, किंगडम ऑफ सऊदी अरब और विन्विश, तिरुवनंतपुरम के साथ समझौता ज्ञापन पर हस्ताक्षर किए।

SELF-ASSEMBLY OF OLIGOMERS & POLYMERS

Self-assembly of π-conjugated molecules has evolved as a powerful strategy to produce new functional materials from individual components. In Nature, many of the highly complex yet efficient devices are formed *via* supramolecular molecular organization of many components. Attempts to mimic nature and produce artificial devices lead to the birth of the field "supramolecular chemistry". Optimizing different intermolecular interactions is essential to have precise control over molecular organization. It is a major challenge and the modulation of this enables to produce materials with varying properties. Low molecular-weight components are gaining much attention in recent times due to their ease of synthesis, purification, substitution with suitable functional groups and through optimizing conditions it is possible to generate novel functional nanomaterials. In this context, the division is actively involved in the design and synthesis of low molecular weight oligomers and polymers as well as optimization of their intermolecular interactions during self-assembly to generate a range of organic nanomaterials including nanowires, nanorods, gels and liquid crystals.

Chain folding controlled by an isomeric repeat unit: Helix formation versus random aggregation in acetylene-bridged carbazole–bipyridine co-oligomers.

An unprecedented, positional effect of the isomeric repeat unit on chain folding in donor–acceptor linked oligomers, which contain alternating bipyridine and carbazole moieties that are connected through an acetylinic linkage, has been observed. 4,4′-Linked oligomer **1** adopts an intrachain helical conformation (CD-active) in $CHCl_3$/MeCN (20:80 v/v), whereas the oligomer **2**, which contains an isomeric 6,6′-linkage, forms interchain randomly coiled aggregates (CD-inactive). The substitution position plays a significant role in controlling the variations in electronic effects and dipole moments around the bipyridyl moiety, which are responsible for this observed phenomenon. Two model compounds of oligomers 1 and 2 (3 and 4, respectively) were prepared and their properties were compared. A systematic investigation of the photophysical and CD properties of these structures, as well as theoretical studies, support the conclusions. (A. Ajayaghosh *et al.Chemistry – An Asian Journal*, **2013**, *8*, 1579–86).



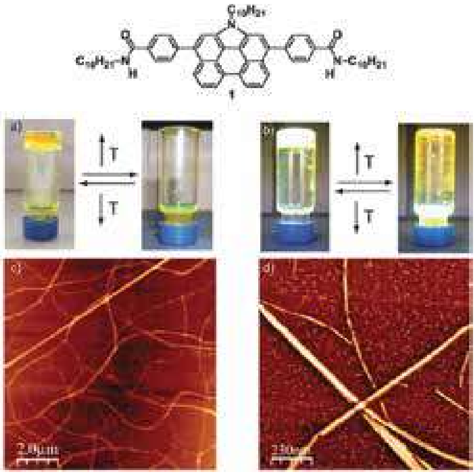
Ultrasound stimulated nucleation and growth of a dye assembly into extended gel nanostructures.

A squaraine dye functionalized with a bulky trialkoxy phenyl moiety through a flexible diamide linkage (GA-SQ) capable of undergoing self-assembly has been shown to form two types of nanostructures, rings and ill-defined short fibers, upon rapid cooling of a hot solution to 0° C. The application of ultrasound modifies the conditions for the super saturation mediated nucleation, generating only one kind of nuclei and prompting the formation of crystalline fibrous structures, inducing gelation of solvent molecules.

The unique self-assembling behaviour of GA-SQ under ultrasound stimulus has been investigated using absorption, emission, FT-IR, XRD, SEM, AFM and TEM techniques. These studies revealed a nucleation growth mechanism of the self-assembled material, an aspect rarely scrutinized in the area of sonication-induced gelation. Furthermore, in order to probe the effects of nanoscale substrates on the sonication-induced self-assembly, a minuscule amount of single-walled carbon nanotubes was added, which leads to acceleration of the self-assembly through a heterogeneous nucleation process that ultimately affords a supramolecular gel with nanotape-like morphology. This study demonstrates that self-assembly of functional dyes can be judiciously manipulated by an external stimulus and can be further controlled by the addition of carbon nanotubes (A. Ajayaghosh *et al. Chemistry - A European Journal*, **2013**, *19*, 12991–13001).

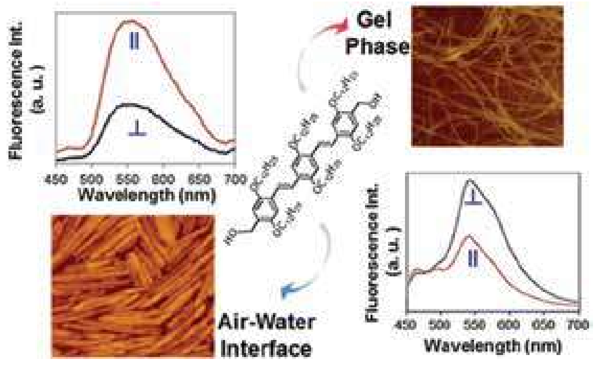
Luminescent and conductive supramolecular polymers obtained from an N-annulated perylenedicarboxamide.

The synthesis, cooperative supramolecular polymerization, photophysical and semiconducting properties of an N-annulated perylenedicarboxamide (NPDC) (compound 1) are reported. N-annulated perylene derivatives are π-conjugated platforms very useful to attain processable materials with highly anisotropic electronic properties. The columnar aggregates formed upon the self-assembly of 1 reported behave as a multifunctional material exhibiting highly luminescent features and also promising values of electric conductivity that makes this compound an appealing candidate with potential applicability in the research field of soft electronics. (A. Ajayaghosh *et al. Chem. Commun*., **2013**, *49*, 9278-80).



Aligned 1-D nanorods of a π-gelator exhibit molecular orientation and excitation energy transport different from entangled fiber networks.

Linear π-gelators self-assemble into entangled fibers in which the molecules are arranged perpendicular to the fiber long axis. However, orientation of gelator molecules in a direction parallel to the long axes of the one-dimensional (1-D) structures remains challenging. Recently, it was demonstrated that, at the air–water interface, an oligo (p-phenylenevinylene)-derived π-gelator forms aligned nanorods of 340 ±120 nm length and 34±5 nm width, in which the gelator molecules are reoriented parallel to the long axis of the rods. The orientation change of the molecules resulted in distinct excited-state properties upon local photoexcitation, as evidenced by near-field scanning optical microscopy. A detailed understanding of the mechanism by which excitation energy migrates through these 1-D molecular assemblies might help in the design of supramolecular structures with improved charge-transport properties (A. Ajayaghosh *et al. J. Am. Chem. Soc.* dx.doi.org/10.1021/ja504014k).



Supergelation *via* purely aromatic π–π driven self-assembly of pseudodiscotic oxadiazole mesogens.

A series of highly luminescent oxadiazole-based stilbene molecules (OXD4, OXD8, OXD10, and OXD12) exhibiting interesting enantiotropic liquid crystalline and gelation properties have been synthesized and characterized. The molecules possessing longer alkyl substituents, OXD10 and OXD12, possess a pseudo disc shape and are capable of behaving as super gelators in nonpolar solvents, forming self-standing gels with very high thermal and mechanical stability. Notably the self-assembly of these molecules, which do not possess any hydrogen-bonding motifs normally observed in most reported super gelators, is driven purely by π-stacking interactions of the constituent molecules. The d-spacing ratios estimated from XRD analysis of OXD derivatives possessing longer alkyl chains showed that the molecules are arranged in a columnar fashion in the mesogens and the self-assembled nanofibers formed in the gelation process. (Suresh Das *et al.*, *J. Am. Chem. Soc.* **2014**, *136*, 5416–23).

Robust polymeric hydrogel using rod-like amidodiol as cross linker: Studies on adsorption kinetics and mechanism using dyes as adsorbate.

The preparation of robust polyacrylic acid hydrogel using rod-like amidodiol as physical cross linker is being reported. PAG hydrogels were characterised for its chemical structure, rheology, swelling, diffusion and adsorption properties. Kinetics and mechanism of adsorption was investigated by UV-visible spectroscopy using dyes such as rhodamine 6G and methylene blue as adsorbate. Results suggested pseudo second order kinetics of multilayer adsorption and hydrogel could retain its shape even after swelling. Effect of amidodiol on the adsorption of dyes was investigated. Extent of interaction between adsorbate-adsorbate and adsorbent-adsorbate was studied using Gile's model. The generated results may provide a low cost simple technology for developing robust polymeric hydrogel adsorbent. The adsorption characteristics results can be exploited for setting up pilot plant adsorbent for the removal of such organic toxic materials. Finally, its application for the removal of dyes from waste water collected from textile and paper industries was demonstrated. (Sudha and Prasada Rao *et al.*, *J. Appl. Polym. Sci.*, **2014**, DOI: 10.1002/app.40908).

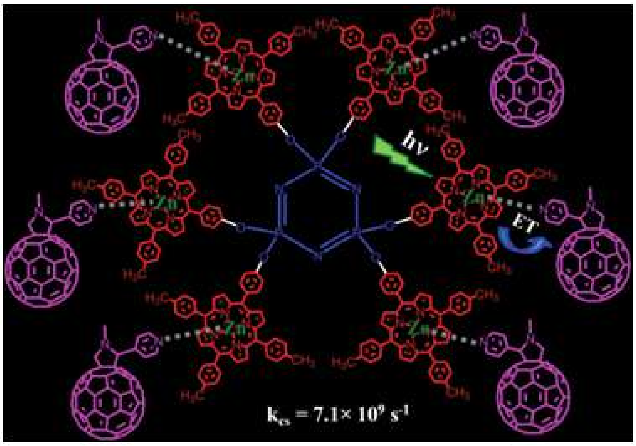
ARTIFICIAL PHOTOSYNTHESIS AND ORGANIC ELECTRONICS

Among the grand challenges facing the creation of a sustainable society, the development of technologies that use renewable sources of energy is one of the major challenges. Artificial photosynthesis is the "Holy Grail" for a sustainable energy generation which involves routes using solar energy to produce H_2 and fuels, in particular those based on the conversion of CO_2 to safe and easily storable liquid fuels. Considerable research effort has been devoted for developing efficient methodologies for solar water splitting. In this context, the efforts will be focused in developing simpler, less costly, and more robust molecular devices that can efficiently produce H_2 from H_2O using sunlight in the absence of sacrificial agents. This will be the first step towards building up a solar fuel hub competitive to international standards for artificial photosynthesis.

The research on organic electronics is maturing into commercial realities in the form of displays, solar cell modules and memories. There are still some performance gaps in terms of efficiency, device lifetime, stability of constituent materials and large area fabrication. These challenges can only be addressed by integrating the capabilities on synthesis of functional molecules and device fabrication. Currently the institute is in the process of setting up a full-fledged facility for fabrication and characterization of organic electronic devices. White light emitting diodes (WOLEDs), red, green and blue emitting diodes, dye sensitized solar cells (dssc), organic photovoltaic cells and organic thin film transistors will be developed at component level and applying them onto large panels will be a long term goal.

Cyclotriphosphazene appended porphyrins and fulleropyrrolidine complexes as supramolecular multiple photosynthetic reaction centers: Steady and excited states photophysical investigation.

New multiple photosynthetic reaction centers were constructed from cyclophosphazene decorated multiporphyrin chromophores and a fulleropyrrolidine having pyridine ligand (FPY). The excited state electron transfer in the self-assembled donor-acceptor assembly was investigated by using steady state absorption and emission, time-resolved emission spectroscopy and nanosecond laser flash photolysis. The effect of metal (Zn^{2+}) coordination to porphyrin units in the multiporphyrin arrays on cyclophosphazine scaffold (P3N3Zn) was studied by comparing with metal free porphyrin assembly on cyclophosphazene scaffold (P3N3). In P3N3Zn, the decrease of absorption and fluorescence intensity and lowering of amplitude of longer fluorescence lifetime with increase of FPY concentration reflect the formation of ground state complex with association constant of ~14,910 M^{-1}. When compared to metal free complex P3N3, the metal coordinated derivative P3N3Zn exhibited shortening of the singlet and triplet state lifetimes and lowering of singlet and triplet quantum yields. The cause of decrease of triplet quantum yields by insertion of zinc metal is discussed along with the possible non-planarity of the porphyrin ring. From the fluorescence lifetime measurements for the P3N3Zn/FPY mixture, it is proposed that self-assembly of donor-acceptor complex leads to charge separated species with rate constant of 7.1×10^9 s^{-1}. The decrease of triplet state intensity and lifetime of the P3N3Zn in P3N3Zn/FPY complex from the nanosecond transient absorption studies support the occurrence of intermolecular electron transfer in the triplet state. (V. Karunakaran *et al.*, *Phys. Chem. Chem. Phys.*, **2014**, *16*, 10149-56).

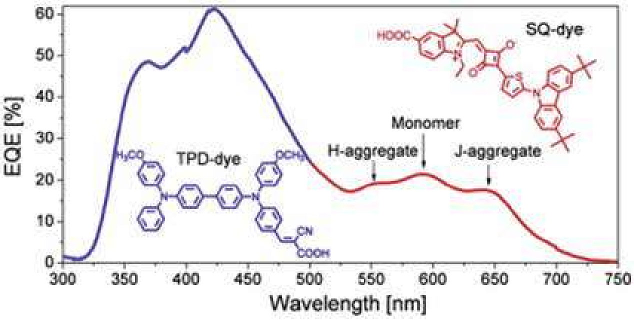


A supramolecular photosynthetic model made of a multiporphyrinic array constructed around a C60 core and a C60–imidazole derivative.

Mimicking natural photosynthetic systems is a challenge as this would eventually lead to technologies and products for effective tapping and conversion of solar energy into other useful forms. It has been identified that light absorption and photo-induced electron transfer are the two key processes occurring in natural photosynthetic systems. The best modalities could be to improve the efficiency of light harvesting and increase the stability of the charge separated state. Porphyrin-fullerene conjugate pairs are one of the well exploited systems in this context and are proposed to be promising materials for photovoltaic applications. The primary process of energy and electron transfer in a supramolecular nanoarchitecture was investigated. The present photosynthetic model system consists of a multi-porphyrin array host constructed around C60 core and an imidazole appended fullerene guest system. The detailed photophysical investigations revealed that (i) in nonpolar environments like toluene, the supramolecular ensemble exhibits a charge transfer emission centered around 930 nm, suggesting the occurrence of intramolecular face-to-face interactions of guest fullerene with neighbouring metalloporphyrin moieties and (ii) in polar solvents like benzonitrile, a very stable and long-lived charge-separated state (as long as 0.3 ms) occured. One of the interesting aspects about the present system is that owing to the large number of porphyrin subunits, the host system serves as an antenna capable of harvesting more light *via* absorption prior to the electron-transfer event. In addition to this the possibility of exciton migration among the different Zn(II)porphyrins in the host system stabilizes the charge transfer state and makes the present artificial supramolecular nanoarchitecture more close to a natural photosynthetic systems (K. Yoosaf *et al.*, *Chem. Eur. J.*, **2014**, *20*, 223-31).

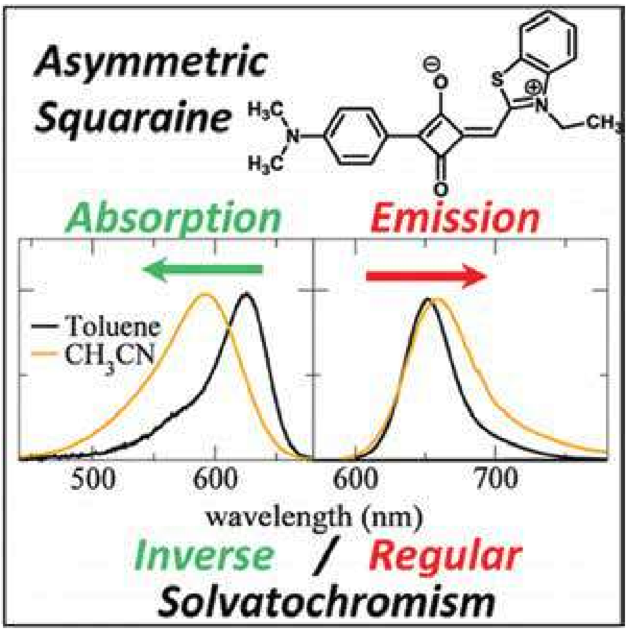
Complementary co-sensitization of an aggregating squaraine dye in solid-state dye-sensitized solar cells.

In this study, the co-sensitization approach to reach panchromatic light absorption in solid-state dye-sensitized solar cells (SDSCs) was used. Two complementary absorbing organic sensitizers were combined, *viz.* a blue-absorbing triphenyldiamine dye (TPD-dye) and a red-absorbing squaraine dye (SQ-dye). The aggregation behaviour of SQ-dye was entirely investigated by steady-state UV/Vis spectroscopy. The formation of H- and J-aggregates was observed in both solution and the chemisorbed state on mesoporous TiO_2. On applying SQ-dye and TPD-dye in single-dye and co-sensitized SDSCs, the external quantum efficiency studies clearly indicated that TPD-dye, as well as the monomer species and the H- and J- aggregates of SQ-dye contribute to the current generation. The performance of the co-sensitized SDSCs regarding the solvent used for the chemisorption, the chemisorption time, and the thickness of the mesoporous TiO_2 layer were optimized. The best result was obtained for a co-sensitized SDSC after chemisorption for 3 h from a tert-butanol/acetonitrile 1:1 solution using a 1.4μm thick mesoporous TiO_2 layer (Suresh Das *et al.*, *Dyes and Pigments*, **2013**, *99*, 1101-06).



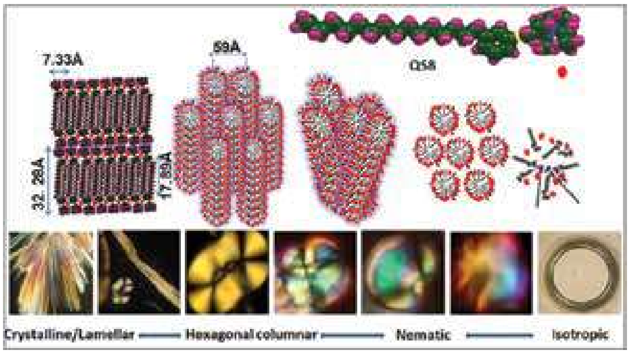
Asymmetric squaraine dyes: Spectroscopic and theoretical investigation.

A joint experimental and theoretical study of two asymmetric squaraine dyes and their parent symmetric dyes was undertaken. The definition of reliable essential-state models for asymmetric squaraines sheds light on the intriguing spectroscopic behavior of this class of molecules, showing inverted and normal solvatochromism in absorption and emission, respectively. This behavior is related to charge redistribution in the excited state, with important implications for optimal design of asymmetric dyes for solar cell applications (Suresh Das *et al*., *J. Phys. Chem. B* **2013**, *117, 8536*–46).



Bio-based Ionic liquid crystalline quaternary ammonium salts: Properties and applications.

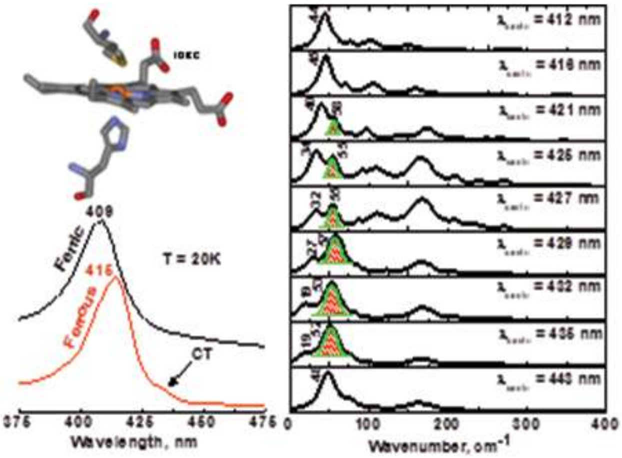
In the present work, the preparation, properties and applications of novel ionic liquid crystalline quaternary ammonium salts of 3-pentadecylphenol, a bio-based low cost material derived from cashew nut shell liquid, are described. Amphotropic liquid crystalline phase formation in QSs were characterised using a combination of techniques such as DSC, PLM, XRD, SEM, and rheology which revealed the formation of one-, two- and three dimensionally ordered mesophases in different length scales. Based on the results, a plausible mechanism for the formation of specific modes of packing in various mesophases was proposed. Observation of anisotropic ionic conductivity and electrochemical stability suggests its applications as a solid electrolyte. Furthermore, its application as a soft template for the preparation of nano structured semiconducting materials such as zinc oxide was demonstrated, which may find diverse applications. (T. P. Rao and Sudha *et al***.**, *ACS Applied Materials and Interfaces,* **2014**, 6 *(6),* 4126-33).



Investigations of the low frequency modes of ferric cytochrome using vibrational coherence spectroscopy.

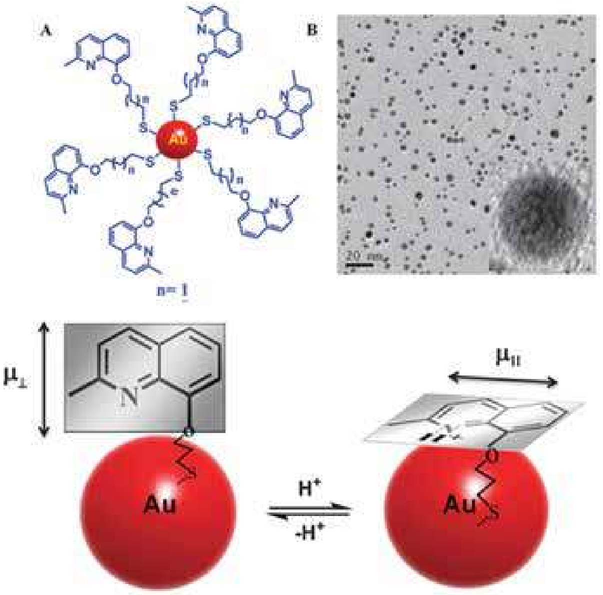
Femtosecond vibrational coherence spectroscopy is used to investigate the low frequency vibrational dynamics of the electron transfer heme protein, cytochrome c (cyt c). The vibrational coherence spectra of ferric cyt c have been measured as a function of excitation wavelength within the Soret band. Vibrational coherence spectra obtained with excitation between 412-421 nm display a strong mode at ~ 44 cm^{-1} that has been assigned to have a significant contribution from heme ruffling motion in the electronic ground state. This assignment is based partially on the presence of a large heme ruffling distortion in the normal coordinate structural decomposition (NSD) analysis of the x-ray crystal structures. When the excitation wavelength was moved into the ~421-435 nm region, the transient absorption increased along with the relative intensity of two modes near ~55 and 30 cm^{-1}. The intensity of the mode near

44 cm^{-1} appears to minimize in this region and then recover (but with an opposite phase compared to the blue excitation) when the laser was tuned to 443 nm. These observations were consistent with the superposition of both ground and excited state coherence in the 421-435 nm region due to the excitation of a weak porphyrin-to-iron charge transfer (CT) state, which has a lifetime long enough to observe vibrational coherence. The mode near 55 cm^{-1} is suggested to arise from ruffling in a transient CT state that has a less ruffled heme due to its iron d^6 configuration (V. Karunakaran *et al.*, *J. Phys. Chem. B*, **2014**, *118*, DOI: 10.1021/jp501298c).



Metal-induced fluorescence lifetime enhancement of quinaldine chromophore on gold nanoparticle surface.

The decay engineering of chromophores on well-defined metal surfaces and nanoparticles has been the subject of intense research in the current decade and has found a wide range of applications in diverse areas of photonics, optoelectronics, material science, biology and catalysis. In chromophore functionalized nanomaterials, the nanoparticles can activate or deactivate the radiative and non-radiative processes taking place in the chromophore, leading to fluorescence enhancement or quenching, lifetime enhancement or shortening. The excited chromophores in the vicinity of the metal surface are closely involved in most of the dynamic processes and therefore their nature and mode of radiative and non-radiative relaxation are subjects of strong interest. Several reports have been presented in literature on the fluorescence lifetime shortening of chromophores placed in close proximity to the nanoparticles whereas, lifetime enhancement of chromophores has seldom been reported, especially in solution phase interactions. The phenomenon of nanoparticle-induced fluorescence lifetime enhancement of a protonated 8-propoxyquinaldine thiol (PQT) derivative covalently attached to the surface of gold (Au) nanoparticles was studied. A dramatic decrease in the fluorescence decay rate was also observed for protonated PQT on the Au nanoparticle surface. These combined effects can be attributed to the parallel orientation of the dipole moment of the chromophore with respect to the metal surface. The parallel orientation results in the coupling of the dipole moment of the probe with its dipole image on the metal surface and thus decreases the effective dipole strength of the fluorophore (Luxmi Varma *et al.*, *New Journal of Chemistry*, **2013**, *37*, 2426-32).

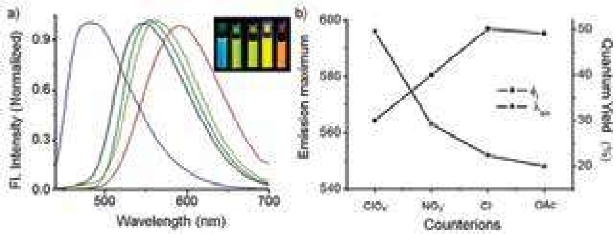


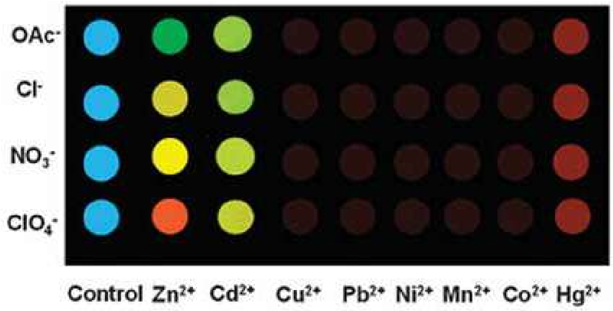
PROBES AND SENSORS

Molecular probes that can selectively transform chemical information into a detectable signal output find use as essential tools in many research areas. A number of proteins, other molecules and ions play essential roles in regulating cellular functions and other activities. Understanding the chemistry of these intracellular molecules and ions, directly inside the cells is one of the biggest challenges of the post genome era. Direct visualisation of cellular molecules, provides us information clarifying their biological significance without homogenizing the cells or dissecting the living organism. Results related to the design of probes and sensors for various applications are described below.

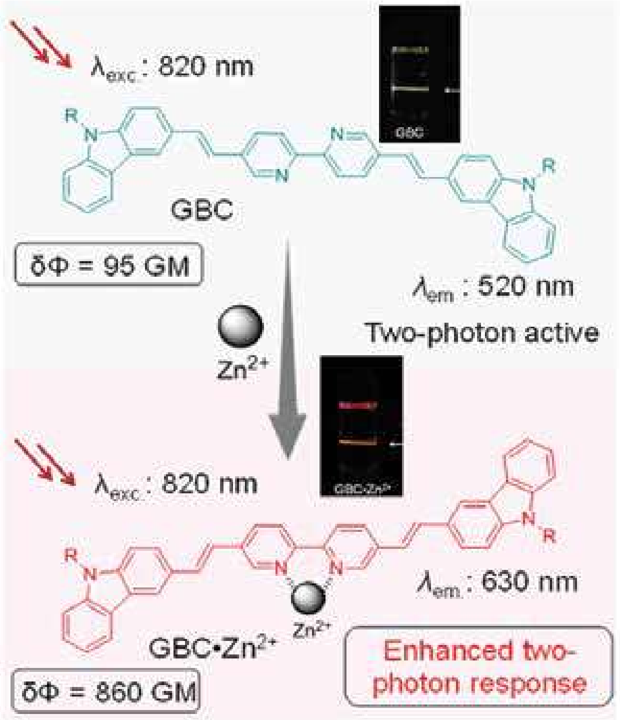
A fluorescent molecular probe for the identification of zinc and cadmium salts by excited state charge transfer modulation.

A D–π–A–π–D type fluorophore with a bipyridine moiety as the receptor site was synthesized, since 2,2′-bipyridine is a versatile ligand in coordination chemistry. Particularly, bipyridine derivatives bind to different transition metal ions and show changes in optical properties. Bipyridine conjugated to heterocyclic moieties shows specific fluorescence response to zinc and cadmium ions whereas other transition metal ions quench the emission. This property has been successfully utilized for the ratiometric sensing of zinc ions under various conditions. It is known that bipyridine based fluorophores show intramolecular charge transfer properties which upon binding of cations will further enhance, allowing considerable modification of the emission properties (A. Ajayaghosh *et al*. *Chem. Commun.*, **2014**, *50*, 6020-22).





A ratiometric fluorescent molecular probe with enhanced two-photon response upon zn^{2+} binding for in *vitro* and *in vivo* bioimaging.



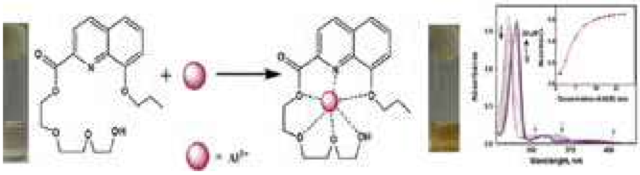
A bipyridine centered donor-acceptor- donor (D-π-A-π- D) type ratiometric fluorescent molecular probe exhibited an unprecedented enhancement in two-photon absorption (2PA) cross section upon Zn^{2+} binding. Moreover, owing to the excited state charge-transfer of the fluorophore π-backbone, a significant enhancement in the two-photon excited (λ_{exc} = 820 nm) fluorescence intensity was observed upon Zn^{2+} binding, resulting in a 13-fold enhancement in the 2PA cross section and 9-fold enhancement in fluorescence brightness at 620 nm when compared to the cation free fluorophore. The high 2PA cross section of 1433 GM and 2P action cross section (860 GM) with excellent 2P excited fluorescence variation at 620 and 517 nm upon Zn^{2+} binding facilitated a ratiometric monitoring of free zinc ions in cells. The low cytotoxicity and good photostability of the fluorophore allowed two-photon Zn^{2+} imaging of HeLa cells. In addition, the *in vivo* two-photon imaging of Zn^{2+} ions in hepatocytes of live mice illustrated the viability of the probe in tissue imaging and monitoring of free zinc ions in live cells (A. Ajayaghosh *et al.*, *Chem. Sci.***2014** **DOI:** 10.1039/C4SC00736K).

Electrochemical synthesis of gold atomic cluster-chitosan nanocomposite film modified gold electrode for ultra-trace determination of mercury.

In the present study chitosan stabilized gold atomic cluster-chitosan nanocomposite was synthesised by a simple electrochemical technique based on the anodic dissolution of gold electrode in presence of a cationic surfactant, cetyl trimethyl ammonium bromide (CTAB), and a biopolymer chitosan on gold electrode. The gold clusters formed were characterized by DLS, TEM, MALDI-TOF- MS, XPS, Fluorescence and cyclic voltammetry. The developed gold atomic cluster-chitosan (AuAC-Chit) nanocomposite modified gold electrode was highly sensitive and selective for the electrochemical detection of Hg (II) ions. It offers wider calibration range of 10^{-14}-10^{-7} M with a limit of detection (LOD) of 0.8×10^{-14} M and limit of quantification (LOQ) of 6.6×10^{-14} M, much below the guideline value of 1×10^{-8} M stipulated by United States Environmental Protection Agency (USEPA), accompanied with a good precision of 1.06% for 10^{-13} M of Hg (II). The designed sensor is selective to Hg (II) ions in the presence of other coexisting species *(Prasada Rao et al., Phys. Chem. Chem. Phys.,* ***2014,****16 8529-35).*

Colorimetric detection of Al(III) ions based on triethylene glycol appended 8-propyloxy quinoline ester.

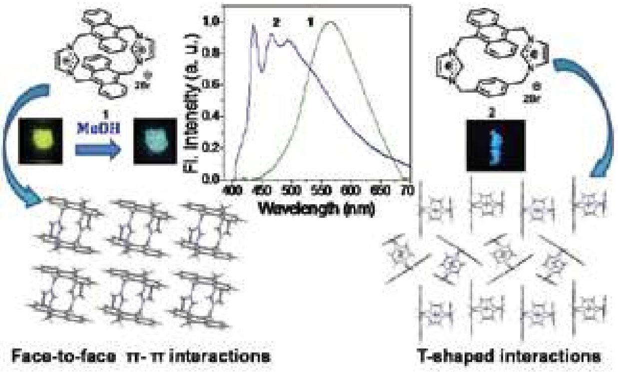
Design and synthesis of small organic molecule based chromophores as sensors/receptors for the sensing of environmentally hazardous metal ions have been an area of research of contemporary importance due to its wide applications in ion transport, chemosensing and imaging, metalloenzyme mimics, catalysis, nuclear waste treatment etc. Chemosensors are especially attractive if they can detect an analyte selectively by naked eye by bringing about a bathochromic or hypsochromic shift of absorption bands or a colour change upon analyte binding. In this context, a triethylene glycol modified quinoline ester (PQTEG) was synthesised which acts as a colorimetric sensor for Al^{3+} ions with a detection limit of 8×10-7 M in acetonitrile/water (95:5) solvent system. The detection limit was lower than that of the permissible level (7.4 μM) for drinking water as defined by WHO. (*Tetrahedron Letters*, **2013**, *54*, 4232-36).



Interplay of monomer, intra- and intermolecular excimer fluorescence in cyclophanes and selective recognition of methanol vapours.

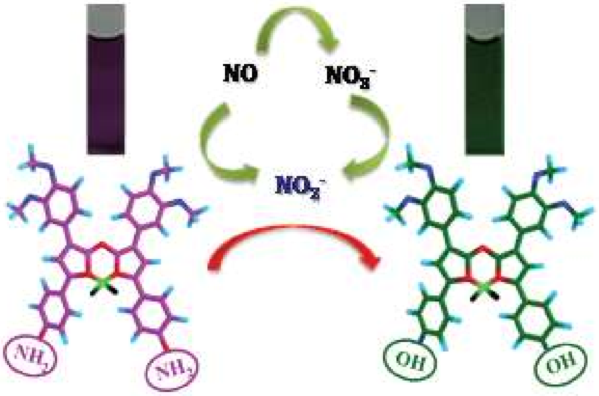
With an objective to develop simple organic systems for optoelectronic applications, the photophysical properties of water soluble cyclophane derivatives **1**, **2** and model compound **3** in solution and solid state were investigated. All these systems exhibited characteristic anthracene absorption and emission behaviour in methanol while the symmetrical cyclophane **1** exhibited an intramolecular excimer emission in the aqueous medium. Interestingly, in the solid state it showed a high red-shifted emission maximum when compared to those in the solution. The unsymmetrical cyclophane

2, on the other hand, exhibited monomer emission in both organic and aqueous media, while a dual emission (monomer and excimer) was observed in the solid state. Insights into these unique fluorescence properties were gained by studying the molecular packing of the cyclophanes through single crystal X-ray structure analysis. The symmetrical cyclophane **1** exhibited a unidirectional *sandwich*-type packing pattern thereby resulting in strong face-to-face π-π stacking interactions between the anthracene chromophores, whereas **2** exhibited both Herringbone and *sandwich*-type pattern, wherein the interacting anthracene moieties were arranged in an intermolecular T-shaped fashion. By virtue of different molecular packing, the cyclophane **1** showed visible fluorescence colour change from yellow to blue when exposed to methanol vapours as compared to ethanol, acetonitrile, hexane and water vapours. Uniquely, this system can detect as low as 1% of methanol in ethanol solution thereby demonstrating its usefulness as an optical probe for the detection of methanol vapours (D. Ramaiah *et al*., *RSC Adv.*, **2013**, *3*, 5624–30).



Efficient reaction based colorimetric probe for sensitive detection, quantification, and on-site analysis of nitrite ions in natural water resources.

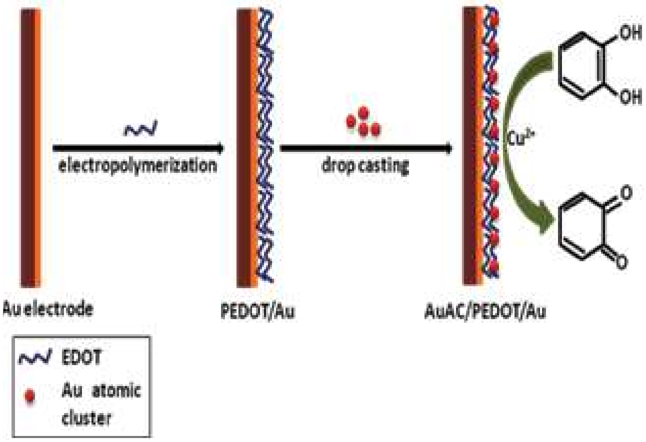
Nitrite (NO_2^-) ions are considered to be type A inorganic contaminants in drinking water and have proven to be of a great threat to human health in many ways. Therefore, a simple and sensitive test for the detection of nitrite ions could greatly aid individuals in evaluating the quality of their drinking water source. In this context, a novel aza-BODIPY probe for the sensitive colorimetric detection of the nitrite ions in the aqueous medium by a simple and direct method was developed. This probe selectively recognizes the nitrite ions through a distinct visual colour change from bright blue to intense green with a sensitivity of 20 ppb. One of the remarkable aspects of the present assay is the use of a stable single molecule, which is highly selective and sensitive, and uniquely, this phenomenon can be exploited in the fabrication of a simple solid state dipstick device that can be used for the visual detection of nitrite ions in the presence of other competing ions in distilled as well as natural water resources. Further, this probe can be used for the sensitive detection of the nitrate ions when coupled to a reduction step. The results demonstrate that this probe not only can be used for the on-site analysis and quantification but also can replace the conventional spot test carried out for the nitrite ions in the laboratory practical experiments (D. Ramaiah *et al*., *Anal. Chem*., **2013**, *85*, 10008–12).



Ultrasensitive voltammetric determination of catechol at gold atomic cluster/poly(3,4–ethylenedioxythiophene) nanocomposite electrode.

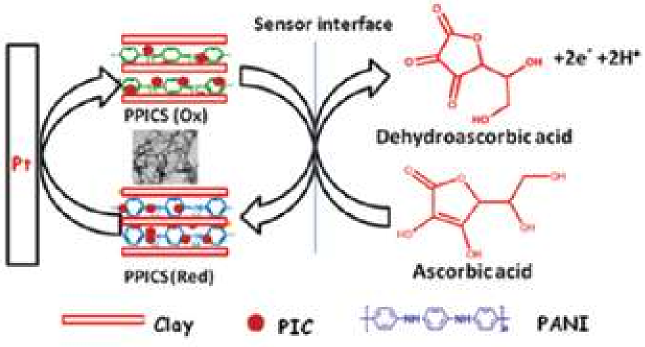
A novel gold atomic cluster- poly(3,4- ethylenedioxythiophene) (AuAC/PEDOT/Au) nanocomposite modified gold electrode has been designed for the trace level sensing of catechol. The addition of copper(II) enhanced the electro-catalytic oxidation of catechol *via* the formation of copper(I). The electrochemically synthesized

PEDOT/Au and the AuAC/PEDOT/Au hybrid films were characterized by electrochemical and morphological methods. Under optimal conditions the nanocomposite modified electrode offers a wider calibration range of 1×10^{-4} to 10 μM with a lowest detection limit of 6.3 pM for catechol. Moreover, the developed electrochemical sensor exhibited good selectivity and acceptable reproducibility (1.23% for 1 nM of catechol) and could be used for the routine detection and quantification of catechol in natural water samples (Prasada Rao *et al. Analyst*, **2013,** *138,5031-38)*.



Design of a nanostructured electromagnetic *polyaniline*–kegginiron–clay composite modified electrochemical sensor for the nanomolar detection of ascorbic acid.

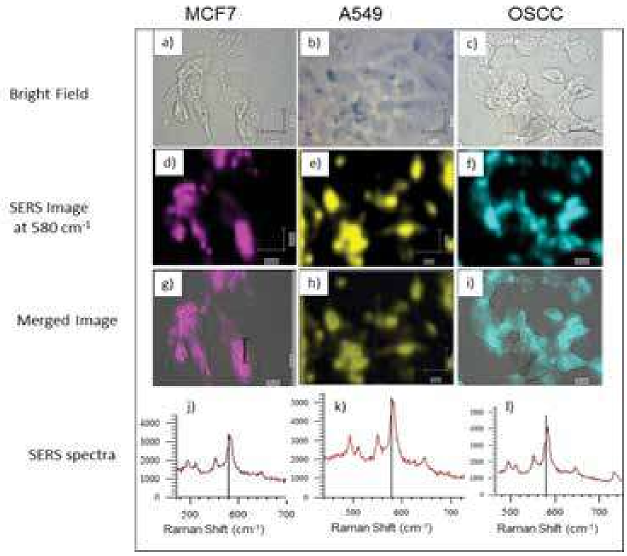
In the present work, the development of novel electro-magnetic interference shielding material from the composite of nanostructured polyaniline- polyhydroxy iron-clay (PPIC) and polycarbonate (PC) through solution blending process was demonstrated. Onset of percolation threshold has been manifested from the morphological studies in combination with electrical conductivity measurements. Temperature dependent electrical conduction mechanism was studied by applying Mott theory and was found to follow 3-D VRH model. The presence of interaction between the host matrix and nanofiller was studied by rheological property measurement in combination with FTIR spectroscopy. Films were further characterized for EMI shielding efficiency and thermo-mechanical properties. Results suggest that these transparent composite films can be used for the fabrication of EMI shielding/ electrostatic dissipation material for the encapsulation of electronic devices and as electrostatic material for high technological applications (Sudha *et al.*, *J. Appl. Polym. Sci.* (**2014**), DOI: 10.1002/APP.40936).



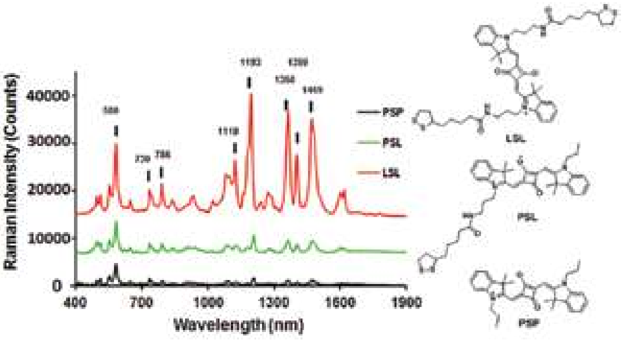
Schematic representation of the proposed PPICS modified platinum electrode and its electrochemical reaction with ascorbic acid

New insight of squaraine based biocompatible SERS nanotag for cancer cell imaging.

Development of sensitive diagnostic probe especially towards the aim of point of care treatment is a challenging task for early and accurate detection of diseases which facilitates monitoring of therapeutic progression to reduce mortality and morbidity. In this regard, optical imaging technologies using nanomaterials such as gold or silver nanoparticles, iron oxide nanocrystals and quantum dots have been successfully applied for molecular diagnosis, *in vivo* imaging and drug delivery. In recent years, surface-enhanced Raman scattering (SERS) technology invented to be most sensitive techniques among other optical imaging modalities as the signal intensity of molecular vibration enhanced 10^{8}–10^{14} folds compare to simple Raman spectra. The Raman scattering enhancement is due to the strong surface plasmon resonance whenever Raman signature molecules

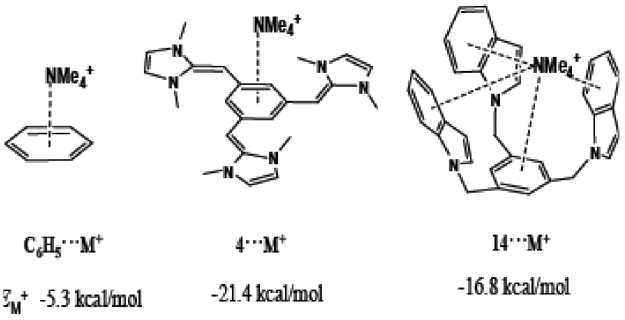


(RSM) come close proximity to the surface of metal nanoparticles (Au/Ag/Cu). In bio-sensing and imaging SERS nanoprobes were successfully tested as an alternative choice to fluorescence-probe within the complex biological systems. However, the major bottleneck for the development of sensitive SERS probe is the lack of sensitive RSM whose excitation wavelength should be closer to the laser source of Raman spectrometer as it enhances the signal intensity by another two /three folds by surface enhanced resonance Raman scattering (SERRS). In this context, new set of RSM based on squaraine dyes were designed. Squaraine dyes have been studied extensively in the last few decades due to their unique optical properties such as tuneable absorption and emission ranges from visible to NIR, high extension coefficient, and moderate fluorescence quantum yield that enable applications in imaging technologies, photo conducting devices, photovoltaics, non-linear optics, sensing and photodynamic therapy. Squaraine dyes as Raman signature molecules have been demonstrated and utilized for biocompatible SERS nanotags construction. Further investigation has been successfully carried with the best nanotag to detect human cancer proteins from breast, lung, head and neck cancer cells by Raman spectroscopic and imaging study (Maiti *et al.*, *Nanomedicine*, (**2014**), in press).



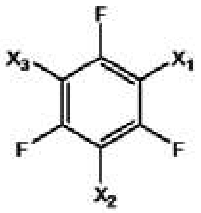
Resonance enhancement *via* imidazole substitution predicts new cation receptors.

Using substituent resonance effect as a key electronic factor, new cation-π receptors ($1{\bullet}{\bullet}{\bullet}M^+$ - $4{\bullet}{\bullet}{\bullet}M^+$; M^+ = Li^+, Na^+, K^+, NH_4^+ and NMe_4^+) have been proposed. DFT calculations showed that using a strategy of resonance donation from six nitrogen atoms *via* three substituted imidazole subunits, more than four-fold increase in cation-π interaction energy (EM^+) can be achieved for a single phenyl ring compared to benzene. EM^+ (M^+ = NH_4^+, NMe_4^+) of $4{\bullet}{\bullet}{\bullet}M^+$, wherein M^+ interacts with only one phenyl ring is significantly higher than EM^+ of a known cation host with several aromatic rings. The hypothesis was verified using several π-systems containing lone pair bearing six nitrogens and observed that nitrogen lone pair attached to a double bond was more effective for donation than the lone pair that was directly attached to the benzenoid ring. Further, a convenient strategy to design electron rich π-systems is provided on the basis of topographical analysis of molecular electrostatic potential (Suresh, C. H. *et al. J. Phys. Chem. A* (**2013**), *117*, 10455).

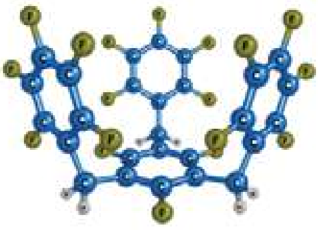


Anion receptors based on highly fluorinated aromatic scaffolds.

Mono, di, and tri pentafluorobenzyl substituted hexafluorobenzene (HFB) scaffolds *viz*. **R_I**, **R_{II}** and **R_{III}** are proposed as promising receptors for molecules of chemical, biological and environmental relevance, *viz*. N_2, O_3, H_2O, H_2O_2, F^-, Cl^-, BF_4^-, NO_3^-, ClO^-, ClO_2^-, ClO_3^-, ClO_4^- and SO_4^{2-}. The receptor-guest complexes modelled using M06L/6-311++G(d,p) DFT showed a remarkable increase in the complexation energy (E_{int}) with increase in the number of fluorinated aromatic moieties in the receptor. Electron density analysis showed that fluorinated aromatic moieties facilitated the formation of large number of lone pair-π interactions around the guest molecule. Lone pair strength of guest molecules quantified in terms of the absolute minimum (V_{min}) of molecular electrostatic potential showed that E_{int} strongly depended on the electron deficient nature of the receptor as well as strength of lone pairs in the guest molecule. Compared to HFB, **R_I** exhibited 1.1 to 2.5-fold, **R_{II}** showed 1.6 to 3.6-fold and the bowl-shaped **R_{III}** gave 1.8 to 4.7-fold increase in the magnitude of E_{int}. For instance, in the cases of HFB**...**F^-, **R_I...F^-**, **R_{II}...F^-** and **R_{III}...F^-** the E_{int} values were -21.1, -33.7, -38.1 and -50.5 kcal/mol, respectively. The results strongly suggest that tuning lone pair-π interaction provides a powerful strategy to design receptors for small molecules and anions (Suresh, C. H. *et al.* *J. Phys. Chem. A* (**2014)**, *118*, 4315).



R_I : X_1, X_2 = F; X_3 = $C_6H_5CH_2$-
R_{II} : X_1=F; X_2, X_3 = $C_6H_5CH_2$-
R_{III} : X_1, X_2, X_3 = $C_6H_5CH_2$-



R_{III}

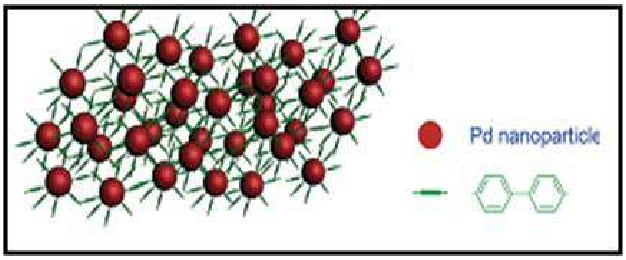
ORGANIC CATALYSIS AND SYNTHETIC METHODOLOGIES

For the development of green processes in chemical industry, increasing attention is shifting towards industrial production of active pharmaceutical ingredients (APIs) and the synthesis of advanced precursors. Two highly effective methods of reducing waste are the widespread use of catalytic processes and the reduction in the number of synthetic steps, preferably through sequential or domino type processes. Thus, the development of short reaction sequences, especially effective catalytic methods are expected to have a particularly large impact on the development of greener pharmaceutical industry.

Among the catalytic technologies, transition metal catalysis and organocatalysis are indispensable tools for the efficient and environmentally benign production of high value organic compounds. These are especially useful in the field of carbon-carbon bond formation and synthesis of heterocycles, where biocatalytic methods can be employed only with difficulty. Typical procedures for the synthesis of pharmaceutically important heterocycles involve stepwise formation of individual bonds in the target molecule, with attendant generation of waste. The possibilities of utilizing the versatility of metal-catalyzed transformations are very appealing and the catalytic methods developed towards various molecules are discussed below.

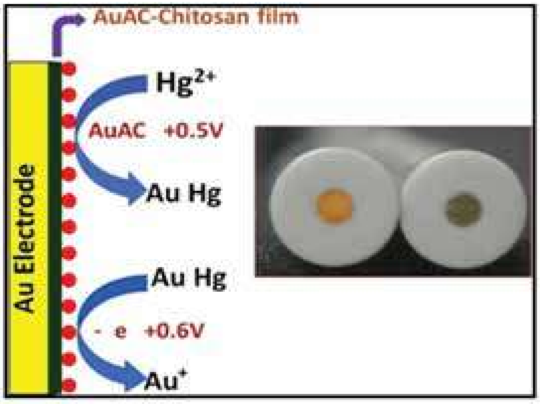
Palladium-nanoparticle-linked organic frameworks: Heterogeneous recyclable catalysts.

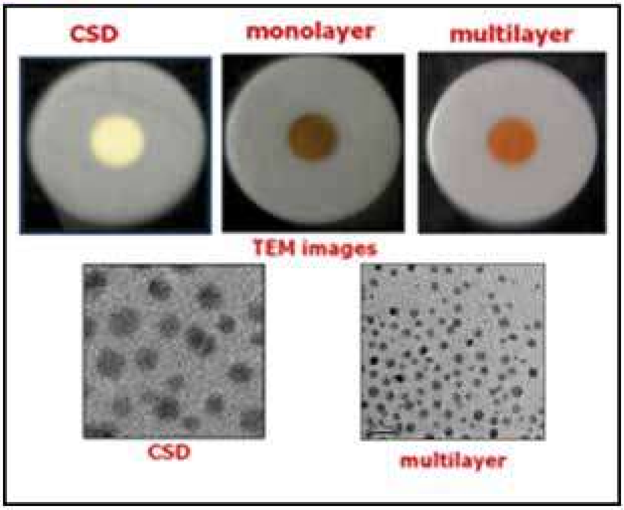
4,4′-Biphenylene-bisdiazonium tetrafluoroborate and a palladium salt were reduced simultaneously to result in the formation of palladium atoms and 4,4′-biphenylene biradicals. The palladium atoms underwent clustering forming palladium nanoparticles, whereas the 4,4′-biphenylene biradicals underwent rapid addition reactions to other radicals and also to nanoparticle surfaces. The resulting product contained palladium nanoparticles covalently linked to an organic framework (PNOF). The effects of different reaction conditions upon metal content as well as on the morphology of the PNOF were studied. The PNOF structure was probed by different experimental techniques. The PNOFs were evaluated as heterogeneous recyclable catalyst in aqueous medium for reduction of 4-nitrophenol and Suzuki coupling reactions. The rate constants obtained from the plots of $\ln(A_t/A_0)$ versus t for the 4-nitrophenol reduction reactions were $k_{PNOF1} \sim 12.44 \times 10^{-3}\ s^{-1}$, $k_{PNOF2} \sim 11.56 \times 10^{-3}\ s^{-1}$ and $k_{PNOF3} \sim 5.88 \times 10^{-3}\ s^{-1}$. Rate constants obtained for PNOF1 and PNOF2 catalysed reactions were comparable to or higher than those previously reported by others. The catalyst exhibited high reactivity even in Suzuki couplings of aryl chlorides. TOFs obtained in this study for the reaction between phenyl boronic acid and activated aryl chlorides were around 55 h^{-1}. For deactivated aryl chlorides, values as high as 40 h^{-1} were obtained at higher temperatures (Gopidas *et al. ChemCatChem 6 (***2014***) 1641 – 51)*.



Studies on deposition of gold atomic clusters on to polycrystalline gold electrode from aqueous cetyl trimethyl ammonium bromide solutions.

Atomic (molecular) clusters, with less than 50–100 atoms (size≤1.5nm) are of special interest and exhibit novel and interesting properties due to quantum confinement of electrons and holes. These properties are quite different from those of gold nanoparticles and hence, understanding of electrochemical phase formation of gold atomic clusters assumes importance. In the present study, a detailed investigation of deposition of gold atomic clusters onto polycrystalline gold electrode from aqueous cationic surfactant solutions was undertaken. The studies were conducted over a wide range of potentials, covering both surface and bulk layer dissolution and deposition processes, by means of cyclic voltammetric and chrono-amperometric techniques. Gold atomic clusters were formed in both surface and bulk layer dissolution and deposition processes as evidenced by AFM, MALDI-TOF, XPS and DLS. Electrocatalytic activity has been performed by the electrochemical reduction of oxygen (O_2) on AuAC modified gold electrode in 0.1 M H_2SO_4. *(Prasada Rao et al,. J. Electroanal. Chem., 722-723(***2014***) 60-67).*



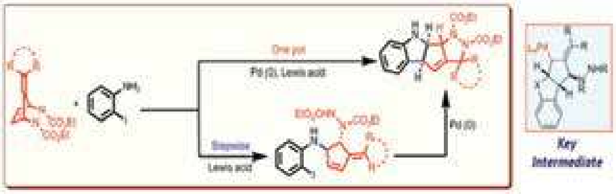


Rhodium catalyzed oxidative coupling of salicylaldehydes with azabicyclic olefins: A one pot strategy involving aldehyde C-H cleavage and π-allyl chemistry to access fused ring chromanones.

An efficient one pot strategy for the synthesis of cyclopentene fused chromanone derivatives through the direct oxidative coupling of salicylaldehydes with azabicyclic olefins in the presence of Rh/Cu catalyst system was tried. This is the first report on the ring opening-ring closing of azabicyclic olefins *via* a metal catalyzed oxidative coupling reaction. The reaction afforded chromanone derivatives with potential biological activity. The ability to use a simple salicylaldehyde and its derivatives with achiral diazabicyclic olefins is noteworthy. Further work to screen the synthesized compounds for bioactivity is in progress and will be reported in due course (Radhakrishnal *et al*., *Chem. Commun*. **2013**, *49*, 7349).

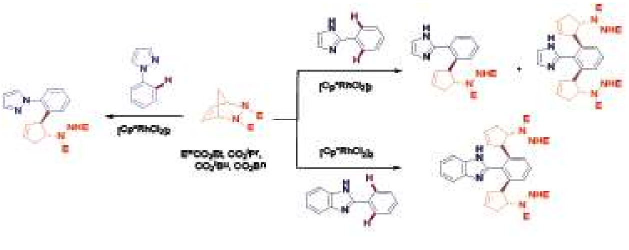
Palladium/Lewis acid mediated domino reaction of pentafulvene derived diazabicyclic olefins:

A Lewis acid/palladium mediated strategy for the synthesis of a new spiropentacyclic motif having indoline and pyrazolidine fused to the cyclopentene core was demonstrated. The reaction involved multiple bond formations. It also showed that the proper positioning of "palladium active" functional groups in the diazabicyclic olefins helped in passing the palladium baton from initial organopalladium addition to the strained olefin, ultimately delivering complex polycycles in a one pot transformation. (Radhakrishnal *et al*., *Organic Letters*, **2013**, *15*, 3338-41).



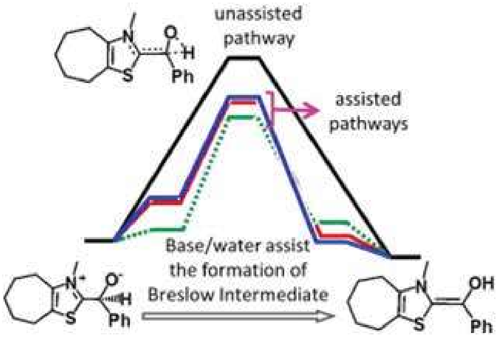
Rhodium (III)-catalyzed C-H activation of phenylazoles toward C-N bond cleavage of diazabicyclic olefins: A facile access to *mono*- and *bis*-cyclopentenyl functionalized aza-heteroaromatics.

A rhodium (III) catalyzed stereoselective C-N bond cleavage of diazabicyclic olefins through C-H bond activation of phenylazoles has been disclosed. The acetate ion assisted ring opening of strained alkenes offers an efficient approach for the preparation of biologically relevant *mono*- and *bis*- cyclopentenyl and alkylidenecyclopentenyl functionalized aza-heteroaromatics. Further studies to broaden the scope of the reaction and exploration of synthetic applications are on-going.



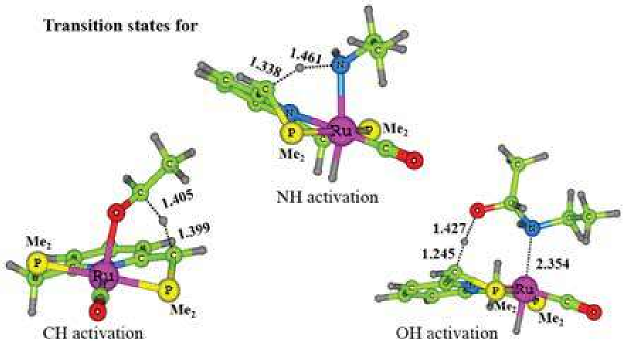
Role of base assisted proton transfer in N-Heterocyclic carbene-catalyzed intermolecular Stetter reaction.

The mechanism of the NHC-catalyzed intermolecular Stetter reaction between benzaldehyde and cyclopropene has been investigated using the PCM-M062X/6-311++G(3df,2p)//M062X/6-31+G(d,p) level of DFT. Compared to the direct reaction, a substantial reduction in the activation free energy by 10.6–14.4 kcal/mol was observed when the reaction was performed in the presence of water, 1,5,7-triazabicyclo[4.4.0]dec-5-ene (TBD), and 1,8-diazabicyclo[5.4.0]undec-7-ene (DBU). The bases promote the proton transfer step of the reaction to yield the Breslow intermediate. An early concerted transition state has been located for the stereo controlling C–C bond formation step ($\Delta G^{\#}$ = 26.6 kcal/mol) which was used to explain the diastereomeric ratio observed in the experiment (Suresh C. H. *et al. Tetrahedron Letters*, **2013**, *54*, 7144).



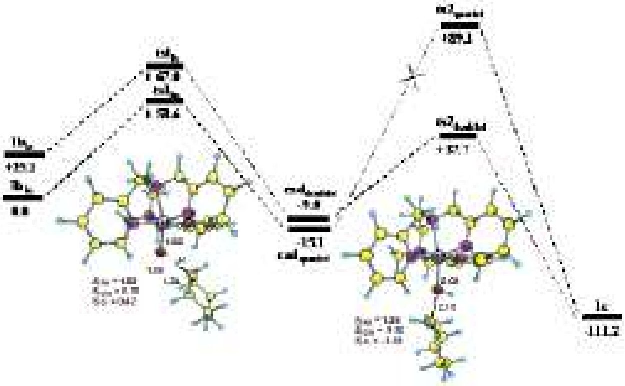
Autotandem aromatization-dearomatization pathways for PNP-Ru-^{ii}catalyzed formation of imine and hydrogen from alcohol and amine.

Mechanism of auto-tandem catalytic reactions involving $EtNH_2$ and EtOH promoted by (PNP)Ru(CO)H complex (**1**) has been investigated at the TPSS level of density functional theory (PNP = $C_5H_3N(CH_2P^tBu_2)(CHP^tBu_2)$ or $C_5H_3N(CH_2P^{iso}Pr_2)(CHP^{iso}Pr_2)$). The reaction was identified with three mechanically distinct catalytic cycles. In cycle I, EtOH adduct of **1** undergoes O-H proton transfer to the PNP ligand to yield the aromatic (PN'P)Ru(CO)(OEt)H complex**3**. Subsequent dearomatization of PN'P ligand leads to the formation of dihydrogen and (PNP)Ru(CO)(OEt) complex **5**. However, an outer sphere mechanism involving the formation of a dihydrogen intermediate complex between **1** and EtOH is more facile for dihydrogen elimination ($\Delta G^{\#}$ = 18.4 kcal/mol) than ligand aromatization-dearomatization pathway ($\Delta G^{\#}$ = 23.9 kcal/mol). In **5**, the migration of a β-hydrogen from OEt ligand to the unsaturated P-arm of PNP, forces removal of MeCHO and formation of aromatic (PN'P)Ru(CO) complex. Regeneration of the catalyst occurs by dearomatization of PN'P ligand through proton migration from P-arm to the metal. In cycle II, aromatization of the amine adduct (PNP)Ru(CO)($EtNH_2$)H leads to (PN'P)Ru(CO)(EtNH)H and subsequent reaction with the MeCHO (formed in cycle I) yields the hemiaminal $EtNHCH(CH_3)OH$. Direct reaction between aldehyde and amine can also yield hemiaminal. In cycle III, the hemiaminal-adduct of the catalyst undergoes aromatization at the PNP ligand *via* N-H proton migration which simultaneously activates C-OH bond to produce imine (EtNCHMe) and (PN'P)Ru(CO)(OH)H, **17**. Removal of H_2O from **17** leads to regeneration of **1**. Aromatization steps are characterized by the proton migration from the coordinated ligands, *viz.* O-H bond of alcohol, C-H bond of alkoxide, N-H bond of amine and N-H bond of hemiaminal to the unsaturated P-arm of PNP and the respective $\Delta G^{\#}$ values are 2.4, 15.7, 18.6, and 13.8 kcal/mol. The efficiency of this auto-tandem catalytic reaction is mainly attributed to metal-ligand cooperativity operating through several facile "aromatization-dearomatization" steps (Suresh, C. H. *et al.*, *Organometallics*, **2013**, *32*, 2926-33).



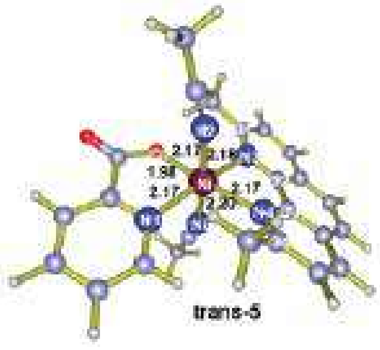
Nickel(II) complexes of tripodal 5N ligands as catalysts for alkane hydroxylation using *M*-CPBA as oxidant.

The combined experimental and computational studies have been performed to investigate the catalytic activity of nickel(II) complexes of the type $[Ni(L)(CH_3CN)](BPh_4)_2$ **1-5**. The complexes **1-5** catalyze the oxidation of cyclohexane in the presence of *m*-CPBA as oxidant up to 530 turn over numbers with good alcohol selectivity (A/K, 7.1-10.6). It is also demonstrated that by replacing the pyridylmethyl arm in $[Ni(L1)(CH_3CN)](BPh_4)_2]$ (**1**) by the strongly σ-bonding but weakly π-bonding imidazolylmethyl arm as in $[Ni(L5)(CH_3CN)](BPh_4)_2$ (**5**), both the catalytic activity and selectivity decreases. The Density Functional Theory (DFT) studies performed on cyclohexane oxidation by **1** and **5** show that the high-spin (S =3/2) $[(5N)Ni^{II}\text{-}O^{\bullet}]^+$ species was found to be the ground state with the low-spin (S=1/2) excited state located close to it. The cyclohexane hydroxylation occurs through a major pathway involving the high-spin $[(5N)Ni^{II}\text{-}O^{\bullet}]^+$ species and two transition states **ts1**$_{hs}$ and **ts2**$_{doublet}$. However, a minor pathway for the same species but with a low-spin state and two transition states **ts1**$_{ls}$ and **ts2**$_{doublet}$ may also operate because both the high-spin and low-spin $[(5N)Ni^{II}\text{-}O^{\bullet}]^+$ species coexist with a small energy gap for the spin cross over. Overall, a two spin-state reactivity is predicted for [(5N)Ni^{II}-O•]$^+$ catalysed cyclohexane hydroxylation reactions wherein the rate-determining step is the H-abstraction. The lower catalytic activity of **5** is mainly due to the formation of thermodynamically less accessible *m*-CPBA coordinated precursor of [Ni^{II}(L5)(OOCOC$_6$H$_4$Cl)]$^+$ (**5a**). (Prabha Vadivelu *et al*. **2014**, *Chemistry A European Journal*, in press).



Effect of supporting ligand in determining the catalytic activity of Ni(ii) complexes.

The DFT calculations have been used to verify the minimum energy possessing geometries of mixed ligand nickel(II) complexes of the type [Ni(PA)(L)(CH$_3$CN)$_n$] BPh$_4$ **1 - 5**, where n = 1,2, PA is 2-picolinic acid and L = *N*,*N*′-tetramethylethylenediamine (L1) **1**, *N*,*N*′,*N*″-pentamethyldiethylenetriamine (L2) **2**, 2,2′-bipyridine (L3) **3**, 1,10-phenanthroline (L4) **4** and 2,9-dimethyl-1,10-phenanthroline (L5) **5** and also to determine the effect of various ligand environment to the coordination geometry. All these observations illustrate the importance of ligand denticity, Lewis acidity of Ni(II) center and π-back bonding in determining the catalytic activity. (Prabha Vadivelu *et al*. *Inorganica Chimica Acta*, **2013**, *407*, 98).

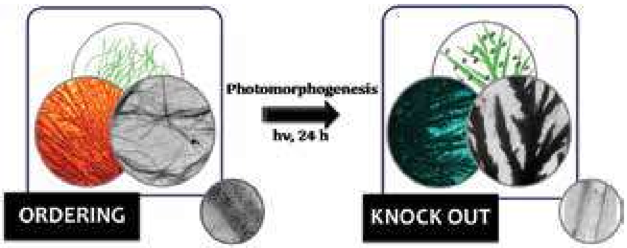


SENSITIZERS AND PROBES FOR BIOLOGY

Photodynamic therapy (PDT) uses light and small molecule based sensitizers for site specific and light-triggered destruction of malignant cells. Being an effective alternative for non-specific chemotherapeutic agents, PDT sensitizers have high potential in photo-medicine. The research in this direction focuses both on the design of new sensitizers and on understanding the chemistry behind the biological activity of PDT sensitizers. The design of probes targeting various biomolecular analytes and understanding the interaction of these probes with biological molecules is also being undertaken. The following section highlights some of the recent achievements from the lab in these aspects.

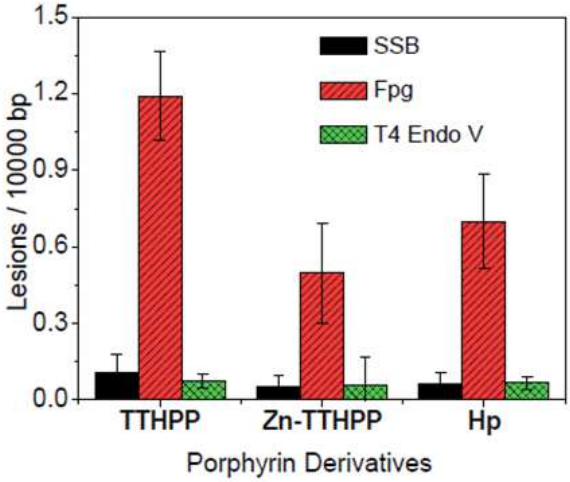
Photomorphogenesis of γ-globulin: Effect on sequential ordering and knock out of gold nanoparticles array.

The synthesized monodisperse protein-gold nanoparticles (AuNPs), using γ-globulin, a blood plasma protein, which acts as a capping, reducing, as well as a templating agent. As analysed through various photophysical, biophysical and microscopic techniques such as TEM, AFM, C-AFM, SEM, DLS, OPM, CD, and FTIR, it was observed that the initial photoactivation of γ-globulin at pH 12 for 3 h resulted in small protein fibres of *ca*. 20 ± 5 nm in size. Subsequently, these fibres found to assist in the alignment of the colloidal gold nanoparticles of average diameter of *ca*. 2-2.5 nm on the surface of protein. At this particular irradiation time, the nano-bioconjugate thus formed exhibited negligible surface plasmon resonance absorption but showed an intense photoluminescence at 680 nm. Further irradiation for 24 h, led to the formation of self-assembled long fibres of the protein of *ca*. 2 ± 0.5 mm in diameter and *ca*. 18 mm in length. Interestingly, such a morphological transformation led to the sequential knock out of the anchored gold nanoparticles resulting in the clustering of the nanoparticles of size *ca*. 5-6 nm and observation of surface plasmon resonance band at around 520 nm with the concomitant quenching of luminescence intensity at 680 nm. The observation of light triggered self-assembly of protein and its effect on ordering and knock out of metal nanoparticles offers an approach for the design of novel nanobiohybrid materials for medicinal and optoelectronic applications (D. Ramaiah *et al*., *RSC Adv*., **2013**, *3*, 13463-69).

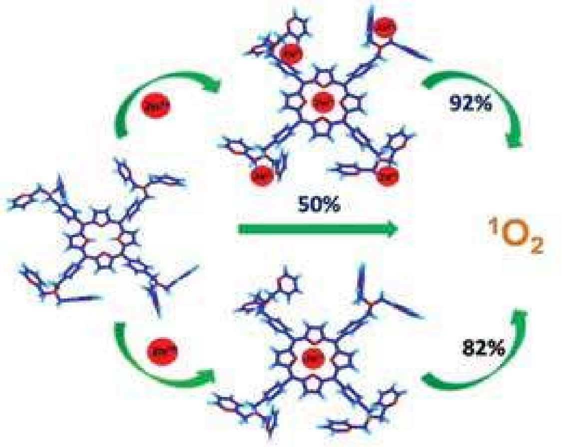


Study of the mode and efficiency of DNA binding in the damage induced by photoactivated water soluble porphyrins.

The neutral porphyrins, which are believed to be the ideal candidates as sensitizers for PDT applications, have received less attention with regard to their interactions with DNA. These porphyrin derivatives are known to undergo groove binding interactions with or without self-stacking on the surface of DNA. The systematic investigation of interactions of the neutral porphyrins TTHPP, Zn-TTHPP and the model compound, hematoporphyrin (Hp) with DNA through various photophysical and biophysical techniques are being reported. These porphyrin derivatives exhibited high affinity toward DNA through groove binding interactions as evidenced through the UV-vis absorption, emission, circular dichroism spectral and viscosity changes. Interestingly, the free base porphyrin derivative, TTHPP generated efficient singlet oxygen mediated DNA damage sensitive to formamidopyrimidine- DNA glycosylase (Fpg protein), when compared with its metal derivative and to the well-known photosensitizer, hematoporphyrin. These results provide direct evidence for the role of DNA binding mode as well as extent of interactions with DNA in the efficiency of photoactivated DNA damage induced by the neutral porphyrins, which are believed to be the ideal candidates for photodynamic therapeutic applications (D. Ramaiah *et al*., *Photochem. Photobiol*., **2013**, *89*, 1100–05).

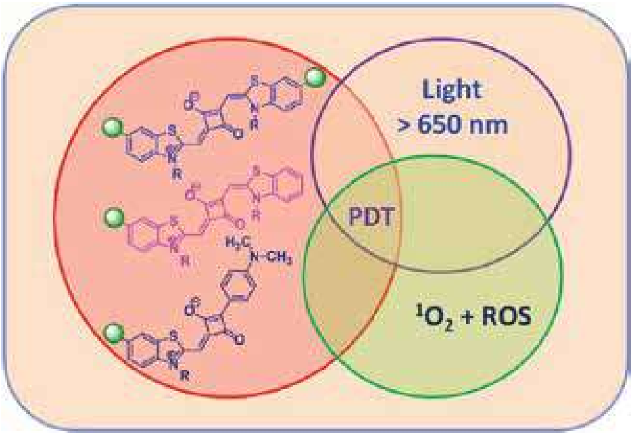


Optimization of triplet excited state and singlet oxygen quantum yields of picolylamine–porphyrin conjugates through zinc insertion.



With an objective to investigate the effect of zinc atoms on the intersystem crossing efficiency of porphyrins, a new class of picolylamine-porphyrin derivatives and their zinc complexes were synthesized and characterised by various spectroscopic techniques. By incorporating zinc ions in the core as well as periphery positions of the porphyrin ring, their triplet excited state quantum yields and their efficiency to generate singlet oxygen were optimized. Uniquely, the picolylamine-porphyrin conjugate having five zinc ions exhibited a triplet excited state quantum yield of *ca*. 0.97 and a sensitized singlet oxygen generation yield of *ca*. 0.92. In contrast, the free base porphyrin derivative exhibited *ca*. 0.64 and 0.5 of the triplet excited state and singlet oxygen quantum yields, respectively. The results demonstrate that the insertion of zinc metal ions in the picolylamine-porphyrin conjugates not only quantitatively enhances the triplet excited state and singlet oxygen yields but also imparts hydrophilicity, thereby their potential use as sensitizers in photodynamic therapy and green photooxygenation reactions (D. Ramaiah *et al. J. Phys. Chem. B*, **2013**, *117*, 13515–22).

Synthesis and characterization of near-infrared absorbing water soluble squaraines and study of their photodynamic effects in DLA live cells.



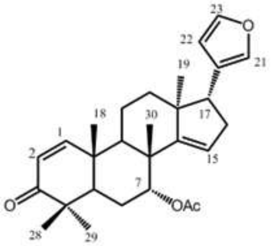
The synthesis, photophysical properties and photodynamic effects in DLA live cells of three water soluble squaraine dyes, *viz*. bisbenzothiazolium squaraine dyes SQMI and SQDI with iodine in one and both benzothiazolium units, respectively, and an unsymmetrical squaraine dye ASQI containing iodinated benzothiazolium and aniline substituents were studied. The diiodinated SQDI showed an anomalous trend in both fluorescence and triplet quantum yields over the monoiodinated SQMI, with SQDI showing higher fluorescence and lower triplet quantum yields compared to SQMI. Nanosecond laser flash photolysis of SQDI and SQMI indicated the formation of triplet excited states with quantum yield of 0.19 and 0.26, respectively. On photoirradiation, both the SQDI and SQMI generate singlet oxygen and it was observed that both dyes undergoing oxidation reactions with the singlet oxygen generated. ASQI which exhibited a lower triplet quantum yield of 0.06 was, however, stable and did not react with the singlet oxygen generated. *In vitro* cytotoxicity studies of these dyes in DLA live cells were performed using Trypan blue dye exclusion method and it reflected an order of cytotoxicity of SQDI>SQMI>ASQI. Intracellular generation of the ROS was confirmed by dichlorofluorescein assay after the *in vitro* PDT. (Suresh Das *et al*., *Photochemistry and Photobiology*, **2014**, *90*, 585-95).

BIOACTIVE NATURAL PRODUCTS

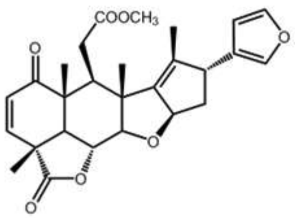
Plants have been well documented for their medicinal uses for thousands of years. They have evolved and adapted over millions of years to withstand bacteria, insects, fungi and weather to produce unique, structurally diverse secondary metabolites. Terpenoids, phytosterols, alkaloids, lectins, natural phenols and polyphenols are the main classes of compounds found in plants. Many of such natural products are found to be useful as drugs for the treatment of various fatal diseases. Identification and synthetic modification of the active principles of these plant extracts may help to define safer and more efficient treatment for various ailments. The institute is actively involved in the isolation, characterization and biological evaluation of natural products from plants found in Kerala. The selection of plants is based on the literature available in Ayurveda and other literature. The isolated compounds are then subjected to detailed biological evaluation for various activities such as anticancer, antidiabetic, antihypertensive, anti-inflammatory etc. The details of some of our activities are listed below.

Biologically active natural products from neem and *Elephantopus scaber*.

The neem tree (*Azadirachta indica*) is one plant which contains many bioactive compounds. The efforts for some years now has been aimed at unravelling the bioactivity potential of medicinal plants used in "Ayurveda". Two compounds isolated from *A. indica*, *viz.*, nimbolide and azadirone have been found to be useful in cancer chemotherapy. Nimbolide, a limonoid triterpene, inhibits growth of human colorectal cancer xenografts by suppressing the proinflammatory microenvironment (Mangalam S Nair *et al*. Clinical Cancer Research, **2013,** *19*, 4465-76) whereas, Azadirone, a limonoid tetranortriterpene, induces death receptors and sensitizes human cancer cells to TRAIL through a p53-independent mechanism with evidence for the role of the ROS-ERK-CHOP-death receptor pathway (Mangalam S. Nair *et al.*, *J. Biol. Chem*.**, 2013,** *288*, 32343-56).



Azadirone

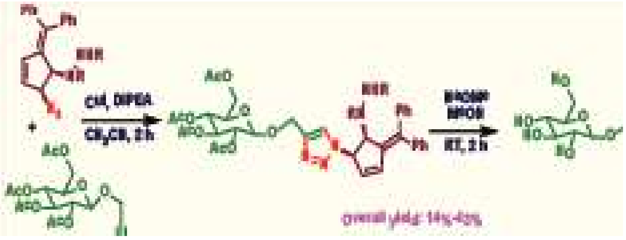


Nimbolide

Deoxyelephantopin and Isodeoxyelephantopin are two naturally occurring lactones isolated from the medicinal plant *Elephantopus scaber* which have also been found to possess very good anticancer activity. Studies indicate that isodeoxyelephantopin leads to apoptosis mediated cytotoxicity on nasopharyngeal carcinoma cells (*Asian J Pharm Clin Res*, ***2013***, *Vol 6, Suppl 2, , 51-56)* in addition to cell cycle arrest and caspase-3-mediated apoptosis in breast carcinoma T47D cells and lung carcinoma A549 cells (*Chinese Medicine* **2014**, 9:14 doi:10.1186/1749-8546-9-14)**.** Deoxyelephantopin showed antineoplastic effects on lung adenocarcinoma (A549) cells (Mangalam S. Nair *et al.* *Journal of Integrative Medicine*, **2013,** *11(4)*, 269-77).

Synthesis and biolgical evaluation of carbohydrate appended hydrazinocyclopentene with potent glycation and α-glucosidase inhibition.

A series of novel carbohydrate hybrids showing good biological activities were synthesized. Out of the six compounds, four compounds were screened against α-glucosidase, α-amylase and protein glycation reaction inhibition assays. From the results, it was found that compound galactose appended molecule is good α-glucosidase inhibitor and a potent anti-glycating agent. Also, the MTT assay proved that the active compound shows that it is non-cytotoxic against normal cell lines up to 40 μM/mL. Further *in vitro* as well as the *in vivo* studies of the active molecule are in progress with a hope to come up with an active molecule which can handle the diabetes mellitus type II.

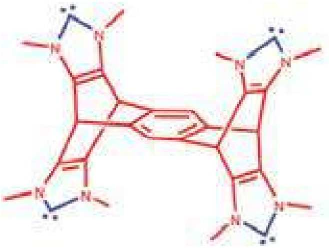


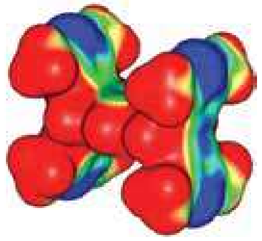
COMPUTATIONAL CHEMISTRY

In recent years, the rapid development of computational hardware and quantum chemical simulation methods have made it possible to construct remarkably accurate computer models of complicated chemical processes providing valuable scientific insights at an unprecedented level of detail. With the growing availability of cheap and fast computing resources, computational chemistry become an inevitable tool for chemical research to foresee the reaction behaviour. Thus, a reliable computational prediction from a computer aided molecular design (CAMD) strategy could deliver significant gains in terms of economy, efficiency and sustainability, potentially replacing extensive screening and reaction optimization with fewer, more targeted experiments. In this context, the institute is actively involved in modelling homogeneous catalytic reactions, particularly focusing on the development of new functional models for water splitting and CO_2 sequestration reactions.

DFT prediction of multitopic *N*-heterocyclic carbenes using Clar's aromatic sextet theory.

Existence of several multitopic N-heterocyclic carbene (NHC) ligands with up to four carbene centers have been predicted on the basis of Clar's aromatic sextet theory. Assessment on stability and reactivity of NHCs was made by quantifying aromaticity, aromatic stabilization energy (E_{aroma}), strength of carbene lone pair, proton affinity, and CuCl binding energy. On NICS(0) and HOMA scales of aromaticity, several NHCs showed high aromaticity, while E_{aroma} (17.2–19.4 kcal/mol) indicated substantial stability for the N-heterocycle. Homodesmotic reactions suggested that heat of formation of most of the newly designed carbenes is very close to that of the existing bis-NHCs. Designing a multitopic ligand through branching *via* C_{sp3} linkage was very effective as it improved the stability of the carbene. Electrostatic potential minimum (V_{min}) at the carbene lone pair suggested that annelation of heterocycle to a benzenoid ring or branching through C_{sp3} linkage can only marginally influence the electron donating power of the ligand. Hence, all multitopic NHCs showed proton affinity (252.3–267.4 kcal/mol) and CuCl binding energy (62.9–66.6 kcal/mol) very close to those of 1,3-dimethylimidazolidine-2-ylidene (1). It has also been demonstrated that branched multitopic 3-dimensional NHCs are attractive for designing metal–organic framework with narrow (1–1.5 nm) cage/pore size (Suresh C. H. *et al. J. Org. Chem.*, **2013**, *78*, 3918–24).



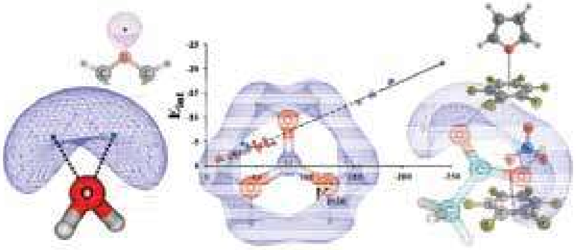


Molecular electrostatics for probing lone pair-π interactions

An electrostatics-based approach has been proposed for probing the weak interactions between lone pair containing molecules and π deficient molecular systems. For electron-rich molecules, the negative minima in molecular electrostatic potential (MESP) topography give the location of electron localization and the MESP value at the minimum (V_{min}) quantifies the electron rich character of that region. Interactive behavior of a lone pair bearing molecule with electron deficient π-systems, such as hexafluorobenzene 1,3,5-trinitrobenzene, 2,4,6-trifluoro-1,3,5-triazine and 1,2,4,5-tetracyanobenzene, explored within DFT brings out good correlation of the lone pair-π interaction energy (E_{int}) with the V_{min} value of the electron rich system. Such interaction is found to be portrayed well with the electrostatic potential for intermolecular complexation (EPIC) model. EPIC model confirms the dominance of electrostatic effects in controlling the orientation of lone pair bearing molecule in the host system as well as the interaction energy of the lone pair-π systems. On the basis of the precise location of MESP minimum, a prediction on the orientation of a lone pair bearing molecule with an electron deficient π-system is possible in majority of the cases studied. It was also noted that the ability of electron deficient aromatic rings to effectively sense a variety of lone pair bearing species was remarkable and hence highly fluorinated aromatic hydrocarbon moieties could be utilized as synthons in the design of sensors for lone pairs as well as volatile organic compounds in the atmosphere (Suresh, C. H *et al.*, *Phys. Chem. Chem. Phys.* **2013**, *15*, 18401).

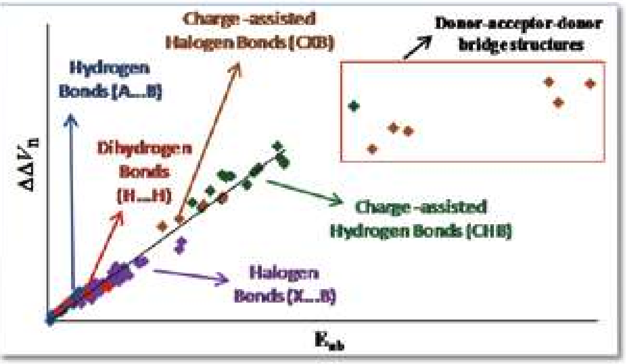
Lone pairs: An electrostatic viewpoint.

A clear-cut definition of lone pairs has been offered in terms of characteristics of minima in molecular electrostatic potential (MESP). The largest eigenvalue and corresponding eigenvector of the Hessian at the minima are shown to distinguish lone pair regions from the other types of electron localization (such as π bonds). It has been proposed that magnitude of eigenvalue at the CP that corresponds to lone pair, is numerically greater than 0.025 a.u. and the eigenvector associated to it nearly points in the direction (angle ≤ 5°) of the atom on which it is localized. A comparative study of lone pairs as depicted by various other scalar fields such as Laplacian of electron density and electron localization function was made. Further, an attempt has been made to generalize the definition of lone pairs to the case of cations (Suresh, C. H. *et al. J. Phys. Chem. A*, **2014**, *118*, 526).



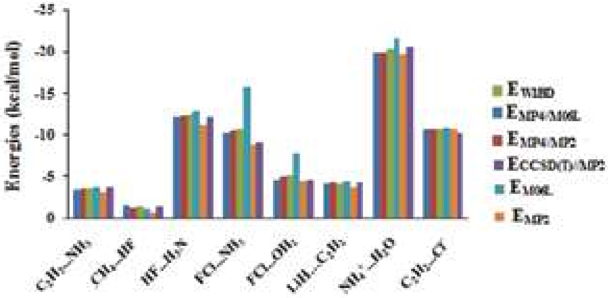
A molecular electrostatic potential analysis of hydrogen, halogen, and dihydrogen bonds.

Hydrogen, halogen and dihydrogen bonds in weak, medium and strong regimes (<1 to ~60 kcal/mol) have been investigated for several intermolecular **D**-**A** complexes at *ab initio* MP4//MP2 method coupled with atoms-in-molecules (AIM) and molecular electrostatic potential (MESP) approaches. Electron density ρ at bond critical point correlates well with interaction energy (E_{nb}) for each homogenous sample of complexes, but its applicability to the entire set of complexes was not satisfactory. Analysis of MESP minimum (V_{min}) and MESP at the nuclei (V_n) showed that in all **D**-**A** complexes, MESP of **A** becomes more negative and that of **D** becomes less negative suggesting donation of electrons from **D** to **A** leading to electron donor-acceptor (eDA) interaction between **A** and **D**. MESP based parameter $\Delta\Delta V_n$ measures donor-acceptor strength of the eDA interactions as it shows a good linear correlation with E_{nb} for all **D**-**A** complexes ($R^2 = 0.976$) except the strongly-bound bridged structures. The bridged structures are classified as donor-acceptor-donor complexes. MESP provides a clear evidence for hydrogen-, halogen- and dihydrogen bond formation and defines them as eDA interactions in which hydrogen acts as electron acceptor in hydrogen- and dihydrogen bonds while halogen acts as electron acceptor in halogen bonds (Suresh, C. H. *et al. J. Phys. Chem. A* **2014**, *118*, 1697).



Accurate binding energies of hydrogen, halogen and dihydrogen bonded complexes and cation enhanced binding strengths.

Interaction energy (E_{int}) values of a variety of hydrogen, halogen and dihydrogen bonded complexes in the weak, medium and strong regimes have been computed using W1BD, MP2, M06L DFT and hybrid methods MP4//MP2, MP4//M06L and CCSD(T)//MP2. W1BD level E_{int} and CCSD(T) results reported in the literature show very good agreement (MAD = 0.19 kcal/mol). MP2 underestimates E_{int} while M06L shows accurate behaviour for all except halogen and charge-assisted hydrogen bonds. MP4//MP2, MP4//M06L and CCSD(T)//MP2 yield E_{int} very close to those obtained from W1BD. The high accuracy energy data at MP4/MP2 is used to study the effect of a cation (Li^+, NH_4^+) on the E_{int}. The cation enhances electron donation from the donor to noncovalent bonding region leading to substantial enhancement in E_{int} (~141 -566 % for Li^+ and ~105 - 539 % for NH_4^+) and promotes a noncovalent bond in the weak regime to medium regime and that in the medium regime to strong regime (Suresh, C. H. *et al., Int. J. Quant. Chem.* **2014**, *114*, 885).

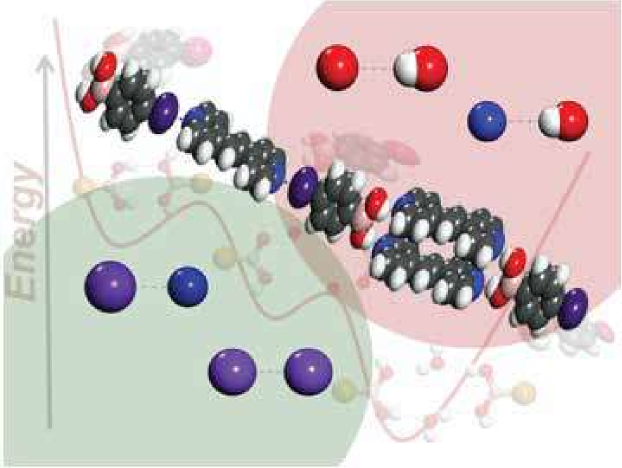


X-RAY CRYSTALLOGRAPHY

X-ray crystallography is a gold standard for the unambiguous determination of internal structure of matter at an atomic level. Though the basic theory of diffraction was developed more than a century ago, constant evolution in data collection instrumentation and data reduction methods, together with the availability of powerful computational resources have evoked deep-seated consequences in chemistry, materials and biology, making it truly interdisciplinary. In this technique, integrated intensities of the diffraction peaks are used to reconstruct the electron density map within the unit cell in the crystal, while the symmetry and periodicity factors are used to draw the information on molecular arrangements in three-dimension. The division houses a Rigaku Saturn 724+ single crystal diffractometer and is being actively employed to study diverse compound-types that vary from metal-organic frameworks to natural products. Apart from the structural studies, this technique is used in tandem with Cambridge Structural Database (CSD), spectroscopy, thermal and computational methods to derive a holistic understanding of crystal packing and bonding characteristics, thereby to deduce structure-property relationships in molecular crystals.

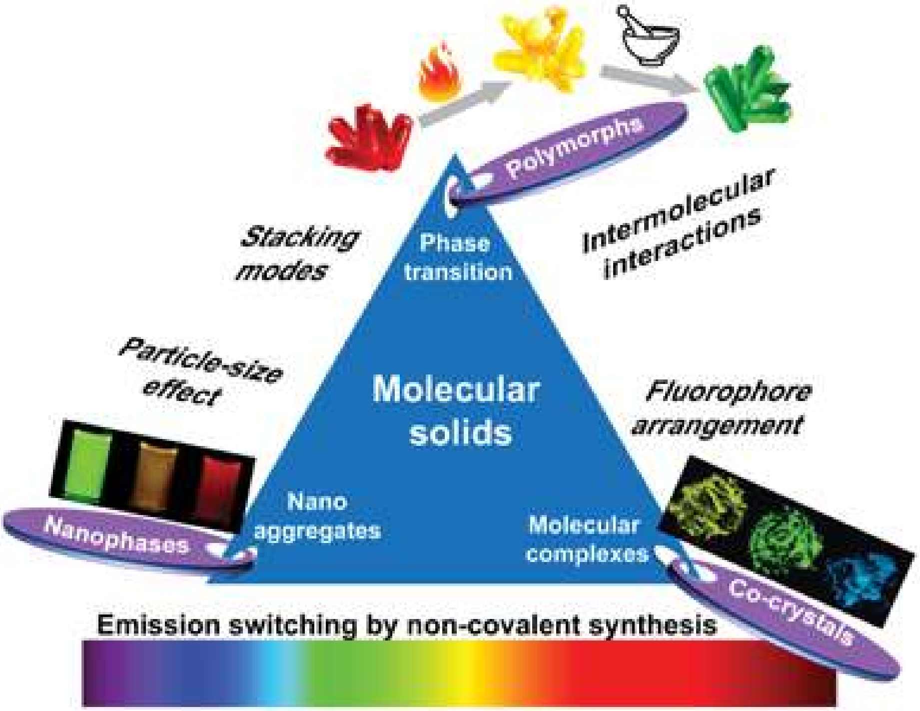
Structural landscape of flexible functionalities: Boronic acid hydrates as archetypal examples.

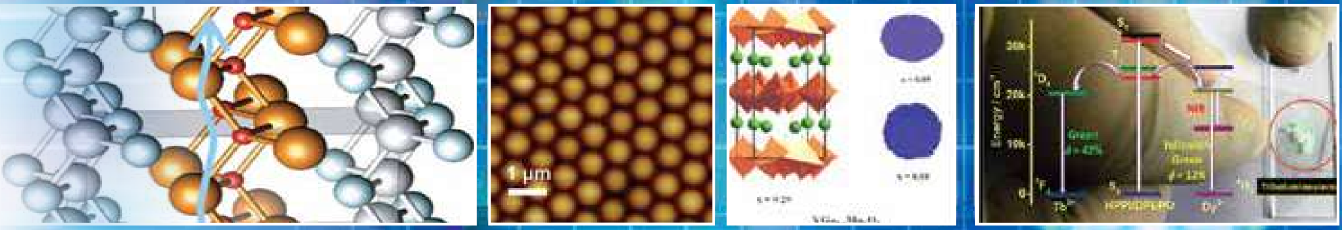
Crystal structure prediction of conformationally flexible molecules is a demanding task since searches where the conformational energy term favours the wrong conformations could generate structures that are unrealistic. To circumscribe this paucity, surveys of related molecular fragments within their crystal structures are generally good guides to conformational preferences in crystal phases and hence could be useful as starting points for further refinement. Traversing the crystal energy landscape, each unique structure could be visualized as a trough which corresponds to a specific stationary point associated with an energy minimum. Since each unique structure/pattern represents a stationary point on the crystal energy landscape, their identification and ranking based on recurrence can be an effective route to ascertain the structural remnants that are kinetically and statistically more probable under certain set of conditions; such structural fragments can be a guidepost to landmark putative structures in the vast structural landscape. Increasing frequency of a specific structure pattern or motif reasonably represents a stable structural pattern, at least in terms of a given set of conditions. Such motifs and their recurrence can be systematically classified and ranked to obtain an understanding of the process of crystallization. Crystal motifs, generally termed as supramolecular synthons, being the kinetic units can be considered as the primary interactions that are present in the solution. Hence their structural analysis could provide a hint to the crystallization mechanisms. High-throughput crystallography was combined with the structural information from Cambridge Structural Database (CSD) to draw a probable landscape of the crystal motifs possible in hydrated assemblies of boronic acids (Sunil Varghese *et al. Cryst. Growth. Des.* **2014**, *14*, in press).



Non-covalent routes to tune the optical properties of molecular materials.

Switching and tuning solid state luminescence properties of molecular materials by modulating molecular packing through non-covalent routes is an attractive prospect. This strategy further makes it feasible to expand the utility of molecules of interest by obtaining a large array of solids–polymorphs, solvates, amorphous phase, nano/micro-crystals and as multi-component systems–with distinct fluorophore arrangement and hence emission characteristics. Because non-covalent interactions that determine the fluorophore arrangements in polymorphs or supramolecular complexes are weak and flexible, their making and breaking become more realistic under ambient conditions, thus to achieve reversible transformations and hence external-stimuli-responsive and switchable molecular fluorescent materials. Recent advances, in this context, were reviewed with the aid of illustrative examples and further emphasized the scope and relevance of interdisciplinary and multi-technique approaches to unravel the structure-optical property relationships and to augment the foundations of factual knowledge (Sunil Varghese *J. Mater. Chem. C*, **2014**, *2*, 3499).





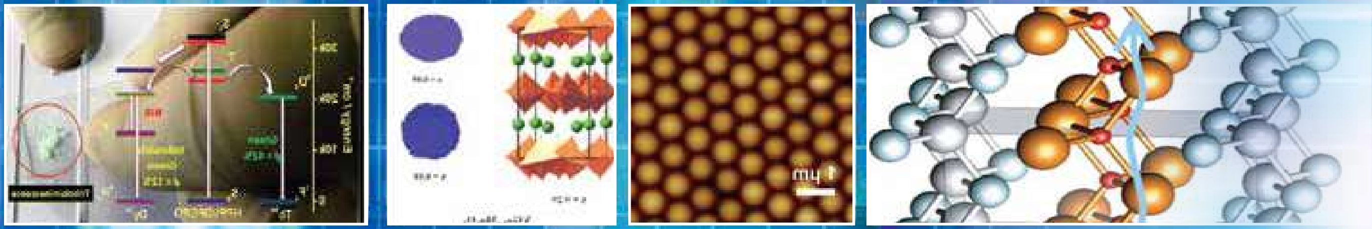
MATERIAL SCIENCES AND TECHNOLOGY DIVISION

The main research activities of the Material Sciences and Technology Division (MSTD) during the year 2013-14 can be broadly classified under (i) rare earth based non-toxic inorganic multifunctional pigments for energy saving paints/coatings (ii) luminescent materials for solid-state lighting, bioimaging and sensors for the detection of explosives (iii) porous ceramic materials for environmental applications (iv) superconducting and magnetic materials for strategic and automobile industries (v) polymers and polymer matrix nanocomposites for flame retardant applications (vi) low k dielectric materials for electronic packaging (vii) metallic materials for aerospace and automobile industries and (viii) mineral based value added products. The Division has also initiated the following new industrial oriented R&D activities for the 12th Five year plan: i) Sustainable Technologies for Utilization of Rare Earths (SURE), (ii) Specialty Materials Based on Engineered Clays (SPECS), (iii) Novel Energy Effective Metallic Materials for Automotive and General Engineering Applications and (v) Intelligent Coatings (INTELCOAT).

As in the earlier years, the members of the Division have been quite successful in publishing 89 publications in SCI journals. Four foreign and Indian patents were also granted to the Division members for innovations developed. The Division has organized a major international conference on Advanced Functional Materials [ICAFM 2014] during February 19-21, 2014. Given below are some of the research highlights of the Division during the year 2013-14, along with brief abstracts of the results published in various international journals.

Highlights

- A series of non-toxic intense blue and yellow inorganic pigments were developed with high solar reflectance for energy saving applications.
- Designed non-wetting lanthanum phosphate crucibles for strategic applications.
- White-light emitting materials developed based on mixed-lanthanide (Eu^{3+}, Gd^{3+}, Tb^{3+}) coordination polymers.
- Designed iridium based phosphorescent compound as a molecular probe for the detection of TNT in vapor and solid phases.
- Designed mitochondria-specific visible-light sensitized europium coordination compound.
- New red phosphor materials were developed for use in LEDs.
- Porous ceramic sorbents were designed for CO_2 adsorption.
- A new $NdFeAsO_{1-x}F_x$ based superconductor developed with remarkably high values of critical temperature and critical field.
- Developed flame retardant materials based on polymers and layer double hydroxides.
- Developed Mg-Gd based alloys for high temperature applications.
- Developed autocatalytic copper coated boron carbide for neutron shielding.



पदार्थ विज्ञान तथा प्रौद्योगिकी प्रभाग

वर्ष 2013-14 के दौरान पदार्थ विज्ञान और प्रौद्योगिकी प्रभाग (एमएसटीडी) की मुख्य अनुसंधान गतिविधियों को मोटे तौर पर निम्न प्रकार से वर्गीकृत किया जा सकता है: (i) ऊर्जा बचत पेंट / कोटिंग्स के लिए दुर्लभ पृथ्वी आधारित गैर विषैले अकार्बनिक बहु- कार्यात्मक पिगमेंट (ii) ठोस अवस्था प्रकाश के लिए संदीप्तिशील सामग्री, विस्फोटकों का पता लगाने के लिए जैवइमेजिंग और सेंसर (iii) पर्यावरण अनुप्रयोगों के लिए सरंध्र सिरेमिक सामग्री (iv) सामरिक और ऑटोमोबाइल उद्योग के लिए अतिचालक और चुंबकीय सामग्री (v) ज्वाला मंदक अनुप्रयोगों के लिए पॉलिमर और पॉलिमर मैट्रिक्स नैनोकंपोजिट (vi) इलेक्ट्रॉनिक पैकेजिंग के लिए कम केल्विन डाईइलेक्ट्रिक सामग्री (vii) एयरोस्पेस और ऑटोमोबाइल उद्योग के लिए धातु सामग्री और (viii) खनिज आधारित मूल्य वर्धित उत्पादों। प्रभाग ने 12 वीं पंचवर्षीय योजना के लिए निम्नलिखित नई औद्योगिक उन्मुख अनुसंधान एवं विकास गतिविधियॉं भी शुरू कर दी है: (i) रेअर अर्थ्स के उपयोग के लिए सतत टेक्नोलॉजीज (एसयुआरई) (ii) इंजीनियर्ड क्लेज के आधार पर विशेषता सामग्री (एसपीईसीएस), (iii) ऑटोमोटिव और सामान्य इंजीनियरिंग अनुप्रयोगों के लिए नूतन ऊर्जा प्रभावी धातु सामग्री और (iv) इंटेलिजेंट कोटिंग्स (इंटेलकोट)।

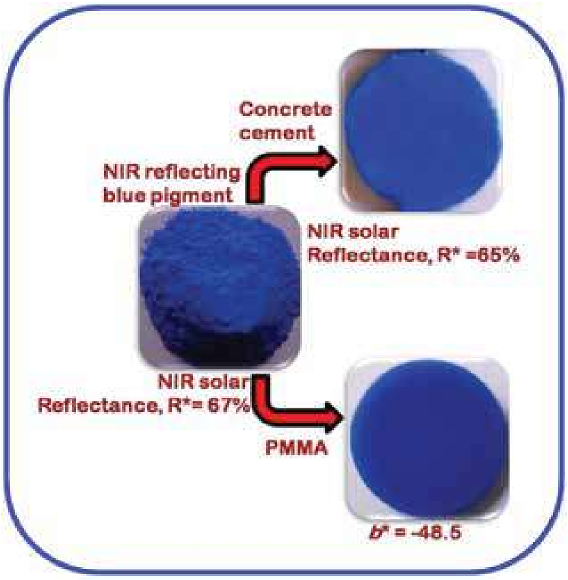
पहले के वर्षों जैसे, प्रभाग के सदस्य एससीआई पत्रिकाओं में 89 प्रकाशनों को प्रकाशित करने में काफी सफल रहे हैं। विकसित किये नवाचारों के लिए चार विदेशी और भारतीय पेटेंट भी प्रभाग के सदस्यों को प्राप्त हैं। प्रभाग ने 19-21 फ़रवरी, 2014 के दौरान उन्नत कार्यात्मक सामग्री [ICAFM 2014] पर एक प्रमुख अंतर्राष्ट्रीय सम्मेलन का आयोजन किया है। विभिन्न अंतरराष्ट्रीय पत्रिकाओं में प्रकाशित परिणामों के संक्षिप्त सार के साथ वर्ष 2013-14 के दौरान प्रभाग के अनुसंधान की कुछ मुख्य विशेषताएं नीचे दी गयी हैं ।

- ऊर्जा बचत अनुप्रयोगों के लिए उच्च सौर परावर्तकता के साथ गैर विषैले तीव्र नीले और पीले रंग के अकार्बनिक पिगमेन्टों की एक श्रृंखला विकसित की गयीं ।
- सामरिक अनुप्रयोगों के लिए गैर गीले लेण्टेनियुम फॉस्फेट क्रूसिबल्स का डिजाइन किया गया ।
- मिश्रित लैन्थेनाइड (Eu3+GD3+Tb3+) समन्वय पॉलिमर के आधार पर सफेद प्रकाश उत्सर्जक सामग्री विकसित की गयी।
- वाष्प और ठोस चरणों में टीएनटी का पता लगाने के लिए एक आणविक प्रोब के रूप में इरिडियम आधारित स्फुरदीप्त यौगिक का डिजाइन किया गया ।
- माइटोकॉन्ड्रिया-विशिष्ट दृश्य प्रकाश संवेदनशील युरोपियम समन्वय यौगिक का डिजाइन किया गया ।
- एल ई डी में उपयोग के लिए नयी लाल फॉस्फर सामग्री विकसित की गयीं।
- कार्बन डाइ ऑक्साइड अवशोषण के लिए सरंध्र सिरेमिक शोषी का डिजाइन किया गया ।
- क्रांतिक तापमान और क्रांतिक क्षेत्र के उल्लेखनीय उच्च मूल्यों के साथ एक नया NdFeAsO1-XFX आधारित अतिचालक विकसित किया गया ।
- पॉलिमर और लेयर डबल हाइड्रोक्साइड के आधार पर ज्वाला मंदक सामग्री विकसित की गयी ।
- उच्च तापमान अनुप्रयोगों के लिए मैग्नीशियम और गैडोलीनियम आधारित धातुओं का विकास किया गया ।
- न्यूट्रॉन परिरक्षण के लिए ऑटोउत्प्रेरक तांबा लेपित बोरान कार्बाइड विकसित किया गया ।

MULTIFUNCTIONAL INORGANIC PIGMENTS

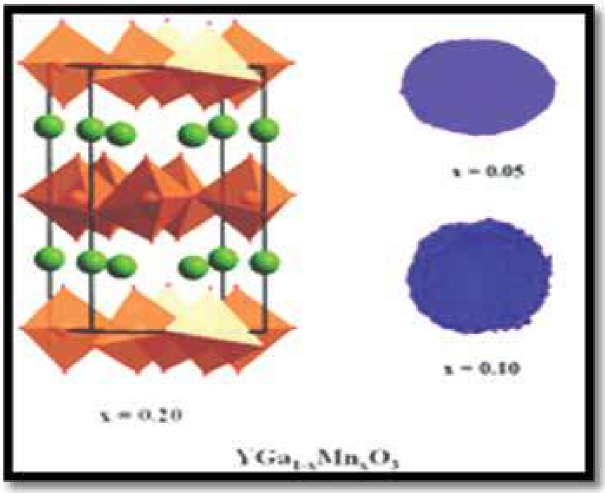
Intense blue inorganic pigment with high solar reflectance

This work focuses on the development of novel non-toxic intense blue infrared reflecting inorganic pigments having the general formula $Sr_{1-x}La_xCu_{1-y}Li_ySi_4O_{10}$ ($x = y$ ranges from 0 to 0.5) as viable alternatives to existing toxic cobalt based blue colorants. The developed pigment powders were characterized by XRD, UV-vis-NIR diffuse reflectance spectroscopy and CIE-$L^*a^*b^*$ 1976 color scales. The substitution of La^{3+} for Sr^{2+} and Li^+ for Cu^{2+} in $SrCuSi_4O_{10}$ gently changes the color of the pigment from sky-blue to intense blue and as a result the band gap of the pigment powders increases from 2.59 to 2.68 eV. The coloring mechanism is based on the crystal field splitting of the Cu^{2+} d-orbitals in a square planar environment. Finally the ability of the pigments to transfer the color as well as IR reflectance properties was demonstrated by coating on to concrete cement block and PMMA. The developed pigments exhibited intense blue color with impressive IR solar reflectance (67%) and were thermally stable. These pigments have potential applications in energy saving paints/coatings (MLP Reddy *et al. Dyes Pigments* ***2013***, *98*, 540-46).



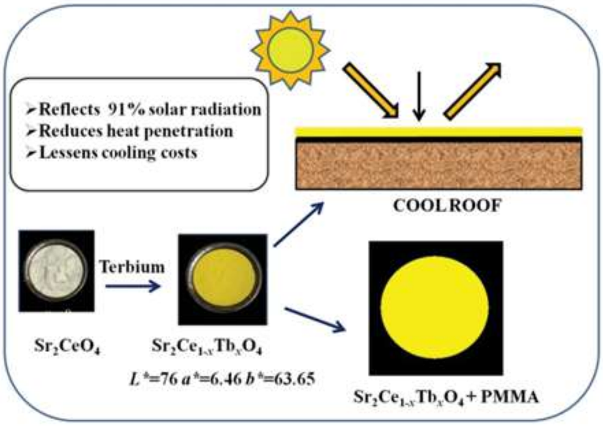
$YGa_{1-x}Mn_xO_3$: A novel purple inorganic pigment

This work explains the synthesis of a purple inorganic pigment, $YGa_{1-x}Mn_xO_3$ ($0 < x \leq 0.10$), based on hexagonal $YGaO_3$. The meta stable series of oxides were prepared by a sol–gel technique where the dried gels, obtained from aqueous solutions of metal nitrate–citric acid mixtures, were calcined for a short duration in a preheated furnace around 850°C. The synthesized pigments were well characterized by XRD, Rietveld analysis, UV-VIS diffuse reflectance spectroscopy, and CIE-$L^*a^*b^*$ 1976 color scales. The purple color of the oxides arises from the specific trigonal bipyramidal ligand field around Mn^{3+} in a $YGaO_3$ host. Other hexagonal $RGaO_3$ hosts for R = Lu, Tm and Ho substituted with Mn^{3+} also produce similar purple colored materials (MLP Reddy *et al. RSC Adv.***2013**, *3*, 3199-202).

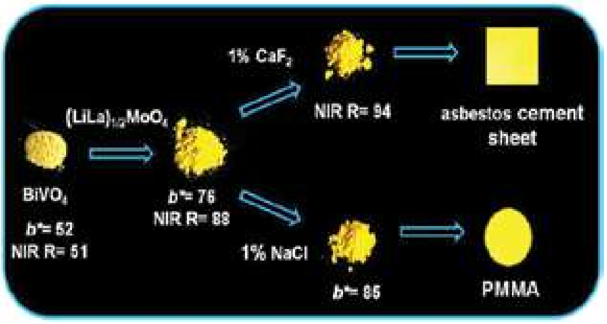


Novel non-toxic yellow pigments: $Sr_2Ce_{1-x}Tb_xO_4$

Novel yellow inorganic pigments: $Sr_2Ce_{1-x}Tb_xO_4$ (x = 0, 0.2, 0.4, 0.6, 0.8, 1.0) were synthesized by the conventional solid-state route. The structure and morphology of the developed pigments were characterized using powder X-ray diffractometer (XRD) and scanning electron microscope (SEM), respectively. UV–vis NIR spectrophotometer was employed to investigate the optical properties and the color characteristics were evaluated by CIE 1976 $L^*a^*b^*$color scales. The terbium substitution extends the absorption edge to longer wavelengths by introducing an additional electronic level between the valence band and conduction band. Consequently, the prepared pigments exhibit various yellow colors by fine tuning of the band gap from 3.03 eV (white) to 2.52 eV (reddish/greenish yellow). Doping of terbium into Sr_2CeO_4 enhances the NIR reflectance at 1100 nm from 87% to 91%. The coloring performance of the synthesized pigments was investigated in polymer matrix for plastic coloring applications. The exhibition of high NIR reflectance with comparable color properties of these pigments with commercial counter parts makes them potential candidate as cool colorants to reduce the heat buildup on building surfaces. (Prabhakar Rao *et. al. Dyes and Pigments* 104, **2014** 41-47).



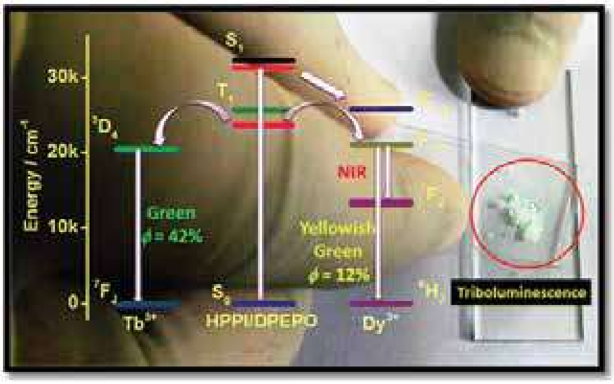
A new series of yellow pigments of the formula $[(Li_{0.5}La_{0.5})_x\ Bi_{1-x}][Mo_xV_{1-x}]O_4$ (x = 0, 0.1, 0.2, 0.3, 0.4, 0.5) were prepared *via* a solid state method. The structural, morphological and colour characteristics of tetragonal scheelite pigments were analyzed. Various shades of toxic metal free pigments were obtained ranging from reddish to greenish yellow as a result of a blue shift of the absorption edge with substitution. The addition of various mineralizers significantly enhances the yellow colour hue and as well as improves the NIR reflectance. The colouring applications of prepared pigments in poly(methyl methacrylate) and asbestos cement sheet demonstrate their potential application as environmentally benign yellow colorants (P. Prabhakar Rao *et al. Chem. Lett*. 43 (7) **2014**.



LUMINESCENT MATERIALS

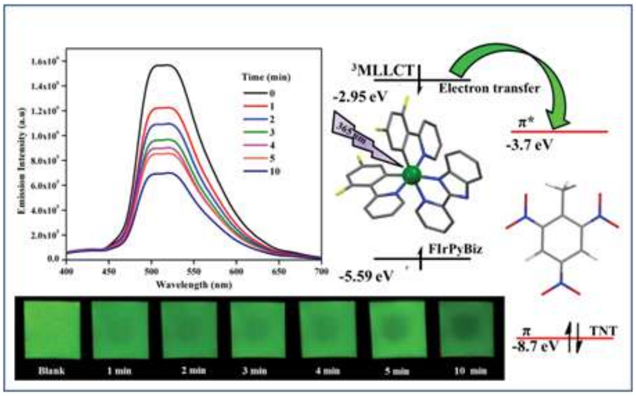
Brilliant photoluminescence and triboluminescence from ternary Dy(III) and Tb(III) complexes

Three new lanthanide heterocyclic β-diketonate complexes $[Dy(PPI)_3(EtOH)_2]$, $[Dy(PPI)_3(DPEPO)]$, and $[Tb(PPI)_3(DPEPO)]$ [where HPPI = 3-phenyl-4-propanoyl-5-isoxazolone and DPEPO = bis(2-(diphenylphosphino) phenyl)ether oxide] were synthesized, characterized and evaluated their photophysical properties. The room temperature lifetime (33 ± 1 μs) and overall quantum yield (12 ± 1%) obtained for Dy(III) complex was found to be the highest values reported so far for Dy(III)-tris-β-diketonates. The crystals of both Tb(III) and Dy(III) complexes showed efficient triboluminescence. Because their high thermal stability, this could be exploited in applications for damage detection of civil, aerospace, and military structures or biomedical materials as well as for impact sensors (M. L. P. Reddy *et al. Inorg. Chem*. **2013**, *52*, 8750 –58).



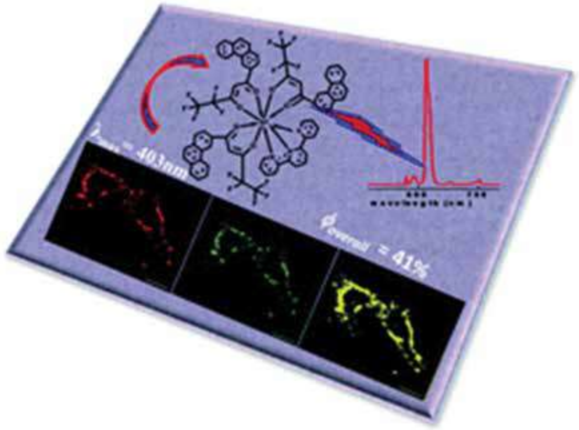
AIPE-active green phosphorescent iridium(III) complex impregnated test strips for the vapor-phase detection of 2,4,6-trinitrotoluene (TNT)

Detection of explosives especially, trinitrotoluene (TNT) is of utmost importance due to its highly explosive nature and environmental hazard. Therefore, detection of TNT has been a matter of great concern worldwide to the scientific community. A new aggregation-induced phosphorescent emission (AIPE)-active iridium(III) bis(2-(2,4-difluorophenyl)pyridinato-N,C2′)(2-(2-pyridyl)benzimidazolato-N,N′) complex [FIrPyBiz] was developed and used as a molecular probe for the detection of TNT in the vapor phase, the solid phase, and aqueous media. In addition, phosphorescent test strips were constructed by impregnated the Whatman filter paper with aggregates of FIrPyBiz for trace detection of TNT in contact mode with detection limits in nano-grams by taking advantage of excited state interaction of AIPE-active phosphorescent iridium(III) complex with that of TNT and the associated photophysical properties.(MLP Reddy *et al.*, *J. Mater. Chem. C*, **2014**, *2*, 515–23).



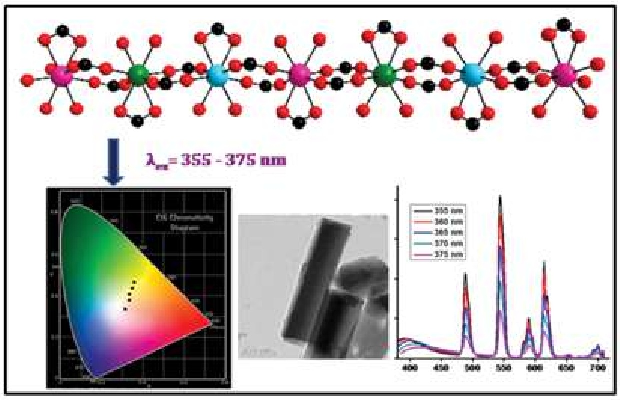
A mitochondria-specific visible-light sensitized europium β-diketonate complex with red emission

The Eu^{3+} coordination compound developed, $Eu(pfppd)_3(tpy)$ [where Hpfppd = 4,4,5,5,5-pentafluoro-3-hydroxy-1-(phenanthren-3-yl)pentanedione and tpy = 2,2′:6,6′′-terpyridine] exhibits significant quantum yield ($\Phi_{overall}$ = 41%) and long $^5D_0$ lifetime (880 μs) values under biologically relevant pH conditions (pH = 7.4) when excited with visible light. Hence, the Eu^{3+} luminescent complex was examined for live cell imaging using the rat embryonic heart cell line, H9c2. The ternary Eu^{3+} complex permeates into the H9c2 cells and co-localises with the mitochondria, as demonstrated by counterstaining experiments. The designed Eu^{3+} bioprobe remained undissociated in the cell medium, showed a good cell permeability and a fast cellular uptake with a specific localization profile. Thus it has the potential to become a time-resolved imaging probe that is excitable in the visible-light range. (Reddy *et al. Dalton Trans.* **2013**, *42*, 12317–23).



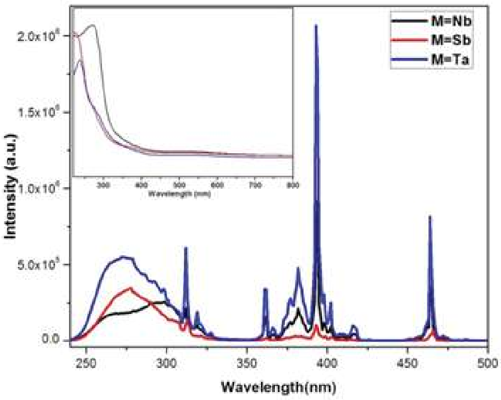
Tunable white-light emission from a mixed lanthanide (Eu^{3+}, Gd^{3+}, Tb^{3+}) coordination polymers derived from 4-(dipyridin-2-yl)aminobenzoate

A series of isostructural mixed Ln^{3+}-4-(dipyridin-2-yl)aminobenzoate coordination polymers [Ln^{3+} = Eu^{3+} (1), Tb^{3+} (2), and Gd^{3+} (3)], was characterized and investigated for their photophysical properties. The results demonstrated that by gently tuning the excitation wavelength of these mixed lanthanide complexes, white light emission can be realized with the Commission Internationale del'Eclairage coordinates (0.32, 0.34). By changing the concentration profiles of lanthanide ions stoichiometrically in mixed-lanthanide complexes and exciting at particular wavelengths, various emission colours can also be successfully obtained. The antenna ligand, 4-(dipyridin-2-yl)aminobenzoic acid, provides an efficient energy transfer for the sensitization of Eu^{3+} and Tb^{3+} complexes and exhibits red and green emissions, respectively. The corresponding Gd^{3+} complex displays ligand - centred visible emission in the blue light region and acts as a blue emitter. Therefore, Eu^{3+} and Tb^{3+} complexes in conjunction with a Gd^{3+} complex is a suitable choice to obtain tuneable white-light-emission from Ln^{3+} coordination polymers. The morphological analyses of the mixed lanthanide coordination polymers by transmission electron microscopy (TEM) disclosed that these compounds exist as unique crystalline nanorods with an average diameter of 200 nm. The mixed lanthanide complexes developed also exhibited high thermal stability (420 °C). By precisely tuning the white-light emission of RGB-color systems will lead to promising applications in color displays, sensing and labeling. (Reddy *et al*. *Dalton Trans*. **2014**, DOI: 10.1039/c4dt00871e).

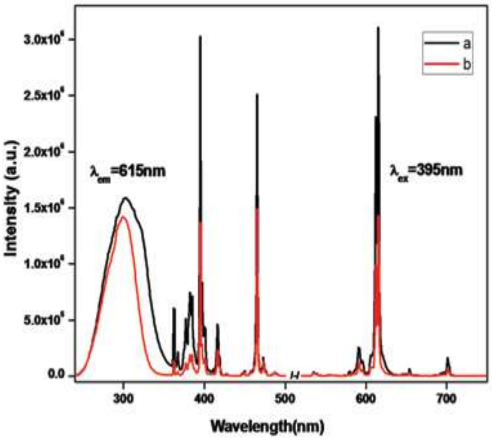


Structural influence on the photoluminescence properties of Eu^{3+} doped Gd_3MO_7 (M = Nb, Sb, Ta) red phosphors

New red phosphor materials of general formula $Gd_{3-x}MO_7$:xEu^{3+} (M = Nb, Sb, Ta) were prepared using a high temperature solid state reaction route. Detailed structural studies using XRD, FT-IR and Raman spectroscopy techniques showed that niobate and tantalate crystallized in the weberite type structure whereas the antimonate was in the fluorite structure. Photoluminescence properties of the samples were correlated with their crystal structures. It was observed that more ordering occurred in the lattice when M site was doped from Sb to Nb to Ta. Although niobate and tantalate samples possess similar structures, more distortions were noticed in the tantalate sample increasing the radiative transition probabilities. Due to the more ordered structure of Gd_3TaO_7 host lattice resulting in the more uniform distribution of Eu^{3+} ions, tantalate system showed better luminescence properties. The variation in the luminescence intensity with various Eu^{3+} concentrations in Gd_3TaO_7 host lattice was also studied to calculate the optimum doping concentration (Prabhakar Rao *et al. Phy. Chem. Chem. Phys.* in press*)*



Effect of Zr^{4+} and Si^{4+} substitution on the luminescence properties of $CaMoO_4$:Eu^{3+} red phosphors

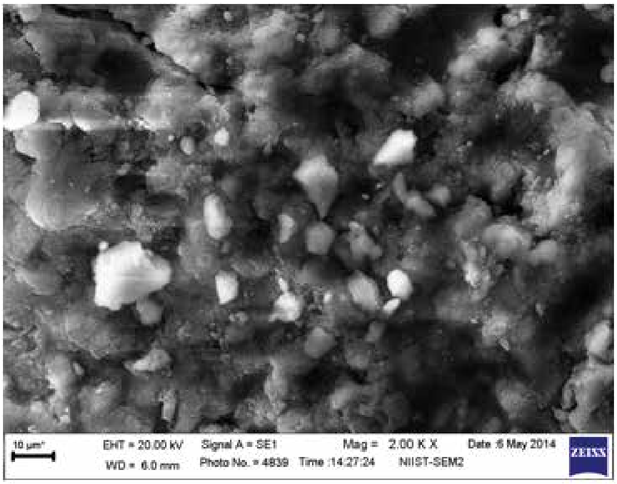


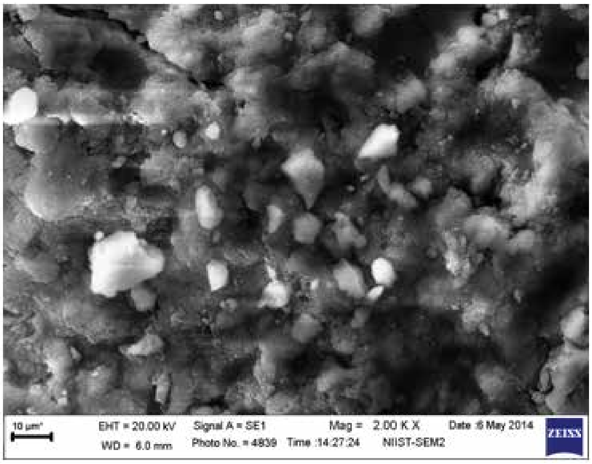
A series of intense red emitting phosphors, $Ca_{0.8-x}Zr_xMo_{1-x}Si_xO_4$: $0.2Eu^{3+}$ (x = 0.025, 0.05, 0.075, 0.1) that could be effectively excited in the UV region was prepared and well characterized. The incorporation of Zr^{4+} and Si^{4+} ions in $CaMoO_4$ lattice maintained the powellite crystal structure. The improvement in emission intensity and quantum efficiency (~ 39%) as compared to $CaMoO_4$: Eu^{3+} can be explained in terms of the local distortion around the Eu^{3+} ions. The CIE colour coordinates of the red emissions were in good agreement with the values of the standard red phosphors, indicating the potential utility in white LEDs. (Prabhakar Rao *et al. J Mater Sci: Mater Electron* **2014,** 25:2387–93)

POROUS CERAMIC MATERIALS: ENVIRONMENTAL APPLICATIONS

Super hydrophilic SiO_2/PVA hybrid aerogels for CO_2 adsorption

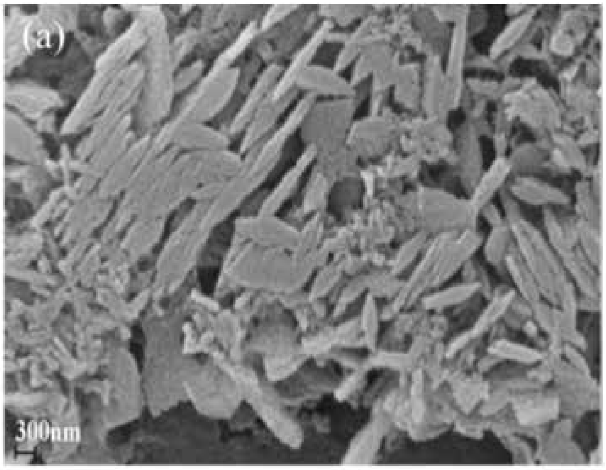
SiO_2 aerogel supports have been prepared using economically cheap sodium silicate precursors *via* gel granulation technique and was surface functionalized with three different amines such as 3-aminopropyltrimethoxy silane (APTMS), polyethylenamine (PEI) and diethanolamine for CO_2 adsorption at low temperatures (<100°C). A facile solvent exchange at ambient pressure drying condition was used to prepare physically stable porous SiO_2 aerogels. Since CO_2 has enhanced solubility in hydrophilic substrates, the SiO_2 aerogel was further modified with polyvinyl alcohol (PVA) hydrogels and then treated with APTMS. The CO_2 adsorption on SiO_2/APTMS/PVA hybrids was compared with amine modified SiO_2 aerogels. Unmodified SiO_2 aerogel had the surface areas of 283 and 149 m^2/gm when it was prepared with APTMS and PEI functional groups. It has increased to the value 360 m^2/gm in SiO_2-PVA hybrids. SiO_2 aerogel without any amine modification showed 8 mg/g of CO_2 uptake at 80°C. Further, it was significantly enhanced to 26 and 28 mg/g, respectively, in APTMS and PEI modified SiO_2 aerogel. The PEI-APTMS admixtures showed superior CO_2 uptake as 48 mg/g. This has been again improved to three times (122 mg/g) in SiO_2/PVA hybrid aerogels.

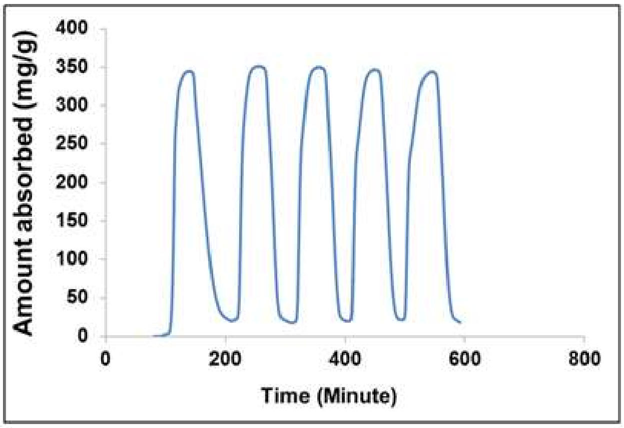




Enhanced CO_2 absorption kinetics in lithium silicate platelets

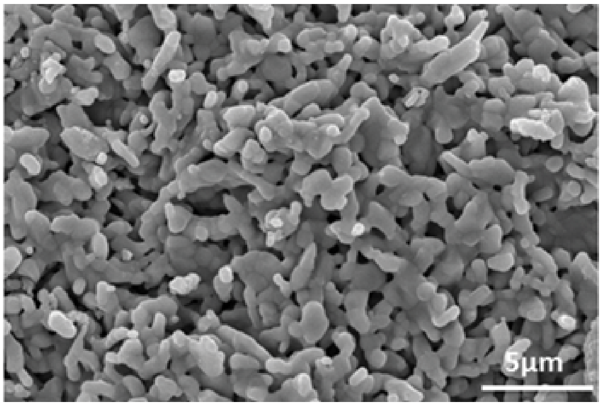
Carbon dioxide emission to the atmosphere is an increasingly important concern owing to its perceived influence over the elevation in atmospheric temperature. Platelet shaped lithium orthosilicate particles were synthesized by a sol gel approach. It was found to display enhanced absorption kinetics for CO_2 compared to the powders prepared by a solid-state reaction process involving Li_2CO_3 and silica. The sol-gel samples showed CO_2 absorption capacity of 350 mg/g at an absorption rate of 22.5 mg/g/min; a value 70% higher than the rate of 13.2 mg/g/min measured with the solid state samples under similar conditions. The higher sorption kinetics of CO_2 by the sol-gel derived lithium orthosilicate could be attributed to the unique platelet morphology of the particles with a very small thickness. A porous carbon mesh coated with the sol-gel based particles exhibited CO_2 absorption capacity of 150 mg/g at an absorption rate of 37.5 mg/g/min. This supported absorbent also showed stable absorption and desorption performance for the 8 cycles examined. The excellent absorption characteristics of the sol-gel prepared powders, more specifically the coated strips provide a successful pathway for the commercialization of these materials *(Hareesh et al. Journal of Materials Chemistry A, in press)*.

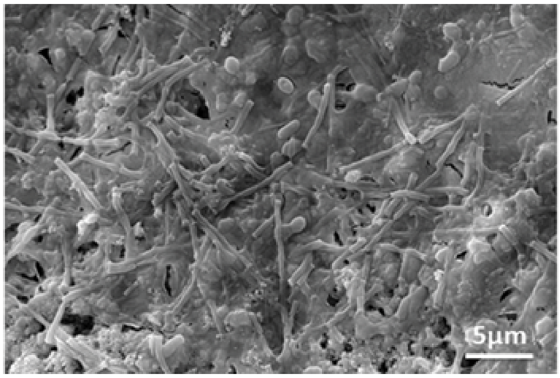




Bi-functional lanthanum phosphate adsorbents and bio catalyst supports for perchlorate removal

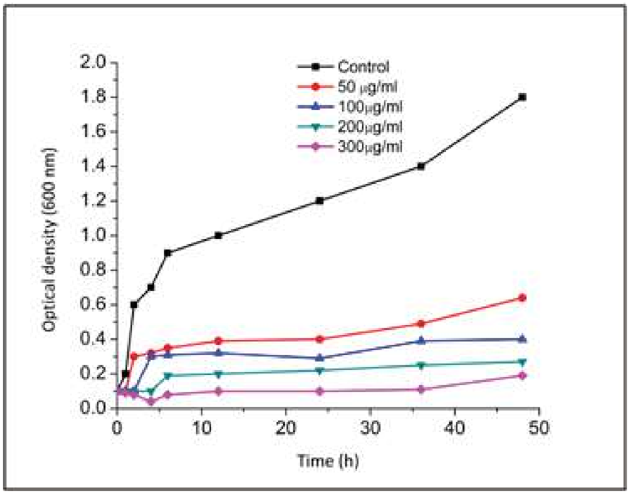
Perchlorate is known to interfere with the functioning of thyroid glands by reducing the level of thyroid gland hormones triiodothyronine (T3) and thyroxine (T4) responsible for regulation of metabolism in human beings. Attempt was made to explore the suitability of lanthanum phosphate porous substrates for the adsorption of perchlorate from water. The intrinsic hydrophobic nature of lanthanum phosphate can, in addition, facilitate biofilm growth of perchlorate reducing microbes owing to the better adherence of the bacteria on the hydrophobic substrates. Porous lanthanum phosphate substrates, obtained by an environmentally benign colloidal forming process employing methyl cellulose, was found to be an excellent adsorbent of perchlorate with >98% efficiency and with 100% reusability. The effectiveness of such substrates as bio catalyst is that it facilitates biofilm formation of perchlorate reducing microbes (*Serratia marcescens* NIIST5). The adsorption of perchlorate ions is attributed to the pore structure of lanthanum phosphate substrate and the microbial attachment is primarily ascribed to its intrinsic hydrophobic property. Lanthanum phosphate thus emerges as a dual functional material that possesses an integrated adsorption/bioremediation property for the effective removal of ClO_4. *(Hareesh et al. Journal of Hazardous Materials, **2014**, 275, 222-29)*.





Anti fungal property of nanosized ZnS particles synthesized by sono-chemical precipitation

Control of microbial growth has become increasingly difficult owing to the resistance offered by microbes against conventional anti microbial agents. The use of nanoparticles such as TiO_2, ZnO, Ag for anti-microbial activity has been successfully demonstrated in recent times. zinc sulphide (ZnS) nanoparticles, synthesized by sono-chemical route employing zinc chloride and sodium sulphide, displayed significant anti-fungal property against the pathogenic yeast *Candida albicans* (MTCC 227) at a minimum fungicidal concentration of 300 μg/ml. The sonochemical synthetic route produced n-ZnS particles with S vacancies that lead to the generation of hydrogen peroxide in aqueous suspensions. The generation of ROS as the dominating mechanism was confirmed by the observation that the fungicidal activity of n-ZnS particles was inhibited by 4mM addition of histidine, a scavenger of hydroxyl radical and singlet oxygen. Additionally, elemental mapping studies carried out along the radius of the zone of inhibition area revealed the presence of Zn in decreasing concentrations. This efflux mechanism releasing Zn^{2+} ions also contribute towards disruption of fungi cell membrane inducing irreversible damage and cell death. *(Hareesh et al., RSC advances* **2014***, 4, 8439).*



Magnetic dye adsorbent based on TiO_2-fly-ash nanocomposite

Novel flyash-based composite materials such as the hydrogen titanate nanosheets-flyash composite, flyash-hydrogen titanate nanotubes composite, and flyash-metal nanoparticles composite were developed *via* innovative approaches. These flyash-based composites find potential application in the removal of harmful organic-synthetic-dyes from the aqueous solutions. Typically, these novel composites can decompose the harmful organic-synthetic-dyes in the Dark-Condition *via* the "One-Step" method of newly developed "Dark-Catalysis" process. To ease the separation of flyash-based composites from the treated aqueous solutions using an external magnetic field, flyash-based magnetic composites have been developed. The dye-decomposition takes place in relatively less time and the non-magnetic as well as magnetic flyash-based composites can be recycled as catalyst for the successive cycles.

Industrial Dye-Removal via "one-stop" Dark Catalysis Mechanism using novel Flyash-based composites

SUPERCONDUCTING AND MAGNETIC MATERIALS

$NdFeAsO_{1-x}F_x$ Superconductor: Impact of fluorine variation

$NdFeAsO_{1-x}F_x$ compound is one of the most promising candidates among the iron based superconductor systems due to its remarkably high values of critical temperature (T_C) and critical field (H_C). It is imperative to understand the electromagnetic properties of this potential superconductor with varying F content in order to achieve the maximum T_C and critical current density (J_C). CSIR-NIIST has successfully synthesized the compound by varying the fluorine content (x=0, 0.1, 0.2, 0.3 and 0.4) at a relatively low temperature of 1000°C and ambient pressure. A maximum transition temperature of 52.0 K and a transport critical current density higher than 1000 A/cm^2 at 12 K were achieved for the samples with x = 0.3 and 0.4 respectively. The transport and magnetic properties observed for each stoichiometry were found to have remarkable correlation with their corresponding structural and microstructural features. Moreover, the super conducting properties exhibited in this material, processed at a relatively low temperature, were at par with those prepared at higher temperatures (1150°C) or high pressures (6 GPa) [*Syamaprasad et al. J. Am. Ceram. Soc.*, ***2013***, *96, 1176-80]*.

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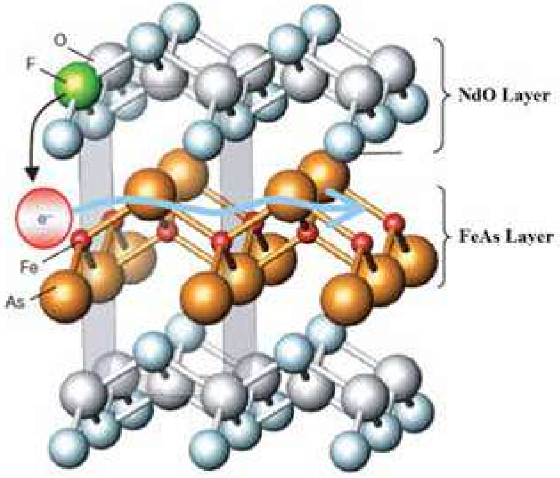
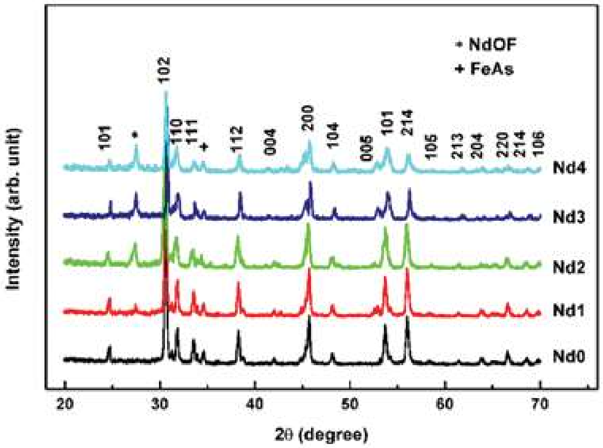
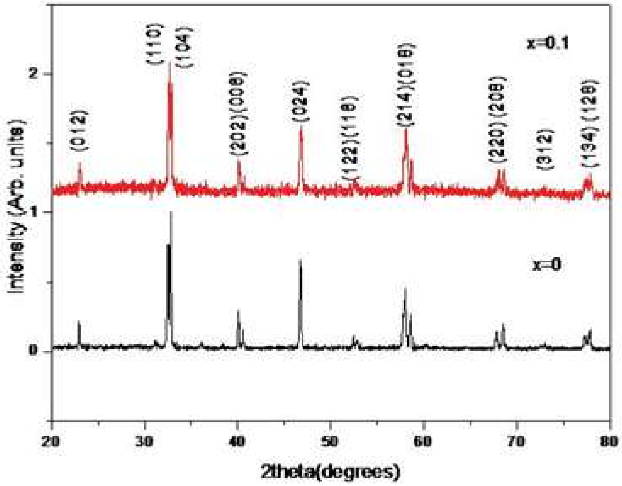
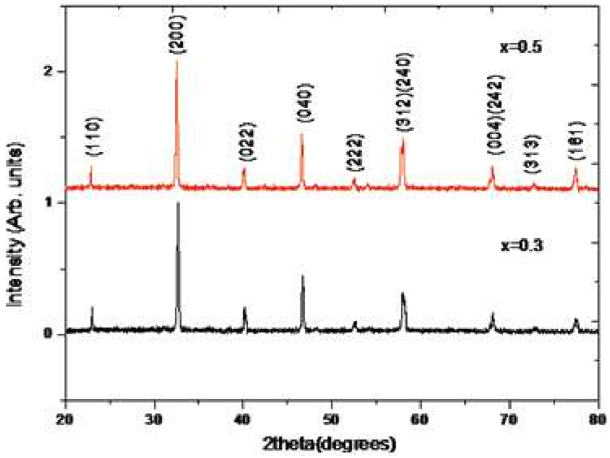




Effect of Cobalt substitution on magetocaloric properties of $La_{0.7}Te_{0.3}MnO_3$

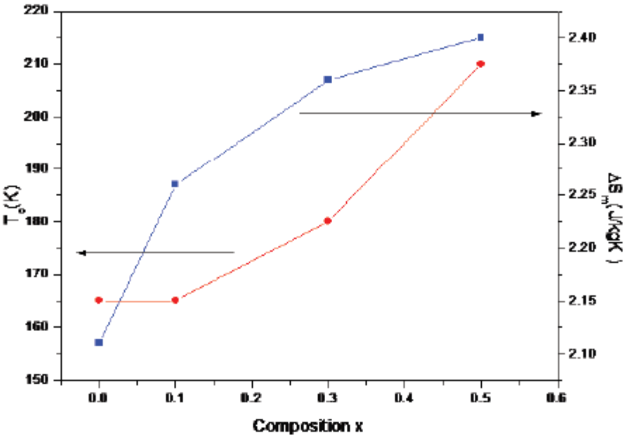
$La_{0.7}Te_{0.3}MnO_3$ is a material reported to have high magnetocaloric effect of ΔS_m=12.5 J/kgK at 280K when it is in its nano form with a particle size of ~ 50 nm. Hence this material was further studied to understand the effect of Co substitution in Mn site on its Curie Temperature Tc and magnetocaloric effect. Co substituted LTMO with composition $La_{0.7}Te_{0.3}Mn_{1-x}Co_xO_3$ (x= 0,0.1, 0.3 and 0.5) was synthesized by solid state ceramic route. The phase purity of the samples was studied using X-ray diffraction with Rietveld refinement. It was observed that with Co substitution the crystal structure transforms from rhombohedral (R-3c space group) to orthorhombic (Pbnm space group) for Co composition x = 0.3. It was also observed that Tc has increased with Co substitution with increase of ΔS_m from 2.11 J/kgK to 2.4 J/kgK.

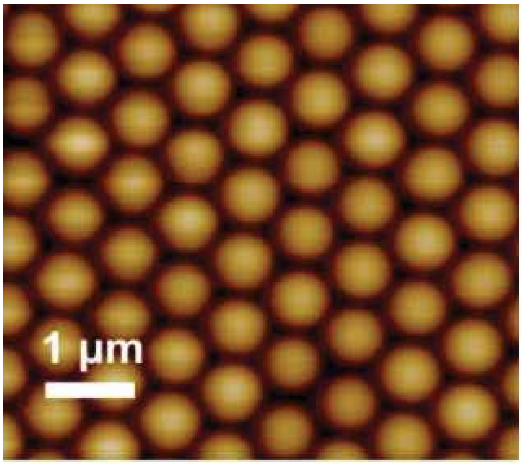




Temperature dependent exchange biased magnetic vortices

The magnetization reversal of vortex structures in Fe as well as in IrMn/Fe magnetic caps at elevated temperatures up to 450 K was investigated. The cap structures were formed by film deposition onto self-assembled silica particles of 900 nm diameter. In the investigated temperature range, the magnetization reversal in Fe caps evolves *via* nucleation and annihilation of a magnetic vortex state. However, in IrMn/Fe nanocaps, the magnetic vortex vanishes as temperature approaches the blocking temperature of IrMn. This was accompanied by an increase in coercivity. Increase in temperature, approaching the Néel temperature of IrMn, results in a reduction of coercivity as well as remanence indicating the re-stabilization of vortex state.



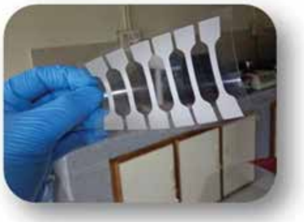


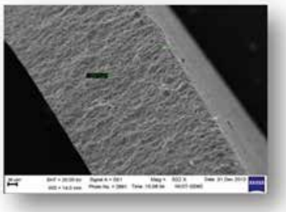
Atomic force micrograph showing the self-assembling of SiO_2 nano spheres

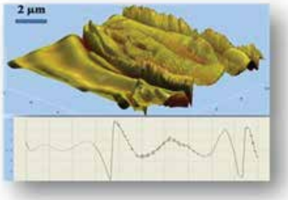
ELECTRO-CERAMIC MATERIALS

Mineral *Zircon* for HTCC substrate applications

The rapid emergence of touch screen phones demands high volume efficiency of the microelectronic devices without degradation of their electrical performance. A novel HTCC substrate was developed based on mineral zircon that is a co-product of the mining and processing of heavy mineral beach sands in Kerala. Process includes preparation of zircon mineral powder *via* milling followed by dispersion in ethanol/Xylene solvent (1:1) with fish oil as the binder. The colloidal slurry of $ZrSiO_4$ with typical pseudoplastic behaviour has been casted in to thin tape of thickness in the range 0.7-0.1 µm. The thermo-laminated multilayered tape (4 layers) sintered at 1400-1700 °C/2h showed excellent microwave dielectric properties with ε_r ranging from 8-10, and $\tan\delta$ around 4×10^{-4} which is better than alumina. The $ZrSiO_4$ has an ultra low coefficient of thermal expansion of ±2 ppm/°C and has a thermal conductivity in the range 10-16 W/m K. The average root mean square (RMS) surface roughness of a typical HTCC zircon substrate was 140 nm. It showed tensile strength of 14-20 MPa and has flexural strength of 130-150 MPa. This HTCC zircon substrate is advantageous over currently available HTCC substrates in terms of production cost, dielectric and thermal and mechanical properties.

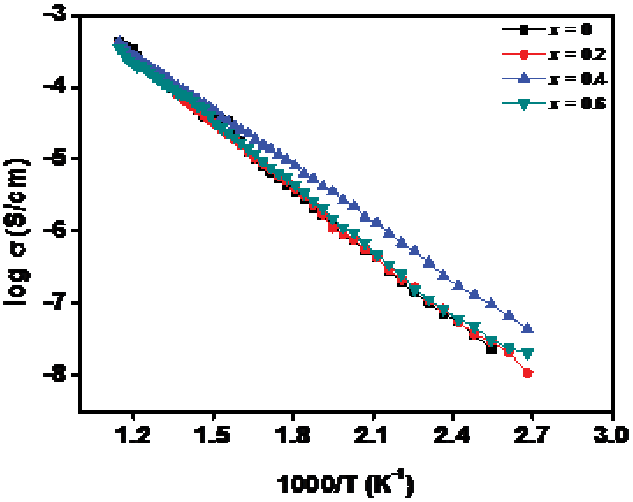






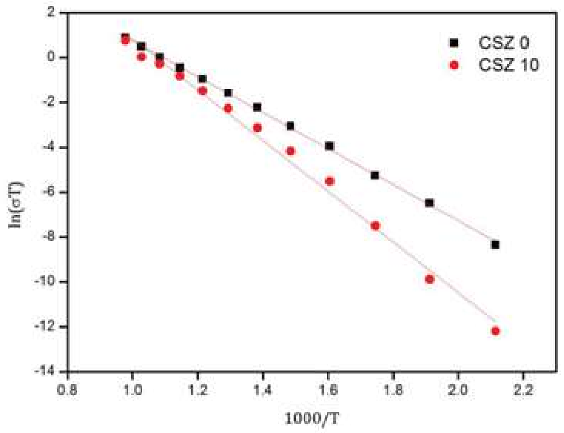
Pyrochlore type $CaCe_{0.6}Mn_{0.4}Sn_{1-x}Fe_xNbO_{7-\delta}$ semiconducting oxides for high temperature NTC thermistor applications

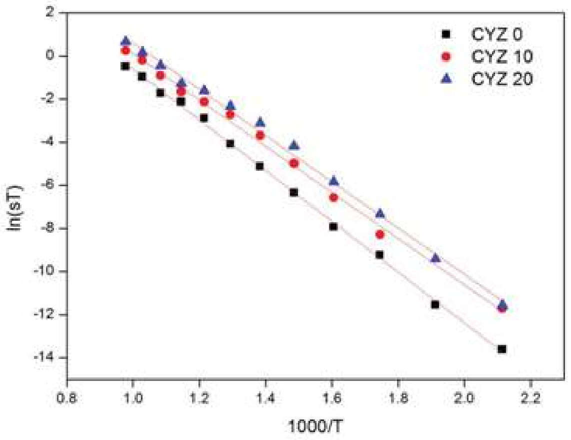
Pyrochlore structured semiconducting oxides $CaCe_{0.6}Mn_{0.4}Sn_{1-x}Fe_xNbO_{7-\delta}$ (x = 0, 0.2, 0.4 and 0.6) were prepared by solid state reaction method. The effect of B-site substitution was studied by employing X-ray diffraction, Raman spectroscopy, scanning electron microscopy and impedance analysis. Microstructural analysis showed an increase in grain size with progressive iron substitution. Conductivity measurements exhibit the negative temperature coefficient of resistance (NTCR) behavior of the samples for a wide range of temperature from room temperature to 600°C. The impedance study of the system provides insight to the bulk or grain contribution in the electrical properties of the system. The activation energy for conduction was decreased by Fe substitution and the sensitivity values were enhanced without affecting the thermistor constant considerably. The conductivity variation with temperature follows the Arrhenius relation. Correlated barrier hopping model was successfully applied for explaining the conduction mechanism within the compounds.



$CaZrO_3$-$RE_2Zr_2O_7$ (RE: Y, Sm) solid ionic conductors

$CaZrO_3$-$(Y,Sm)_2Zr_2O_7$ system where the solid solutions contained *x* mol% of $CaZrO_3$ in $(Y,Sm)_2 Zr_2O_7$ (*x* = 0, 10, 20, 33.3) along with pure $(Y,Sm)_2Zr_2O_7$ were prepared (being labeled as CYZ 0, CYZ 10, CYZ 20, CYZ 33, CSZ 0, CSZ 10, CSZ 20, CSZ 33 respectively). CYZ 0 and CSZ 0 crystallized in two different crystal structures. CYZ 0 forms a defect fluorite type cubic structure with Fm3m space group whereas CSZ 0 forms an ideal cubic pyrochlore structure with Fd3m space group. This is attributed to the ionic size difference between Y and Sm. $Y_2Zr_2O_7$ lattice can accommodate up to 20% of $CaZrO_3$ in its lattice without secondary phase formation. However in CSZ series, it can be seen that x = 20 and 33.3 show impurity peaks of $CaZrO_3$. The super lattice peaks show a progressive decrease in intensity as x increases as an indication of induced disorder caused by the addition of $CaZrO_3$. The ionic conductivity was studied by impedance spectroscopy. The Arrhenius plot of the CYZ series showed an increase in conductivity with increase the fraction of $CaZrO_3$. While in CSZ system, the conductivity decreased slightly by the addition of $CaZrO_3$. The addition of divalent Ca to the disordered $Y_2Zr_2O_7$ lattice can create oxygen vacancies. This increases the amount of charge carriers in the lattice thereby increasing the conductivity. In the case of $Sm_2Zr_2O_7$, Ca addition disrupts the lattice order leading to enhanced ion-ion interaction and hence to decreased conductivity.

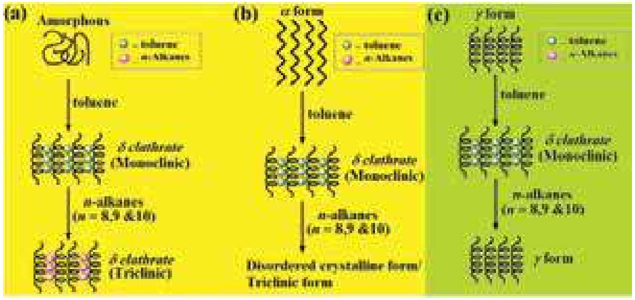




POLYMERS AND POLYMER MATRIX NANOCOMPOSITES

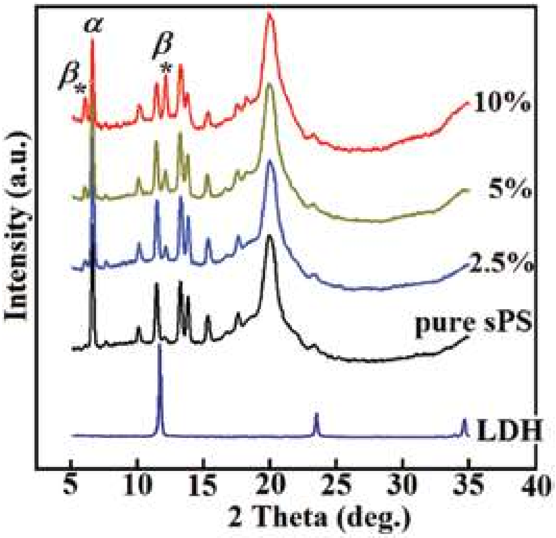
Influence of host preparation method on the structural phase transitions of syndiotactic polystyrene upon the guest exchange with *n*-alkanes

Syndiotactic polystyrene (sPS) has a tendency to form polymer-solvent complexes (co-crystals) with a large number of guest molecules. The starting morphology used for the preparation of the sPS/solvent complex, has a significant role in facilitating the phase transitions of the host structure upon guest exchange process. This effect was studied on the structural changes of sPS, using guest exchange process, with a series of *n*-alkanes. SPS-solvent complexes (monoclinic δ form) were prepared with different starting morphologies i.e. amorphous, α and γ forms using toluene and chloroform as guests. Upon guest exchange process (performed by dipping the samples in a series of *n*-alkanes viz. *n*-octane to *n*-decane), toluene treated amorphous and α form samples (i.e. monoclinic δ form) transformed into the triclinic δ form irrespective of the starting morphology. However, the toluene treated γ form transformed back to the γ form in presence of *n*-alkanes. Chloroform treated amorphous sample (i.e. monoclinic δ form), however, converted to a mixture of δ form (triclinic) and ε form, while chloroform treated α and γ forms transformed into triclinic δ form and ε form, respectively. (Bhoje Gowd *et al*. *Polymer*, **2013**, 54, 6617-27).



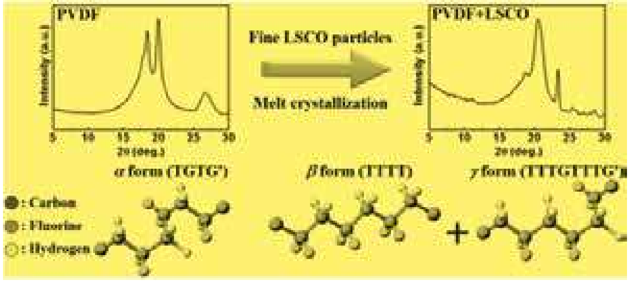
Polymer/ layer double hydroxide nanocomposites as flame retardant materials

New nanocomposites were prepared using syndiotactic polystyrene (sPS) and surfactant free layered double hydroxides (SF-LDH). This method involves wash treatment of prepared SF-LDH in appropriate organic solvent followed by gel formation in a nonpolar solvent. This gel was directly used to make highly dispersed polymer nanocomposites using solvent mixing method. The influence of highly dispersed SF-LDH platelets on the crystallization, polymorphism, thermal stability and flame retardancy of sPS were examined with differential scanning calorimetry, wide-angle X-ray diffraction, themogravimetric analysis and microscale combustion calorimetry. It was shown that SF-LDH significantly enhances the crystallization rate of sPS and favours the formation of thermodynamically stable β form along with the α form of sPS. Moreover, highly dispersed SF-LDH significantly decreases the heat release rate and total heat release of sPS indicating the enhancement of flame retardant properties of sPS. In this way, it was found that the dispersed SF-LDH platelets act as multifunctional nanofiller for sPS.



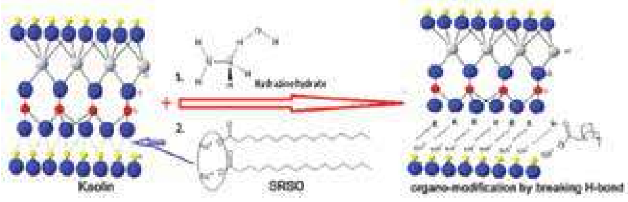
Poly-vinylidene fluoride (PVDF)/ $La_{0.5}Sr_{0.5}CoO_{3-\delta}$ (LSCO) composites

Dielectric composites composed of poly-vinylidene fluoride (PVDF) and $La_{0.5}Sr_{0.5}CoO_{3-\delta}$ (LSCO) were developed. The effects of particle size of LSCO (fine (~250 nm) and coarse (~3μm)) on the phase crystallization of PVDF were studied. The inclusion of fine LSCO into PVDF readily favours the formation of polar crystals (β and γ-phases), which makes the composite suitable for both electromechanical and high charge storage embedded capacitor applications. Addition of fine LSCO not only favours the polar crystals but also increase the overall crystallization rate and melting point of PVDF considerably (Bhoje Gowd *et al*. *Phys. Chem. Chem. Phys.* **2014**, *In press*).



Organo-modified kaolin rubber nano-composites

Natural rubber (NR) and its blends with butadiene rubber (BR) or nitrile rubber (NBR) containing very low amounts of kaolin modified with either sodium salt of rubber seed oil (SRSO) or phosphorylated cashew nut shell liquid prepolymer (PCNSL) showed improvements in cure characteristics, filler dispersion and physico-mechanical properties such as tensile modulus, tensile strength, elongation at break, thermal stability and dynamic mechanical characteristics.



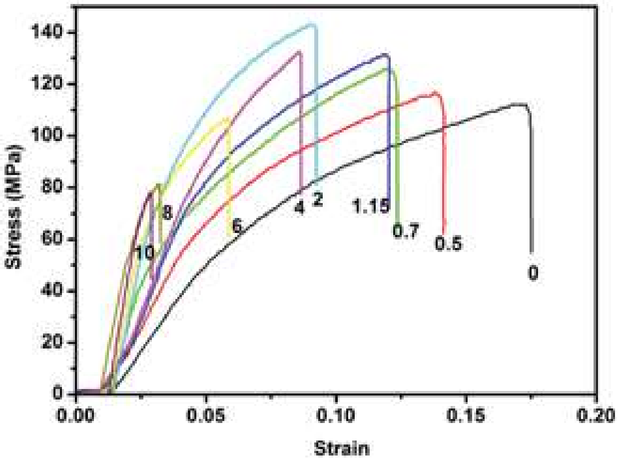
METALLIC MATERIALS

Al-Mg-Zr alloys for aerospace applications

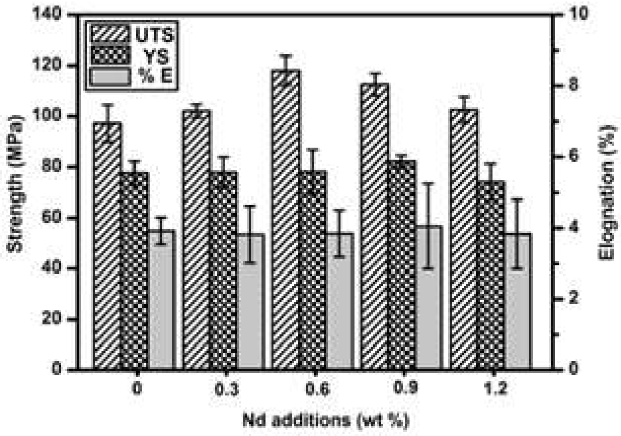
Light weight aluminium alloys which provides high strength, good formability and good weldability is being developed to increase the fuel efficiency in automobile and aerospace applications. Addition of transition elements such as Zr to Al-Mg alloy provides high strength at room temperature and microstructural stability at high temperatures by forming fine and stable dispersoids such as Al_3Zr. In order to find the suitability of Zr addition as a substitute for Scandium in Al-Mg alloys 0.2% Zr additions were made and compared with the alloys made without Zr addition. The as-cast microstructure given below reveals presence of Al_3Mg_2 intermetallic compounds distributed in the Al-matrix. The size and volume of Al_3Mg_2 increased with increase in Mg content. Addition of Zr lead to the formation of Al_3Zr-dispersoids which enabled super plastic deformations. By hot rolling and annealing the grain size of the alloys were reduced significantly. The grain size of the alloys found to decrease with increase in Mg content. The tensile properties of the alloys in the rolled and annealed condition revealed an increase in strength with increase in Mg content as influenced by the precipitates and reduction in the grain size contributed by Zr addition. However, at higher Mg content (8%) and Zr addition, the percentage elongation gets lowered (16-20%) compared to the 4%Mg containing alloy (20-30%). The tensile fractured surface revealed a large proportion of the fracture being intergranular. Dimples which are an indication of tensile ductility and secondary phase particles could be seen on the fractured surface. In some locations cleavage facets perpendicular to the tensile axis were also noticed. The formability studies on these alloys and role of rare earth additions are under progress.

Rare earth modified Mg-Si based alloys

Mg-Si alloys are potential candidate for high temperature applications in automobile industries. The preliminary results indicated that the eutectic Mg_2Si in the hyper eutectic Mg-Si alloys (Si=0.5, 0.7 and 1.15 wt.%) appeared as a coarse Chinese script morphology. Also, the primary Mg_2Si particles in the hyper eutectic alloys (Si = 2,4,6,8 and 10 wt.%) solidified as a coarse dendrites. These features reduced the tensile properties. The previous work indicated that addition of MM, Nd, modifies these morphologies. In the present work, tensile properties of Mg-Si alloys and effect of modification on the tensile properties were studied. The properties of Mg-Si alloys (a) and typical properties of Nd modified Mg-6Si alloys (b) are shown below (UTS Pillai *et al. Proceedia Engineering* 55 (2013) 103-08).



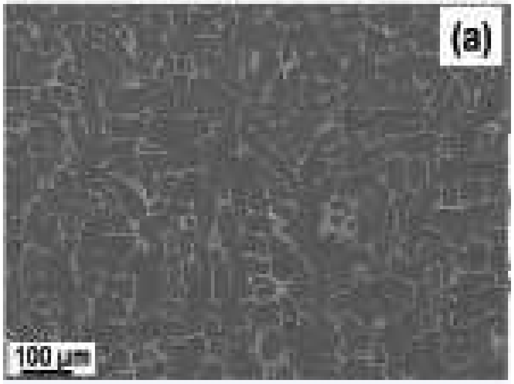
(a)

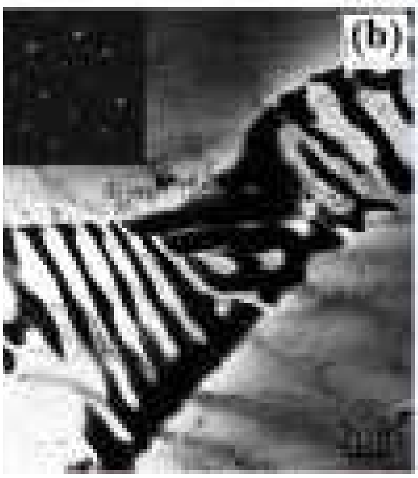


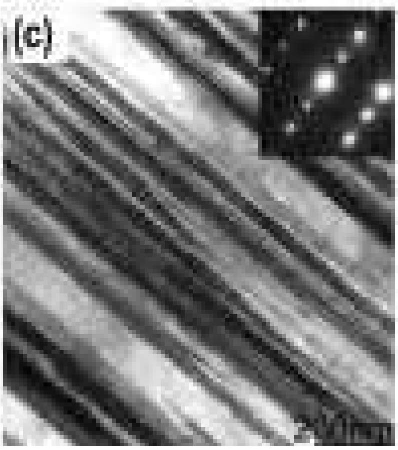
(b)

Development of high creep resistant Mg-Gd-Zn Alloys

Recently, magnesium alloys with heavy and high solubility rare earth elements (RE) such as Gd, Dy are subjects of scientific investigations as RE additions are very effective alloying elements for strengthening. Gd is one such rare earth elements being investigated for the possibility of developing new magnesium alloys with a good combination of mechanical and corrosion properties. In the present work, microstructure and mechanical properties of four alloys, Mg-2Gd-2Zn, Mg-2Gd-6Zn, Mg-10Gd-2Zn and Mg-10Gd-6Zn (all are in weight percentages), prepared by gravity permanent mould casting were investigated. The results indicated that the intermetallic phases in the Mg-2Gd-2Zn alloy consisted mainly of (Mg, Zn)$_3$Gd phase whereas the Mg-2Gd-6Zn alloy consisted of both I (Mg$_3$Zn$_6$Gd) and (Mg, Zn)$_3$Gd phases. Lamellar LPSO phase was observed in alloys containing high concentrations of Gd (Mg-10Gd-2Zn and Mg-10Gd-6Zn alloys) in addition to the continuously distributed (Mg,Zn)$_3$Gd phase along the interdendritic regions and grain boundaries. Mg-10Gd-xZn alloys (x=2,6) exhibited higher yield strength due to the higher solutes contents and the presence of long period stacking ordered (LPSO) phase in the matrix, but showed poor elongation due to the coarse continuous second phase at the boundary. Low Gd containing alloys showed better elongation to failure and moderate strength due to the lower volume fraction of fine scale second phases (A. Srinivasan *et al. Mater. Sci. Eng. A* 595 (**2014**) 224-34).

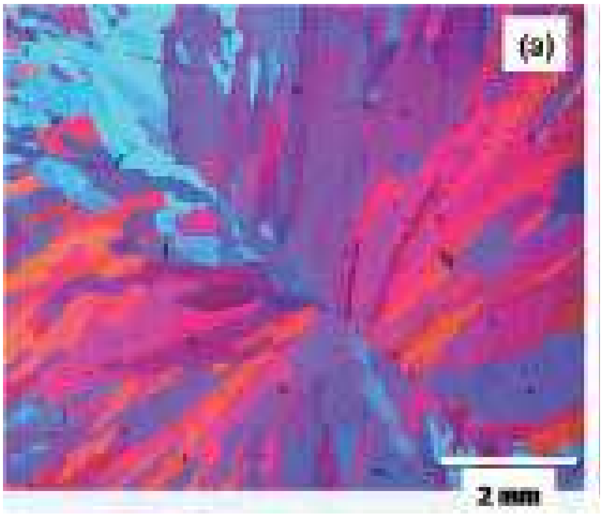






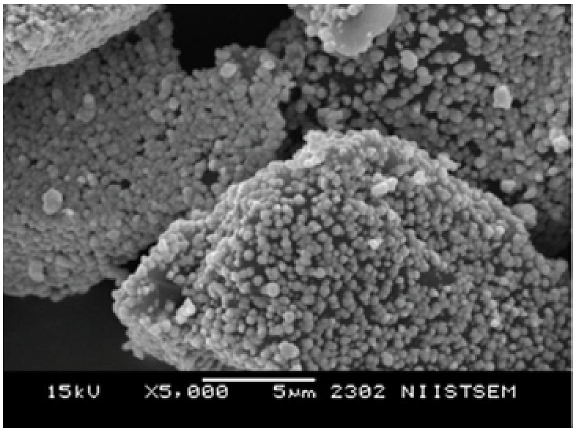
Hot tearing characteristics of Mg-RE alloy castings

Many solidification defects during casting still occur and lead to production loss in cast shops. Hot tearing is one such defect, which represents a formation of an irreversible crack in the final stage of solidification of a casting. In the present work, hot tearing characteristics of Mg-xGd (x = 1, 2, 5 and 10 wt.%) binary alloys have been studied in an constrained rod casting (CRC) apparatus attached with a load cell and data acquisition system. The results indicated that the susceptibility (defined by the volume of crack) increased with increase in Gd content to reach a maximum at 2 %, and then reduced with further increase in Gd to reach a minimum with 10% Gd. The high susceptibility observed in Mg-2% Gd was attributed to its cellular or columnar grain structure, which facilitated easy tear propagation, high strain at the onset with little amount of remaining liquid. In contrast, the lowest susceptibility of Mg-10% Gd was related to its equiaxed grain structure, which effectively accommodated the strain during solidification by reorienting themselves and the ability of the Gd rich liquid to partially or completely refill the tear at the end of solidification. (A. Srinivasan *et al.Metall. Mater. Trans. A* 44A (**2013**) 2285-98).



Autocatalytic copper coating on boron carbide particles

The functional and structural applications of boron carbide (B_4C) for neutron shielding and engineering sectors are limited due to brittleness and low temperature oxidation; however its use is enhanced by the synthesis of its composites. The interfacial compatibility of boron carbide with the matrices can be improved by the formation of metallic coatings. Autocatalytic copper coating over surface treated B_4C particles with varying bath parameters and its influence on coating morphology and uniformity were evaluated. An effective coating of copper over boron carbide was obtained at pH12 and a bath temperature of 30 °C. Above pH 12 as well as higher bath temperatures of 50 and 75 °C led to predominant co-deposition of metallic copper clusters within the reaction bath. SEM observations showed copper clusters in the size range of 200–400 nm and the Debye–Scherrer crystal size calculation showed that copper crystallite size in each clusters vary from 17 to 25 nm. The morphology of Cu coating changed from cauliflower-like structure to angular shape with increase in bath temperature and pH. *(TPD Rajan et al. Surface Coating and Technology, 214 (**2013**) 77-85)*



MINERALS

Investigations on Orissa grade ilmenite in the preparation of synthetic rutile

In view of the non availability of Chavara (Kerala) grade ilmenite for the preparation of synthetic rutile for private mineral industries, efforts were made to explore the possibility of employing abundantly available Orissa grade ilmenite for the same. After a detailed chemical and physical characterization, the Orissa grade ilmenite was subjected to metallization using commercial grade coal. Physical characterization such as XRD had revealed that the ilmenite was the least weathered among the important commercial ilmenite resources of the country. The chemical analysis of ilmenite reported 51.56% TiO_2 and the total iron content at 35.35%.

Commercial grade B grade coal having fixed carbon content of 46% was used as the reductant for the metallization of ilmenite. Reduction experiments were carried out in a SS tubular reactor. Thoroughly mixed ilmenite and coal were loaded into the reactor tube and the tube was introduced into a muffle furnace preheated at 1050 ° C. The reduction was carried out a temperature of 1050°C for duration of 4 hours. Metalized ilmenite after separation from excess coal, ash and unreduced ilmenite using magnetic separation was subjected to chemical analysis of metallic and total iron for the elucidation of percentage metallization. Metalized ilmenite having more than 85% metallization was subsequently subjected to aeration rusting in presence of a suitable catalyst for the removal of metallic iron in the form of rust. Aeration rusting was carried out in PVC beaker fitted with baffles. The pH of the aqueous solution was adjusted to 4 immediately after the addition of metalized ilmenite. The contents were kept in agitation using a stirrer and the solution was purged with air continuously. Rusting was carried out for 12 hours after which the slurry containing iron oxide and beneficiated ilmenite was separated by dilution and decanting. Beneficiated ilmenite free from iron oxide was analyzed for the residual iron content. Beneficiated product with residual iron ranging from 9-13% was obtained in a series of experiments. The pressure leaching of this product is planned using an autoclave for the preparation of synthetic rutile of about 96-97% TiO_2.

Utilization of waste iron oxide from titanium mineral industries

M/s. Kerala Minerals and Metals Limited, Kollam, Kerala produces tonnage quantities of iron oxide during the product of TiO_2 pigment by chloride route. Intense colour, fine size and huge quantity of this by product is a major challenge for the industry in terms of environment and air/water pollution. A systematic physical and chemical characterization of waste iron oxide received from M/s. KMML was carried out for utilization of waste iron oxide for pigment applications by suitably converting them into saleable pigments. Physical characterization include, XRD, particle size distribution, TG-DTA and FTIR. The analysis revealed that the product is very fine with average size of 1.68 micron. FTIR spectra confirmed the presence of Fe_2O_3 with vibration bands at lower frequencies. XRD further revealed that the major phase is Fe_2O_3 with impurity phases such as TiO_2 and SiO_2.

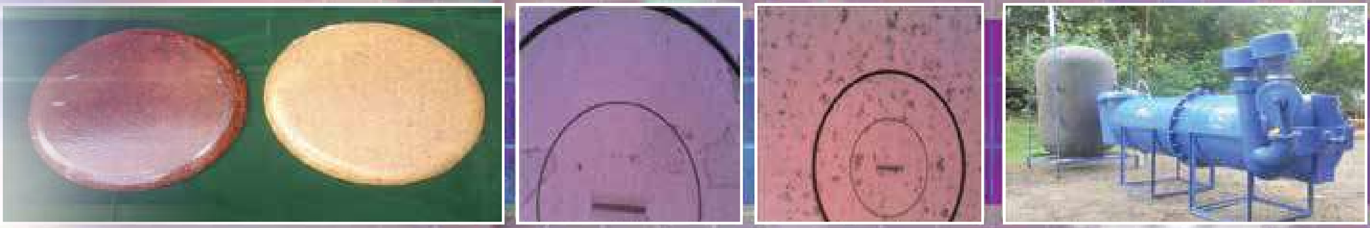
Specialty materials based on engineered clays

Under the above 12th FYP Network Program, NIIST has received about 9 clay samples. Mineralogical studies of 2 samples from Kerala, 2 from Gujarat and 1 from Andhra Pradesh using optical microscopy, XRD, TG/DTA, SEM and TEM studies were completed. Kerala clays in general showed kaolinite as the major phase with minor impurity phases such as anatase, haematite, rutile and quartz. The clay samples from Gujarat showed again kaolinite as the major phase with quartz and nacrite as the impurity phases. However, the clay sample from Andhra Pradesh showed quartz as the major phase and hence had to be rejected and not considered for further beneficiation. Four new organic molecules were designed and hybrid clays based on them were synthesized as adsorbents. These clay based adsorbents were subsequently used at concentration of 2.5g/L as a matrix in the bioremediation of perchlorate ions in water. The results were very encouraging with the complete conversion of perchlorate ion to chloride ion in bioreactors. Blends of natural rubber (NR)/ butadiene rubber and NR/nitrile rubber containing 4 phr of sodium salt of rubber seed oil modified kaolin with improved curing characteristics, filler dispersion, chemical crosslink density index, tensile properties, and dynamic mechanical properties were prepared for tyre side walls. Modified kaolins were used as the fillers in the place of toxic silicious fibres.

Studies on exfoliation of kaolinite clay with *in situ* incorporation of polyhedral oligomeric silsesquioxane (POSS) as the guest species was carried out. SEM/TEM studies revealed the formation of uniformly distributed vesicles. These vesicles could be used for storage and control release of paints and cosmetics. Highly exfoliated sPS (*Syndiotactic Polystyrene)* nanocomposite by simple solution blending method was prepared using highly dispersed unmodified LDH. Thermal stability and flammability properties as a function of LDH loading were studied. Heat release rate showed decreasing trend with the increase in LDH loading.

Investigation on the potential beach placer deposits along Thiruchendur Coast, Tamilnadu, India

Granulometric studies of samples from all the sectors showed a single source deposition. Sands of all the sectors mostly fall in medium grade. Low tide line samples in some cases showed irregular coarse grains due to the action of wave motion. The deposition of sediments showed the Aeolian action of wind by the result of linear discriminative function and CM pattern revealed that all the samples fall in shallow agitated Aeolian deposits and were deposited by the process of graded suspension and beach environment. The heavy mineral distributions in the two sectors in southern sectors showed higher concentration than other sectors in northern part of study area. The total heavy mineral percentage is high in berm samples of the last two sectors Periyathalai and Ovari. The optical microscopic studies of heavy mineral count percentage showed domination of garnet, ilmenite, sillimanite. While in medium fraction the garnet was dominated (Avg.53.17%), whereas in fine fraction sillimanite (42.33%) and garnet (avg.28.76%) were dominated. However, the very fine fraction was more dominated by ilmenite followed by sillimanite. The surface morphological studies of quartz and garnet by scanning electron microscope revealed physical / mechanical and chemical weathering / alteration, solution activities on its surface. Placer deposits of northern sector (Thiruchendur, Kallamozhi, Kulasekarapattinam, Manapad) dominated by mechanical weathering and southern sector (Periyathalai,Ovari) dominated by the chemical weathering.



PROCESS ENGINEERING AND ENVIRONMENTAL TECHNOLOGY DIVISION

The Process Engineering and Environmental Technology Division develops processes and technologies for value addition to the region's resources and for the management of the region's environment. The environmental management services are used by industry and government for statutory environmental impact assessment studies and clearances of new projects in mining, infrastructure and process industry. The division's computational modelling services provides computational tools and services for investigating natural phenomena and for designing engineering processes. The multi-disciplinary team comprising engineers, chemists, physicists, mathematicians, biologists and computer scientists addresses real problems such as:

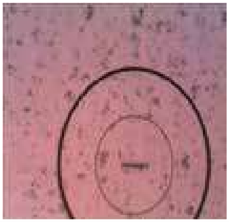
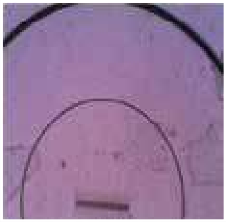
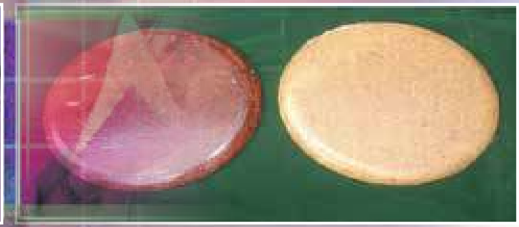
- Municipal and household waste treatment
- Industrial effluent treatment
- Odour control
- Dioxins and persistent organic pollutants in the environment
- Environmental impact analysis
- Water quality analysis
- Groundwater pollution from industrial waste disposal
- Anaerobic technology: retting for extraction of plant fibres
- Anaerobic technology application in production of white pepper
- Beneficiation and value addition of clay minerals
- Enhancing industrial profitability through affordable indigenous software
- Computational fluid dynamics applications in process industry

While technology goals for local problems are the priority, the division also carries out R&D on with longer term goals on global issues, in the following areas:

- Developing technology for the production of microalgae for biofuel
- Development of Agent Based Simulations for understanding behavior of biological systems

The activities of the Division are under four sections namely Chemical Process Engineering, Environmental Technology, Computational Modeling and Simulation and Dioxin Research. Some of the research highlights for the year are:

- AutoCast XI commercial software upgrades
- Detected and mapped groundwater contamination from perchlorate at Aluva
- Detected and mapped spread of contaminants from industrial waste disposal ponds at Chavara
- Completed of Phase I of NMITLI project 'Biofuel from marine microalgae'. Engineered natural selection process developed for cultivation of microalgae for biofuel.
- Demonstration Plant commissioned for banana and pineapple fibre extraction
- Gas biofilter commissioned for fish meal factory, Palghat

प्रक्रिया इंजीनियरिंग तथा पर्यावरण प्रौद्योगिकी प्रभाग

प्रक्रिया इंजीनियरिंग तथा पर्यावरण प्रौद्योगिकी प्रभाग इस क्षेत्र के संसाधनों के मूल्य वर्धन के लिए और इस क्षेत्र के पर्यावरण के प्रबंधन के लिए प्रक्रियाओं और प्रौद्योगिकियों को विकसित करता है। वैधानिक पर्यावरण प्रभाव आकलन अध्ययन और खनन, बुनियादी ढांचे और प्रक्रिया उद्योग में नई परियोजनाओं की मंजूरी के लिए उद्योग और सरकार द्वारा पर्यावरण प्रबंधन सेवा का उपयोग किया जाता है। प्रभाग के कम्प्यूटेशनल मॉडलिंग सेवाओं द्वारा प्राकृतिक घटनाओं की जांच के लिए और इंजीनियरिंग प्रक्रियाओं के डिजाइन के लिए कम्प्यूटेशनल उपकरण और सेवाएं प्रदान करती हैं। बहु - विषयी टीम जिसमें इंजीनियरों, केमिस्टों, भौतिकविदों, गणितज्ञों, जीवविज्ञानियों और कंप्यूटर वैज्ञानिकों शामिल है, के द्वारा निम्नलिखित वास्तविक समस्याओं का हल हो जाता है :

- नगर और घरेलू अपशिष्ट उपचार
- औद्योगिक बहिः स्राव उपचार
- गंध नियंत्रण
- वातावरण में डाइऑक्सीन और सतत कार्बनिक प्रदूषक
- पर्यावरण प्रभाव का विश्लेषण
- जल की गुणवत्ता विश्लेषण
- औद्योगिक अपशिष्ट निपटान से भूजल प्रदूषण
- अवायवीय प्रौद्योगिकी: पादप फाइबर की निकासी के लिए रेटिंग
- सफेद मिर्च के उत्पादन में अवायवीय प्रौद्योगिकी का अनुप्रयोग
- मिट्टी खनिजों के मूल्य संवर्धन और इष्टतमीकरण
- सस्ती स्वदेशी सॉफ्टवेयर के माध्यम से औद्योगिक लाभप्रदता का बढ़ाव
- प्रक्रिया उद्योग में कम्प्यूटेशनल फ्लुइड डायनैमिक्स अनुप्रयोग

जबकि स्थानीय समस्याओं के लिए प्रौद्योगिकी लक्ष्यों को प्राथमिकता हैं, तो भी प्रभाग द्वारा निम्नलिखित क्षेत्रों में वैश्विक मुद्दों पर लंबे कार्यकाल के लक्ष्यों के साथ अनुसंधान एवं विकास कार्य जारी किये जाते है:

- जैव ईंधन के लिए सूक्ष्म शैवाल के उत्पादन के लिए प्रौद्योगिकी का विकास
- जैविक प्रणालियों के व्यवहार का पता लगाने के लिए एजेंट आधारित सिमुलेशन का विकास

प्रभाग की गतिविधियॉं चार अनुभागों अर्थात् रासायनिक प्रक्रिया इंजीनियरिंग, पर्यावरण प्रौद्योगिकी, कम्प्यूटेशनल मॉडलिंग और सिमुलेशन और डाइऑक्सिन रिसर्च के तहत की जाती हैं। वर्ष 2013-14 के दौरान प्रभाग के अनुसंधान की कुछ मुख्य विशेषताएं नीचे दी गयी हैं।

- ऑटोकास्ट XI वाणिज्यिक सॉफ़्टवेयर अपग्रेडों
- आलुवा में पेरक्लोरेट से भूजल प्रदूषण का पता लगाया गया और मैप किया गया।
- चवरा में औद्योगिक अपशिष्ट निपटान तालाबों से फैल प्रदूषणों का पता लगाया गया और मैप किया गया।
- एनएमआईटीएलआई परियोजना "समुद्री सूक्ष्म शैवाल से जैव ईंधन" का पहला चरण पूरा किया गया। जैव ईंधन के लिए सूक्ष्म शैवाल की खेती के लिए विकसित प्राकृतिक चयन की प्रक्रिया का इंजीनियरी किया गया।
- केले और अनानास फाइबर की निकासी के लिए प्रदर्शन संयंत्र कमीशन किया गया।
- मछली खाना कारखाना, पालघाट के लिए गैस बायोफिल्टर कमीशन किया गया।

ENVIRONMENTAL TECHNOLOGY

The Environmental Technology programme at NIIST has the objective of developing innovative technology for environmental pollution control for problems specific to the region and providing engineering and management consultancy services for environmental management.

Biofuel from marine microalgae

The Phase I of the project has been completed. In Phase I, a new approach to microalgae production for biofuel- 'Engineered Natural Selection' - was developed. The new approach enables the production of high lipid yield phototrophic consortia that are perpetual, while being easy to harvest. It overcomes all the known technical issues of microalgae cultivation for biofuel. Engineered natural selection is more competitive than other technologies for microalgae cultivation. But microalgae oil is not competitive against mineral oil because of the capital costs for establishing even low-cost open raceway ponds. Project Phase II was proposed, for field scale development and demonstration of microalgae cultivation by the method of engineered natural selection.

Mango waste treatment

Mango is available in a short season of less than 60 days. There are clusters of mango pulp units in mango growing areas that operate during the mango season to produce mango pulp. The waste generated is dumped on land, mostly illegally. NIIST developed a process flowsheet to produce electric power, liquid fertilizer and boiler solid fuel, in a common waste treatment facility for these clusters. The concept plant will operate throughout the year with preserved mango waste. Preservation is by ensilation technology. The preserved waste is separated to pulp and stone. The stone is dried to separate kernel and shell. The pulp is anaerobically digested to biogas and the digestate is a good liquid fertilizer for mango plantations.

Laboratory studies were conducted with the waste from the 2013 mango season. Anaerobic treatability studies showed that methane can be produced. Ensilation studies showed rapid formation lactic acid is responsible for preservation. Data on leachate generation and volume reduction during ensilation was obtained. Sizing design of silage system and biomethanation plant was completed. The flow-sheet was refined. Economic analysis shows that the treatment plant has a break even of less than 4 years. A call for expressions of interest for this project was issued by GIZ, New Delhi in Europe and a company is evaluating possible project development.

Ensiled mango waste after 110 d retains colour and mango flavour

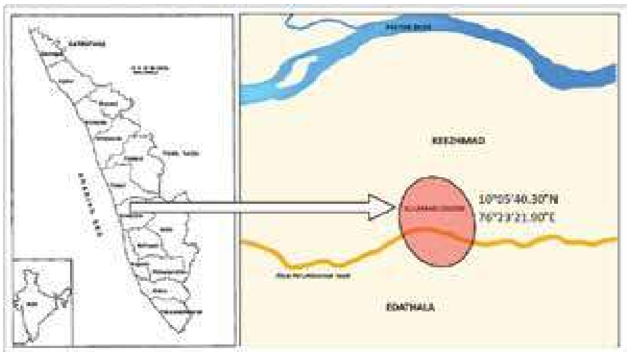
Gas biofilter for fish meal factory

A Gas biofilter 28m x 12 m as per NIIST design installed and commissioned at M/s Herald Marine Products, Ltd. Chittoor, Palghat District. It uses the patented biofilter media developed at NIIST.

Gas biofilter installed at M/s Herald Marine Products, Ltd. Chittoor, Palghat District.

Perchlorate contamination of ground water

Perchlorate (ClO_4) is the primary oxidizer of fuel in rockets, missiles and explosives. It is also used in industries such as electroplating, dye, fireworks, matchbox manufacture. Perchlorate ion is known to interfere with the functioning of thyroid gland causing hypothyroidism.

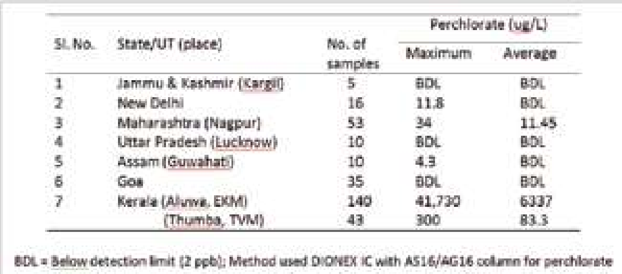


Map showing heavy perchlorate contaminated area in Kerala

The previous studies revealed high level of perchlorate in ground water samples from Aluva (Ernakulam Dist.) and Thumba (Thiruvananthapuram Dist.). Rigorous screening of ground water was conducted during December 2013 at Aluva in EKM dist. Compared to the observation in 2012, the level of perchlorate in this area was found have elevated very high. In a few public wells, the concentration was found to be approx. 40,000 ppb. This may be viewed against USEPA's permissible level of 15 ppb in drinking water. Severe contamination was observed around 2-3Km^2 area in Keezhmad (Kulakkad colony) and Edathala Panchayats in Aluwa.

To monitor the incidence of hypothyroidism, a social survey was conducted in Keezhmad panchayat during Jan 2014 with the help of Kerala State Health Department and many people in the area found were to have symptoms of hypothyroidism. NIIST provided analytical support to Kerala State Pollution Control Board, State Groundwater Department and State Health Services Department to assess the magnitude of perchlorate contamination of ground water in Aluwa.

Table: Average and maximum value of perchlorate in drinking water samples from different States/TUs

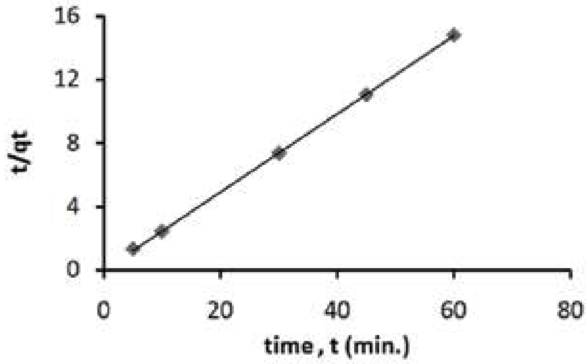


Sl. No.	State/UT (place)	No. of samples	Perchlorate (ug/L)	
			Maximum	Average
1	Jammu & Kashmir (Kargil)	5	BDL	BDL
2	New Delhi	16	11.8	BDL
3	Maharashtra (Nagpur)	53	34	11.45
4	Uttar Pradesh (Lucknow)	10	BDL	BDL
5	Assam (Guwahati)	10	4.3	BDL
6	Goa	35	BDL	BDL
7	Kerala (Aluva, EKM)	140	41,730	6337
	(Thumba, TVM)	43	300	83.3

BDL = Below detection limit (2 ppb); Method used DIONEX IC with AS16/AG16 collumn for perchlorate

Development of low cost adsorbents for removing perchlorate

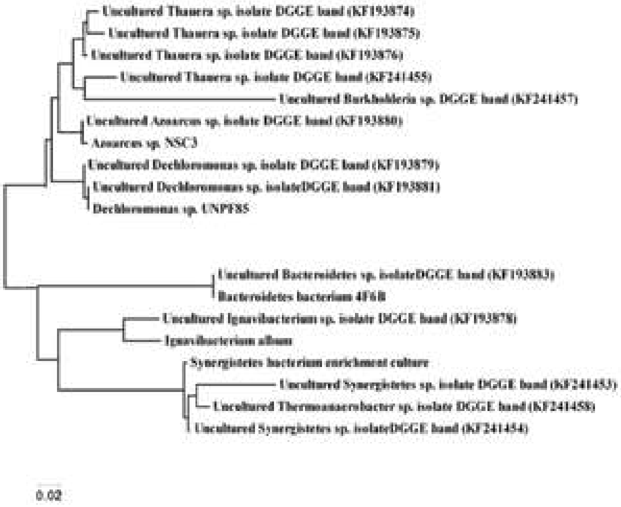
Studies were conducted to develop novel and low cost adsorbents for removing perchlorate from water. A novel adsorbent was developed by organo-functionalization of indigenous bentonite clay with a cationic surfactant, hexadecyl triethyl ammonium bromide (HDTAB). The adsorbent removed around 80% of perchlorate at 50 ppm level in 10 min. The adsorption followed a pseudo-second order kinetic model. Langmuir and Freundlich adsorption isotherms were applicable to the adsorption process and their constants were evaluated. The thermodynamic parameters (ΔH^0, ΔS^0andΔG^0) calculated from the temperature dependent adsorption isotherms suggests that the adsorption of $ClO_4^-$was exothermic and a spontaneous process. Studies are continuing for simultaneous adsorption and degradation of traces (ppb level) of perchlorate in bulk water using the adsorbent and perchlorate reducing enrichment consortium.



Psuedo-second-order kinetic plot for the adsorption of ClO_4^- on HDTAB-GB

Bioremediation of perchlorate and microbial ecology of the reactor sludge

Bioremediation of perchlorate is a continuing activity of the environmental technology lab. During the past year, the microbial ecology of a perchlorate reducing reactor sludge was studied through metagenomic approach. Denaturing Gradient Gel Electrophoresis (DGGE) targeting bacteria (primers EUB 341f-GC & 907r) and Archaea (primers ARCH 344f-GC & 958r) communities in the sludge was done and the dominant populations were identified. It was found that *Thauera* sp., a known nitrate reducer and acetate utilizing bacteria as a dominant species in the perchlorate reducing sludge. Among the Archaea, the prominent bands were represented by the methane producing *Methanosaeta sp*. The sequences were submitted to Genbank (KF193874–883 and KF241453–458). Efforts are in progress for a pilot scale reactor study for removing perchlorate from water.



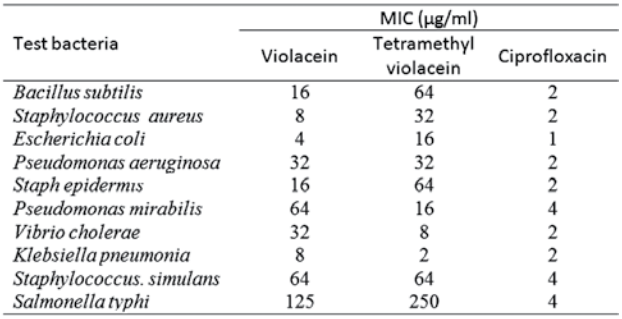
Neighbor-joining phylogenetic tree based on bacterial 16S rDNA sequences derived from DGGE result of sludge from the perchlorate reducing sludge.

Several new strains of halophilic perchlorate reducing bacteria were isolated and identified. *Micrococcus sp*. NIIST1, *Bacillus sp*. NIIST2, *Bacillus pumilus* NIIST6 and *Halomonas* NIIST3 are the novel strains. A bacterial cocktail was formulated with these strains and it is under testing for reducing (degrading) perchlorate adsorbed on surface modified clay and other matrices developed in NIIST.

In a separate study, *Serratia* sp. NIIST5 was found to form a biofilm and effective to reduce perchlorate adsorbed on to porous lanthanum phosphate developed by NIIST Material science division. The phyto-remediation of perchlorate using locally available floating macrophyte, *Pistia* was established. This may find application for removing perchlorate contaminated surface water sources.

Semi-synthetic approach for novel bio-molecules from natural microbial populations

The study with *Chromobacterium* sp NIIST, producing the purple blue bioactive compound, violacein (US 20130074735, EP 2545181A1, WO 2011110932A1) was continued from last year. A semi-synthetic approach was tried for modifying pure violacein from the NIIST strain and the novel compounds formed was analyzed for their potential activity. In one of the approaches, Violacein was modified to tetramethyl violacein. The synthesized compound was characterized (H NMR and LCMS) and its antibacterial activity was evaluated against different pathogenic strains. Compared to pure violacein, the tetramethyl violacein exhibited better activity against *Staph epidermis, Pseudomonas mirabilis, Vibrio cholera* and *Klebsiella pneumonia*. The activity against *Klebsiella pneumonia* was comparable to commercial ciprofloxacin.



Test bacteria	MIC (µg/ml)		
	Violacein	Tetramethyl violacein	Ciprofloxacin
Bacillus subtilis	16	64	2
Staphylococcus aureus	8	32	2
Escherichia coli	4	16	1
Pseudomonas aeruginosa	32	32	2
Staph epidermis	16	64	2
Pseudomonas mirabilis	64	16	4
Vibrio cholerae	32	8	2
Klebsiella pneumonia	8	2	2
Staphylococcus. simulans	64	64	4
Salmonella typhi	125	250	4

Activity of Violacein & Tetramethyl violacein against different pathogenic bacterial strains

Commercialization of compact anaerobic digester cum biogas plant

An improved anaerobic treatment system was developed by NIIST for the management of household biodegradable wastes (Patent application No. PCT/IN2013/000140). The major advantages of NIIST anaerobic digester include: works as a complete treatment system for household biodegradable wastes, compact and versatile, yields higher quantity of methane in the biogas, composted wastes requires no further processing to use as organic fertiliser and operation of the system requires no electricity. This development was licensed to M/s Carris and Pipes Pvt. Ltd., Ernakulam, Kerala and M/S. B.M. Industries, Paingattoor, Moovattupuzha, Kerala for mass production and marketing of the biogas plant.

Photograph of the commercial anaerobic treatment system cum biogas plant for household biodegradable wastes

Demonstration plants for bioextraction of pineapple leaf fibre, banana fibre and coir fibre

The potential of coir fibre, banana fibres and pineapple leaf fibres are well known. However, the current methods of extraction of these fibres are inappropriate to produce quality fibres in reasonable scale. An anaerobic extraction was developed in the institute for plant fibres, which facilitates to make good quality fibres without pollution and enables process water recycle. The process was taken up to demonstrate in the field for the production of coir fibre, banana fibres and pineapple leaf fibres with the financial support of KSCSTE, Govt. of Kerala and DST, Govt. of India. NGOs and self-help groups are involved in this programme for developing skills to utilize such resources through this technology and building up livelihood opportunities.

The demonstration plant for the bio-separation of pineapple leaf fibre was established in Maneed Pancahayat, Piravom and it was inaugurated on 25th February 2014 by Shri. Anoop Jacob, the honourable Minister for Food and Civil Supplies, Consumer Protection & Registration, Govt. of Kerala in a meeting presided by Shri. Jose K Mani, Honourable Member of Parliament.

Agreement signed with Kudumbashree of Kerala State in presence of the Honourable Minister Dr M.K. Muneer, Panchayat and Social Welfare for setting up demonstration plants for the bioextraction of banana fibre and pineapple leaf fibre

Demonstration plant for pine apple leaf fibre bioextraction plant in Piravom, Ernakulam, Kerala

Coir fibre composite for furniture

"Polycoir", is composite material made from needle-felt coir fibre and polymer. This thermoset mouldable natural fibre polymer composite has potential as substitute for wood-based or alternative products. The material can be engineered as per requirement with properties like fire resistance, termite resistance and water resistance.

The technology for polycoir was developed in this institute during 1994-1997 but could not be transferred. New efforts were made to make products from polycoir. The surface finish was improved for better market acceptability. This technology was transferred to Kerala Furniture Consortium Pvt. Ltd, Ernakulam District, Kerala, as an initiative under the National Innovation Council, Government of India.

Photograph of stool top prepared from coir composites

Studies on estimation of heat of degradation of fish: a calorimetric study

Wastewater dripping from insulated trucks transporting fish on to roads and parking lots is a complaint referred to the institue by the Kerala State Pollution Control Board. The wastewater is generated from melting of ice used for packing the fish. Some locations receive regular spillage on daily basis and these places start to smell badly of putrid fish. The sources of heat for melting of ice are: the sensible heat which cools the fish from room temperature to ice temperature, heat conducted through the insulation walls of the transporting vehicle and the heat generated due to the degradation of fish at its storage temperature. Micro calorimetric studies were conducted to estimate the heat generated due to the degradation of the fish Indian Mackerel (*Rastrelliger kanagurta*) at various storage temperatures. The exponential variation of heat generation as a function of temperature, shown in the figure, confirms that fish degradation is very sensitive to the storage temperature. Storing Indian Mackerel at ice temperature (273 K) generates nearly 3.0 mW/kg of heat due to degradation as computed using the Arrhenius relationship.

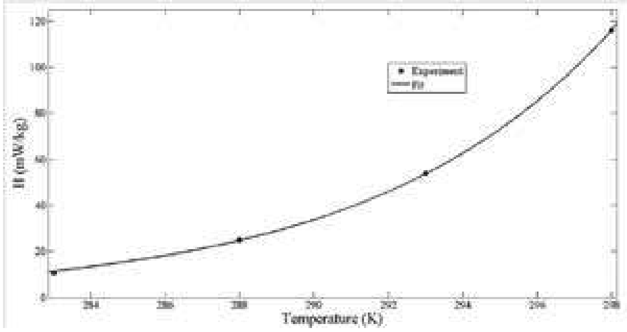


Figure: Exponential variation of heat generation due to degradation with temperature.

Conceptual design of a waste water treatment system for NIIST

For facilitating the treatment of waste water generated from various R&D laboratories and the Canteen of NIIST, a conceptual design of a treatment system was carried out. Employing a custom-constructed flow measurement system, the effluent from NIIST was quantified, which was to the tune of 50,000 litres/day. The conventional biological treatment in combination with membrane technology is identified as the appropriate treatment method. Two parallel membrane bio reactor (MBR) modules are required for the treatment, in which one operates at a time and the other is standby for dismantling and cleaning. The MBR modules will be housed in a tank having an anoxic zone and an aerobic zone. These zones enable the nitrogen removal by the nitrification-denitrification process. The flow sheet for the proposed treatment process was prepared.

Environmental Impact Assessment (EIA) study for the old sludge ponds of Kerala Minerals & Metals Ltd (KMML), Chavara , Kollam

The Kerala Minerals and Metals Limited (KMML) is manufacturer of rutile grade titanium dioxide by chloride process. The spent acid generated during the beneficiation process is further processed to regenerate the acid. During the acid generation process, iron oxide is produced as a by-product. The common effluent neutralization unit produces sludge. The iron oxide and ETP sludge are stored separately in secured ponds. The objective of the study is to carry out the Environmental Impact Assessment (EIA) of the sludge storage ponds. The study includes survey of groundwater and soil pollution in the surrounding area, material balances and recommendations.

The environmental impact of the old ponds is mainly due to the seepage of sludge into nearby water bodies owing to the damage to the pond walls and the LDPE linings, leading to water and soil contamination. The study covers and an area of 2 km radius keeping the sludge ponds in the centre.

The hydrological survey of the wells surrounding the pond was conducted. 99 well water samples and 69 samples of soils/sediments were collected. Groundwater flow direction is predominantly towards Northwest, South West and to the western side of KMML. Preliminary results indicate groundwater contamination from ponds currently used for storing wastes.

CLAY AND CLAY MINERALS PROCESSING

Clay is one of the most important mined minerals in Kerala. NIIST is India's leading laboratory in characterizing clay resources, and developing technology for the processing of china clay into value added products. Kaolin ($Al_2O_3.2SiO_2.2H_2O$) or china clay is a versatile industrial mineral. The raw clay is to be processed and refined to suit the required specifications for end use. Iron minerals are important among the deleterious impurities in kaolin, because it imparts colour to the white kaolin. Efforts have been continued on process development for the beneficiation of kaolin from various locations in the country.

Specialty Products based on Engineered Clays

The PEET division is identifying suitable clay deposits from across the country that can be developed into cosmetic and pharmaceutical grade clay, and specialty clays for water clean-up operations with special emphasis to industrial wastewaters. Seven samples from 3 states were evaluated. Detailed characterization, impurity mineral identification, selection and optimization of suitable processing techniques for the value addition of indigenous clays are in progress to obtain material specification suitable for production of specialty materials such as matrix clay for formulations in cosmetics, medicines and also as adsorbents for removal of toxic colors/metals/organics from waste streams.

Modern and eco-friendly process and flow sheet development for Kasargode and Kannur China clays

Beneficiation of a clay from Erikulam, Kasaragod District, Kerala was undertaken during the period. Mineralogical analysis indicated that kaolinitie is the predominant mineral and contaminated with mica, quartz, anatase, and other ferruginous impurities. Total iron content was 1.5% of which 70% could be attributed to the presence of extra framework ferruginous impurities. Sieve analysis indicated the bulk clay recovery to be around 63%. The material has been subjected to removal of > 45µm fraction or de-gritting using 2" stub cyclone. The < 45µm slurry was further size classified for enriching the fines.

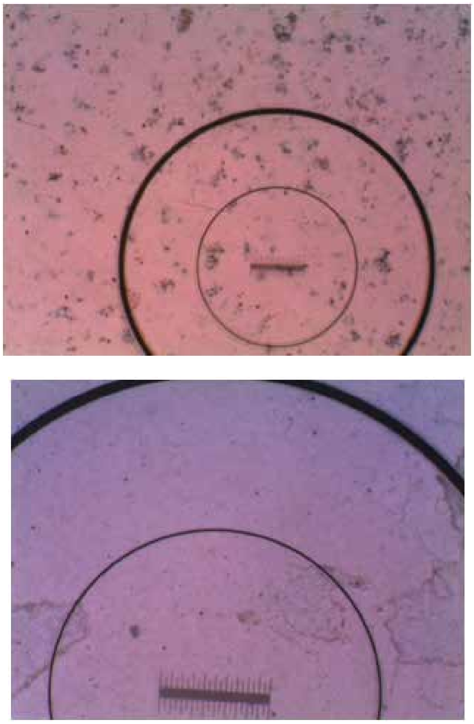
The < 2 micron size fraction in the case of ROM clay is only 45.9%. Conventional hydros bleaching did not improve the brightness. However, the maximum brightness was achieved through a combination of size separation, wet high intensity magnetic separation (WHIMS) and calcination which resulted in an overall increase in brightness by 15 units ie. 80.2%. Beneficiation flowsheet is under preparation.

Brightness improvement studies on China clays

Work related to 'clay beneficiation studies' was continued at NIIST on two china clays supplied by the sponsoring agency. A clay from Bhuj was found to contain kaolinite as the major mineral constituent contaminated with ancillary minerals such as anatase, haematitie, psuedorutile etc. and exhibited a brightness of 80.8% (ISO) against 0.32% Fe_2O_3 and 0.9% TiO_2 contents. After suitable beneficiation *via* a combination of hydrocyclone separations, WHIMS and chemical bleaching under optimized conditions , a hydrated product with 89% brightness and a calcined product of brightness 93.2% could be obtained with potential application in paper, paints etc.

Sheer floc-flotation is a specialized form of froth flotation in which the ultrafine particles to be floated are made to flocculate under high shear energy so as to form flocs of particles suitable for normal flocculation. This technique has been employed for the removal of ultrafine graphitic impurities from another clay sample supplied by the sponsor.

Fahrenwald Flotation Cell



Coated paper. top: clay before flotation; below: clay after flotation; bar 0.1 mm;

COMPUTATIONAL MODELLING AND SIMULATION

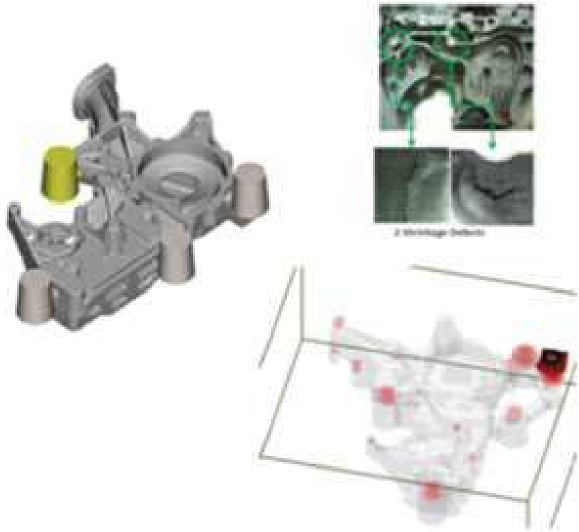
Computational Modeling and Simulation Section has an inter-disciplinary team and undertakes modeling of physical and biological systems. It supports technology development and new knowledge generation.

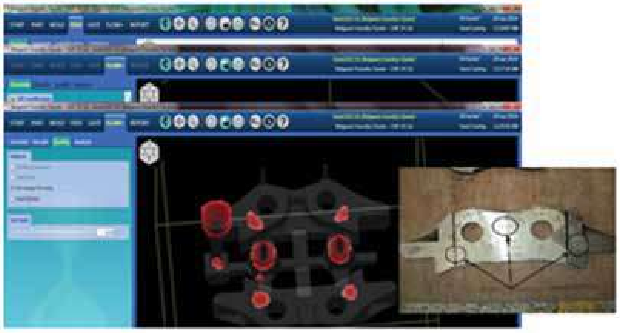
Commercial status of Virtual Casting Technology and development of new modules

In 2011, the Virtual Casting Solver technology was transferred to 3D Foundry Tech Pvt. Ltd., (3DFT). During 2012-13, Virtual Casting solver code was completely redesigned for efficient memory management and a better shrinkage prediction algorithm and was integrated into the upgraded version AutoCAST X1 as FLOW+ module. The front-end GUI of this new module in AutoCAST X1 environment is shown in Figure.

Frontend GUI of AutoCAST X1 with FLOW+ module

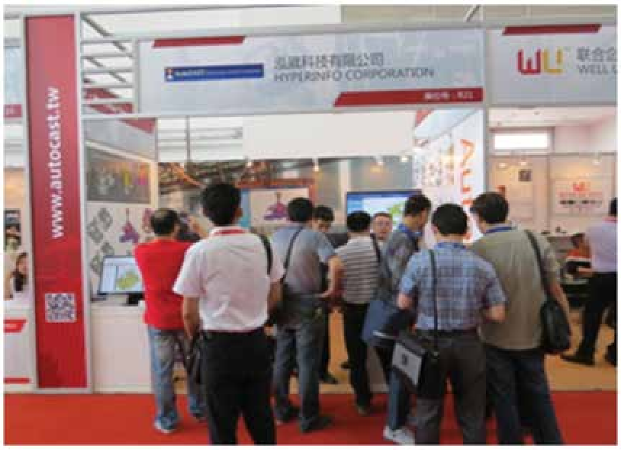
The **FLOW+ module** takes as input the thermo-physical properties of the metal and the mold along with the geometry of the casting and meshing from AutoCAST platform, calculates the flow pattern in the mold cavity during filling, temperature changes in the metal and predicts the defects that could occur in the solidified casting. This code was benchmarked and validated for various industrial castings and with commercial software codes available in the market like FLOW 3D and NovaCAST. Some benchmarking results for shrinkage prediction results with industrial castings are shown below.





Shrinkage defects as precited by FLOW+ module of AutoCAST X1

The commercial release of AutoCAST X1 was made during IFEX-2013. From April 2013 to March 2014, 3DFT has transferred around 12 licenses. In addition, 3DFT now has a reseller in China which is a Taiwan-based company, called Hyperinfo. In April 2014, they got the first order for AutoCAST X1 from Taiwan Control Valves, Taiwan. AutoCAST X1 is now available in Chinese and also has a website in Chinese www.autocast.tw.

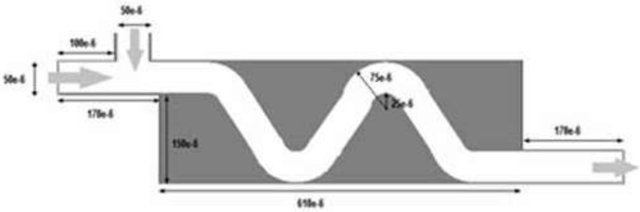


Reseller in China for AutoCASt X1 - Hyperinfo Corporation

A new gas and venting module which can predict the occurrence of blowholes during filling of the casting has been developed and transferred to 3DFT in January 2014 in a separate MOU. This module was showcased during IFEX 2014.

CFD Simulation of Micro Structured Reactors (MSRs)

CFD is used as an enabling technology for simulation of fluid dynamic parameters like pressure drop, mass transfer and heat transfer coefficient values for various combinations of micro channels. The commercial CFD simulation software FLOW-3D® was used to simulate chaotic advection in droplet based microfluidic devices. Chaotic advection can occur in time-periodic 2D flow or 3D flow and a chaotic mixer can be either an active or a passive one. Passive chaotic mixers are time-independent and they use specially designed 3D channel geometry to generate chaotic advection. Droplets travelling through a micro channel experience internal recirculation, which has been used to enhance mixing in plugs and slugs. In straight channels, two symmetric vortices form on the left and right halves of a plug. The mixing occurs by convection within each half and mainly by diffusion between the two halves of the plug. In winding channels the interface between the two halves of the plug is re-oriented from the direction of plug movement and is stretched and folded by recirculation. This technique greatly enhances mixing. The extent of mixing is dependent on the number of winding turns. The micro channel geometry used for the current simulation is shown in the figure. The central stream acts as a separator between the two reagent streams preventing mixing of reagents until they reach the T-junction



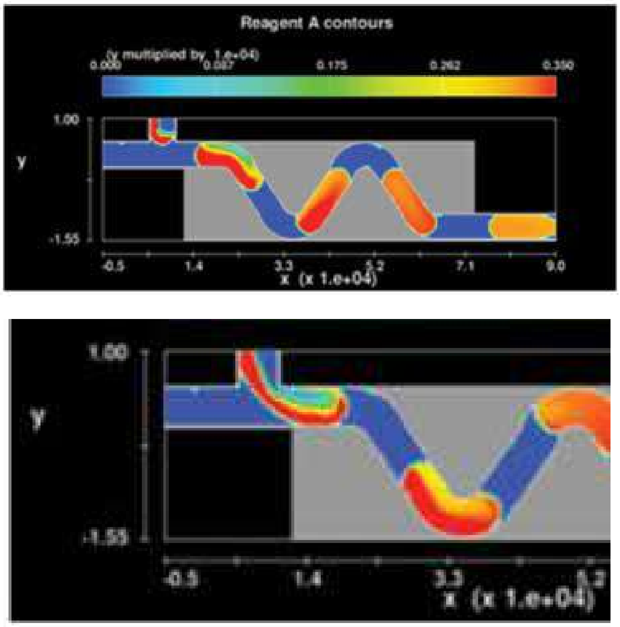
Computational domain used for the CFD simulation

For the simulation, water was taken as the disperse phase and a perfluorocarbon, PFD was taken as the continuous phase. Two reagents A and B were added to the stream of water. The following flow conditions were used. Incompressible fluid flow with sharp interface model was chosen for simulation type and 3D simulation was carried out using FLOW-3D.

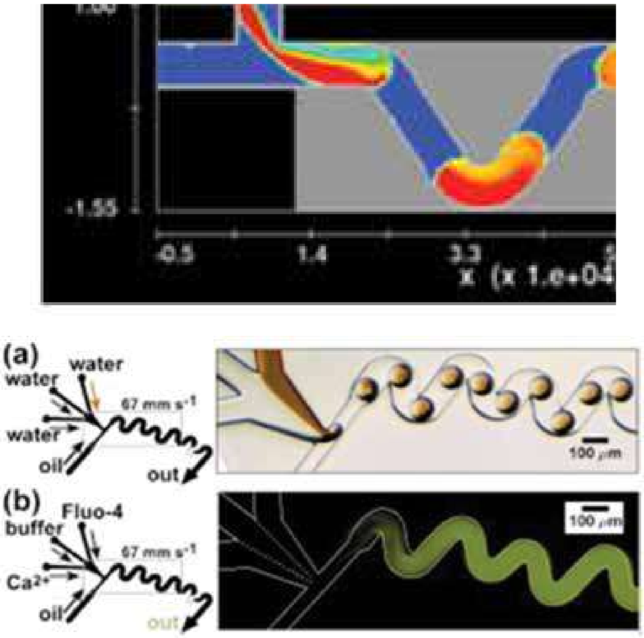
Flow conditions: (i) continuous inlet of PFD with volume rate = 3.6 micro liters per minute, (ii) reagent A, water and reagent B, parallel inlet in 1:1:1 ratio with no intermixing before the junction and net volume flow rate = 3.9 micro liters per minute, and (iii) outlets open to atmosphere.

Fluid properties : Water: viscosity = 0.001 Pa-s, density = 1000 kg/m^3, surface tension coefficient = 0.073 Kg/s^2, contact angle 60°. PFD: viscosity = 0.0051 Pa-s, density = 1900 kg/m^3.

Some typical contour plots of concentration of reagent A are shown in the following figure for various inlet conditions.



Contour plot of concentration of reagent A



Contour plot of concentration of reagent A along with the experimental results

The contour plot shows that the fluid undergoes chaotic advection and results in almost complete mixing of the two reagents by the time it reaches the end of the micro channel as observed experimentally and reported in literature.

Computational Biology

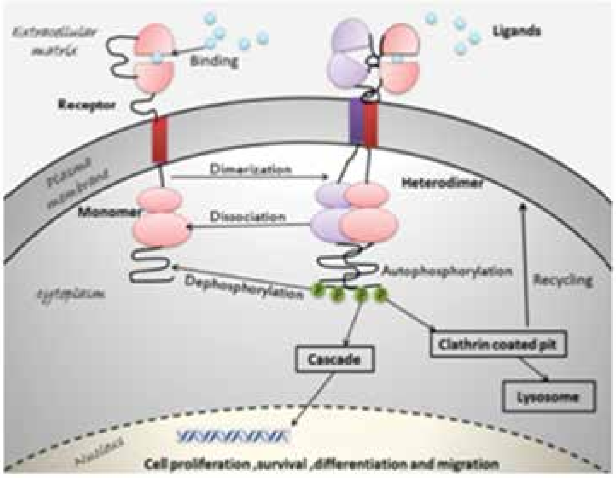
Agent Based Modeling (ABM) is a computational paradigm to study the dynamics of complex systems that self - organize and create an emergent order. The ability of ABMs to cater to multiple scales of biological processes, taking into account spatial and temporal aspects, makes it well-suited for Systems Biology. ABMs in the past used cell level tissue modeling with cells as primary agents to study tumour growth, morphogenesis and wound healing. Moving to the intracellular scale, ABMs can provide a means by which mechanistic information generated by experimentation can be integrated to find phenomenological behaviours of the system as a whole.

An ABM to study the ErbB signal transduction within the cell has been developed. The ErbB family of receptor tyrosine kinases regulates a wide range of biological phenomena, including physiological roles in development and maintenance of tissues by generating cell proliferation, adhesion, survival, differentiation and migration signals. The aberrant activity of these receptors, particularly ErbB1 and ErbB2, are also linked to the initiation and malignancy of numerous types of human cancers.

In-silico experiments of EGFR-HER2 receptor activation and trafficking

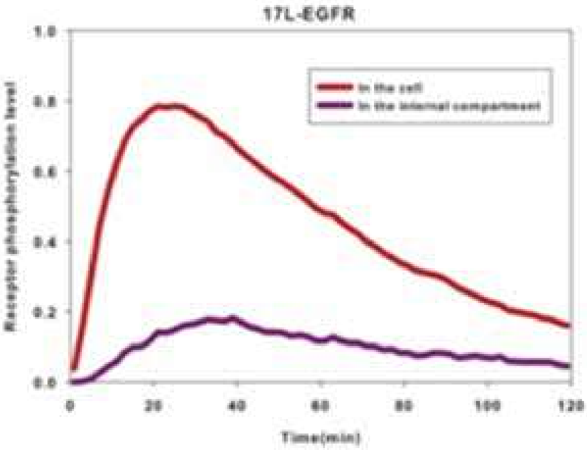
The ErbB signaling pathway is one of the most documented networks because of the prolific activity in both experiments and modeling in the last two decades. Experiments coupled with model-based analysis can obtain trends, patterns and emergent characteristics of networks whose combinatorial complexity does not permit precise quantification of signaling outcomes.

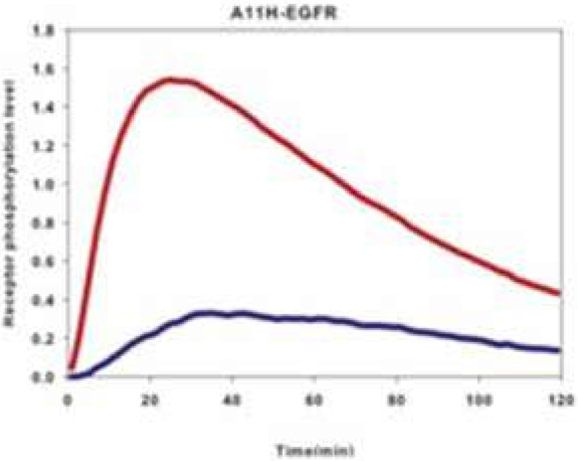
ErbB signaling is characterized by multiple extracellular ligands, four trans-membrane receptors - ErbB1(EGFR)-ErbB4 or HER1-4, cytoplasmic adapters, scaffolds, enzymes and small molecules. Signal initiation occurs on ligand binding to the receptor, leading to homo or hetero-dimerization of receptors, followed by the activation of multiple downstream effectors.

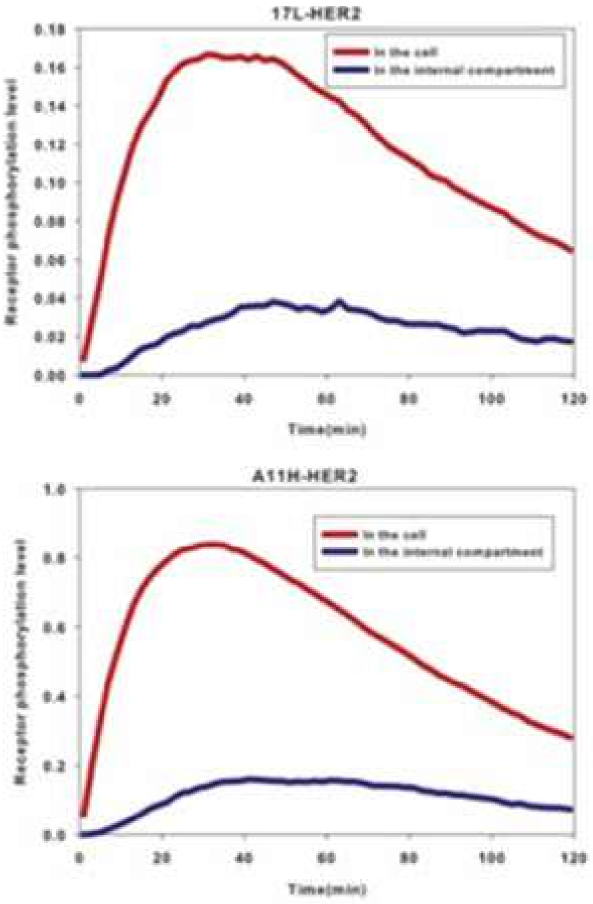


Schematic of ErbB Signaling

The model assumes molecular agents dispersed in sub-cellular compartments whose combined actions and interactions are studied by simulations. Parameter values for receptor activation and dimerization affinities, trafficking rates and phosphorylation levels are available from mathematical models that fit experimental data from cell lines. These rates were used to drive the agent behaviors over space and time. The in-silico experiments were able to quantitatively predict dimerization patterns and extent of phosphorylation of EGFR and HER2 when activated by ligand EGF. The phosphorylation levels of 17L cell line, a low expressor of HER2 were much less than that of A11H which expresses ten times more HER2. Both homo and hetero-dimers contribute to the phosphorylation.







Receptor phosphorylation levels of ErbB1 and HER2 in 17L and A11H cell lines

The software code was developed on a generic ABM framework earlier by NIIST. The model is being extended to include other receptors, ligands and downstream signaling events.

CSIR - National Institute for Interdisciplinary Science & Technology

S & T SERVICE SECTIONS

PLANNING & PERFORMANCE AND BUSINESS DEVELOPMENT

CONTRACT RESEARCH PROGRAMMES – 2013-14

Sl No	Client	Project Title	Project Leader
Agro Processing Division			
1	DST	Study on the mechanism of anoikis in human mammary cancer cell, induced by a purified lectin from Morus Alba L	Dr S Priya
2	Haryana State Co-Operative Supply & Marketing Federation	Process development for blanching & drying of fresh turmeric	Dr V V Venugopal
3	DBT	Fluorescent probes for biosensing applications	Dr P Jayamoorthy
4	Spices Board	Development of functional food products from spices and botanicals for better health management	Dr P Nisha
5	KSCSTE	Synthesis utility of dien aminodioate for synthesis of 1,2- Dihydropyridines and its resulting derivatives for evaluational of their anti microbial, anti tuberculosis & anti malarial potential	Dr L Ravi Shankar
6	KSCSTE	Endophytic bacterial flora of the rice plants from the acidic soil of Kuttanad and their exploitation in improved paddy	Dr B S Dileep Kumar
Biotechnology Division			
7	DST	Biochemical and molecular investigation on stress mediated lipid accumulation and biomass productivity in microalgae	Dr M Arumugham
8	DBT	Stereo selective synthesis of chiral alcohols of pharmaceutical importance via microbial oxidoreductases: Process development and scale-up	Dr P Binod
9	DBT	Waste to wealth: Development of green process for the production of second generation biofuel from crop wastes	Dr R Sindhu
Chemical Sciences & Technology Division			
10	DST	Design a smart drug delivery system using activatable cell penetrating peptides scaffold based non peptide carriers for targeting human cancer	Dr Kaustabh Kumar Maiti
11	DBT	Detection of Zinc in epileptic condition using ratiometric fluorescent molecular probes	Dr Ajayaghosh

12	DST	Development of novel organic materials for photovoltaic applications	Dr C Vijayakumar
13	DST	Development of semi conducting push pull polymers for photovoltaic applications	Dr B Bijitha
14	DST	Utilization and activation of CO_2 via transitions metal mediated insertion reactions- A computational study	Dr V Prabha
15	KSCSTE	Silver starch hydrogel hybrid nano composite for anti microbial wound healing applications	Dr J D Sudha
Material Sciences & Technology Division			
16	KSCSTE	Development of rare earth based double peroskites A_2 Fe ReO_6(A=Sr, Ba, Ca, Ce, La, Nd)	Dr Manoj Rama Verma
17	NORITAKE Co. Ltd Japan	Adsorbants for gas & vapour molecules: Rational design of materials, porous nano structures and surface chemistry	Dr S Ananthakumar
18	BRNS	Development of photocatalytic reactor based on wide spectrum nano titania- organic hybrids for decomposition of dyes and recovery of precious additive / solvent in spent laser dye solutions	Dr Saju Pillai
19	BRNS	Tailoring of magneto- structural phase transitions near the room temperatures in intermetallic Heusler alloys for the magnetic refrigeration applications	Dr M Vasundhara
20	DST	Development and pilot scale production of microwave ceramic substrates and LTCC green tapes suitable for microwave circuits	Dr K P Surendran
21	BRNS	Multicaloric effects in certain systems with magneto structural transistors	Dr Manoj Rama Verma
22	Binani Zinc Ltd	Development of high value ceramics and functional nanomaterials from Zn metal and zarosite resources produced by Binani Zinc Pvt. Ltd	Dr S Ananthakumar
23	DST	Exchange biased magnetic heterostructures	Dr Sinoy Thomas
24	DST	Dielectric ink for printed electronics: Materials to Devices	Dr K P Surendran
25	DST	Aluminium –Silicon piston alloy development by squeeze casting process for strategic application	Dr M Ravi
Process Engineering & Environmental Technology Division			
26	KSCSTE	Bioremediation of soil contaminated with perchlorate	Mr Prajeesh
27	DST	Study of driven non equilibrium systems and biological processes	Dr Mamata Sahoo

CONSULTANCY PROGRAMMES

Sl No	Client	Project Title	Project Leader
1	Spices Board, Cochin	Technical evaluation of project proposals for technology upgradation process modification	Mr M M Sreekumar
2	M/s Vinvish Technologies Pvt Ltd, Trivandrum	Design and development of confoal microscope with super continuum white laser source	Dr K Yoosaf
3	Collagen Marine Products, Malappuram	Fish meal factory odour control and effluent treatment	Mr Ajith Haridas
4	KMML	EIA for KMML pond	Mr Ansari
5	Galaxy Environ, Malappuram	Ice cream factory ETP for Papai ice cream, Palghat	Mr Ajith Haridas
6	M/s 3D Foundary Tech Pvt Ltd, Mumbai	Additional module for flow+ for air blowhole identification during filling in casting	Dr Savithri
7	WAPCOS	Marine study for 3 ports (Beypore, Cochin Naval Base & Ratnagiri)	Mr Ansari

List of MoU/Agreements

Sl No	Title	Date of Signing	*Nature of the MoU*	*Name of the firm/firms with whom the MoU/ Agreement is entered into*	Project Leader
1	Agreement for licensing of know how for UASB reactor	23.5.2013	*Technology Transfer*	Shri Anoop M A , M/s Galaxy Environ, Airport Road, Mattor Junction, Kalady, Ernakulam, Kerala 683574	Mr Ajith Haridas
2	Agreement for sponsored research for conversion of Zinc metal nano Zinc oxide	3.7.2013	*Agreement*	M/s Binani Zinc Ltd	Dr Ananthakumar
3	Disclosure of information agreement with British American Tobacco	4.7.2013	*Agreement*	British American Tobacco, Marketing futures, Regents Park Road, Mill Brook	Dr Ashok PAndey
4	Confidentiality agreement	13.8.2013	*Agreement*	BP Biofuels North America LLC (BP), Company with offices at 4955 Director's place San Diego, CA 92121	Dr Ashok Pandey
5	NDA -Magnesium alloys and polymers for Turbo charger applications	28.8.2013	*Agreement*	Honeywell Technology Solution Lab Pvt Ltd, 151/1 , Porasisanipalya Bannerghatta Road, Banglore - 560226	Dr U T S Pillai
6	Mutual confidentiality agreement for collaboration relating to chemical and physical research with focus on OLED materials and pigments	01.9.2013	*Agreement*	Merck KGaA, Frankfurter, StraBe 250, 64293 Darmstadt, Germany	Dr M L P Reddy
7	Agreement for EIA & EMP study for mining area IREL Block- IV and IV EE and obtaining clearance from MoEF for enhanced excavation	30.9.2013	*Agreement*	INDIAN RARE EARTH LTD, Chavara, Kollam	Mr J Ansari

8	Confidentiality agreement for collaboration in the area of bioenergy from biomass and phytochemicals from agricultural residues	03.10.2013	*Agreement*	DSM India Pvt Ltd, #401-402, 4th floor NSG IT Park, Aundh, Pune 411007	Dr Ashok Pandey
9	Agreement for research collaboration between CUSAT and CSIR-NIIST	25.10.2013	*Agreement*	CUSAT, Thrikkakkara, Cochin - 22	Dr. Ajit Haridas
10	Technology Marketing Agreement with CSIR-Tech	26.11.2013	*Agreement*	CSIR-Tech Pvt. Ltd., 100, NCL Innovation Park, Dr. Homi Bhabha Road, Pune – 411008	Business Development Division initiative
11	Agreement for sponsored research for SABIC.	03.12.2013	*Agreement*	Saudi Basic Industries Corporation, P.O. Box 5101, Riyadh 11422, Kingdom of Saudi Arabia	Dr. Mangalam Nair
12	Agreement with Spices Board for development of functional food products from spices and botanicals.	24.12.2013	*Agreement*	Spices Board, NH By-Pass, "Sugandha Bhavan", Palarivattom P O, Cochin – 682025	Dr. P. Nisha
13	MoU with RCC, Thiruvananthapuram for the research project titled 'Significance of Surface-Enhanced Raman scattering techniques in Diagnostic Cytopathology '	06.01.2014	*MoU*	Regional Cancer Centre, Thiruvananthapuram	Dr. K.K. Maiti
14	Agreement for Consultancy for air blowholes identification in castings.	06.01.2014	*Agreement*	3D Foundry Tech Pvt. Ltd, CM-05, SINE, CSRE, IIT-B, Powai, Mumbai 400 076,	Dr. S. Savithri
15	MoU with ESSO-NIOT for joint research on pilot scale outdoor mass culture of marine microalgae to revalidate the techno-commercial feasibility of commercial scale mass culture of marine microalgae for bio fuel production	21.01.2014	*MoU*	The Earth System Sciences Organization - National Institute of Ocean Technology NIOT Campus, Velachery – Tambaram Main Road, Narayanapuram, Pallikaranai, Chennai – 600 100, Tamil Nadu	Dr . Ajit Haridas

16	Amendment to Technology Marketing Agreement signed on 26.11.2013 with CSIR-Tech	29.01.2014	*Agreement*	CSIR-Tech Pvt. Ltd., 100, NCL Innovation Park, Dr. Homi Bhabha Road, Pune – 411008	Business Development Division
17	Consultancy Agreement for Design, development and fabrication of Confocal Microscope.	04.02.2014	*Agreement*	Vinvish Technologies Pvt. Ltd., C-16, Thejaswini Building, Technopark, Trivandrum, Kerala PIN – 695581	Dr. K. Yoosaf
18	Tripartite Agreement with MILMA and Director of Agriculture for establishment of a Ginger Processing Unit at Wayanad District, Kerala	29.03.2014	*Technology Transfer*	Malabar Regional Co-operative Milk Producers Union of MILMA, Peringulam, Kunnamangalam (P.O.), Kozhikode – 673 571 & Director of Agriculture, Directorate of Agriculture, Vikas Bhavan, Thiruvananthapuram – 695 033	Mr. V.V. Venugopal

PATENTS

Filed in India

NFNO	Title	Inventors	Filing Date	Application No.
0022NF2013/IN	SEMICONDUCTOR OXIDE NANOTUBES-FLYASH AND SEMICONDUCTOR OXIDE NANOTUBES-METAL OXIDE COMPOSITE PARTICLES, THEIR PROCESSING VIA ION-EXCHANGE MECHANISM, AND METHODS FOR THEIR RECYCLING IN THE DYE-REMOVAL APPLICATION THEREOF	SHUKLA SATYAJIT VISHNU, PADINHATTAYIL HAREESH, NARAYANI HARSHA, JOSE MANU, KARUNAKARAN REMYA	24/05/2013	1563DEL2013
0180NF2012/IN	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	AYYAPPANPILLAI AJAYAGHOSH, PALAPPURAVAN ANEES	30/08/2013	2564DEL2013
0082NF2013/IN	SELF HEALING SILICA BASED LOW K DIELECTRIC INK FOR PRINTED ELECTRONIC APPLICATIONS	KUZHICHALIL PEETHAMBHARAN SURENDRAN, MAILADIL THOMAS SEBASTIAN, JOBIN VARGHESE	12/12/2013	3620DEL2013
0022NF2013/IN	SEMICONDUCTOR OXIDE NANOTUBES-FLYASH AND SEMICONDUCTOR OXIDE NANOTUBES-METAL OXIDE COMPOSITE PARTICLES, THEIR PROCESSING VIA ION-EXCHANGE MECHANISM, AND METHODS FOR THEIR RECYCLING IN THE DYE-REMOVAL APPLICATION THEREOF	SHUKLA SATYAJIT VISHNU, PADINHATTAYIL HAREESH, NARAYANI HARSHA, JOSE MANU, KARUNAKARAN REMYA	24/05/2013	1563DEL2013

Filed in Foreign Countries

NFNO	Title	Inventors	Filing Date	Application No.
0009NF2012/WO	BLUE COLORED INORGANIC PIGMENTS, HAVING NEAR INFRARED REFLECTANCE, BASED ON MIXTURES OF LANTHANUM, STRONTIUM, COPPER AND LITHIUM SILICATE AND PROCESS THEREOF	MUNDLAPUDI LAKSHMIPATHI REDDY, SHEETHU JOSE	02/05/2013	PCT/ IN2013/000292
0102NF2012/WO	A PROCESS FOR DECOMPOSITION OF ORGANIC SYNTHETIC DYES USING SEMICONDUCTOR-OXIDES NANOTUBES VIA DARK CATALYSIS.	SHUKLA SATYAJIT VISHNU, WARRIER KRISHNA GOPAKUMAR, BABU BABITHA KUNNATHUPARAMBIL	17/05/2013	PCT/ IN2013/000319
0169NF2010/US	METAL OXIDE MODIFIED AND UNMODIFIED MOLECULARLY IMPRINTED CONDUCTING POLYMER FILM BASED AQUEOUS AMINOACID SENSORS	VARGHESE SAUMYA, KRISHNA PILLAI PADMAJA KUMARI PRATHISH, TALASILA PRASADA RAO	01/08/2013	13/983229
0169NF2010/JP	METAL OXIDE MODIFIED AND UNMODIFIED MOLECULARLY IMPRINTED CONDUCTING POLYMER FILM BASED AQUEOUS AMINOACID SENSORS	VARGHESE SAUMYA, KRISHNA PILLAI PADMAJA KUMARI PRATHISH, TALASILA PRASADA RAO	04/08/2013	2013-552325
0170NF2010/US	MOLECULAR PROBES WITH HIGH FLUORESCENCE FOR SOLID-STATE LIGHTING, SELECTIVE DISCRIMINATION OF COUNTERIONS OF ZINC, TWO PHOTON IMAGING	AYYAPPANPILLAI AJAYAGHOSH, KIZHUMURI P. DIVYA, SAMPATH SRINIVASAN	13/08/2013	13/985085
0170NF2010/EP	MOLECULAR PROBES WITH HIGH FLUORESCENCE FOR SOLID-STATE LIGHTING, SELECTIVE DISCRIMINATION OF COUNTERIONS OF ZINC, TWO PHOTON IMAGING	AYYAPPANPILLAI AJAYAGHOSH, KIZHUMURI P. DIVYA, SAMPATH SRINIVASAN	13/08/2013	12719447.0

0169NF2010/EP	METAL OXIDE MODIFIED AND UNMODIFIED MOLECULARLY IMPRINTED CONDUCTING POLYMER FILM BASED AQUEOUS AMINOACID SENSORS	VARGHESE SAUMYA, KRISHNA PILLAI PADMAJA KUMARI PRATHISH, TALASILA PRASADA RAO	14/08/2013	12708168.5
0169NF2010/EP	METAL OXIDE MODIFIED AND UNMODIFIED MOLECULARLY IMPRINTED CONDUCTING POLYMER FILM BASED AQUEOUS AMINOACID SENSORS	VARGHESE SAUMYA, KRISHNA PILLAI PADMAJA KUMARI PRATHISH, TALASILA PRASADA RAO	16/08/2013	13180706.7
0069NF2008/DE	PREPARATION OF GREEN COLORANT FROM MIXED RARE EARTH AND MOLYBDENUM COMPOUNDS AND PROCESS THEREOF AS SURFACE COATINGS	MUNDLAPUDI LAKSHMIPATHI REDDY	25/09/2013	602010010543.1
0170NF2010/JP	MOLECULAR PROBES WITH HIGH FLUORESCENCE FOR SOLID-STATE LIGHTING, SELECTIVE DISCRIMINATION OF COUNTERIONS OF ZINC, TWO PHOTON IMAGING	AYYAPPANPILLAI AJAYAGHOSH, KIZHUMURI P. DIVYA, SAMPATH SRINIVASAN	15/10/2013	AWAITED
0180NF2012/WO	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	AYYAPPANPILLAI AJAYAGHOSH, PALAPPURAVAN ANEES	09/12/2013	PCT/ IN2013/000757
0138NF2011/GB	DYE ENTRAPPED SOL-GEL FILM BASED TEST STRIP SENSOR FOR NITRITE AND A PROCESS THEREOF	SANTHAKUMAR DHANYA, TALASILA PRASADA RAO	13/12/2013	1322114.8
0183NF2012/WO	A NOVEL AZA BODIPY DERIVATIVE FOR THE SELECTIVE DETECTION OF NITRITE IONS IN WATER: A PROCESS THEREOF AND ITS APPLICATION IN WASTE WATER MANAGEMENT	DANABOYINA RAMAIAH, NAGAPPANPILLAI ADARSH, MADHESH SHANMUGASUNDARAM	28/01/2014	PCT/ IN2014/000067

GRANTED IN INDIA

TITLE	INVENTORS	GRANT DATE	PATENT NO
A PROCESS FOR CONTINUOUS PRODUCTION OF MAGNESIUM DIBORIDE BASED SUPERCONDUCTORS	SYAMAPRASAD UPENDRAN, ABHILASH KUMAR RAVEENDRAN NAIR GIRIRAJKUMARI AMMA, VINOD KRISHNAN KUTTY, ALOYSIUS RAJAPPAN PADMAVATHY, SARUN PALLIAN MURIKOLI, THENNAVARAJAN SUBRAMANIAN GURUSWAMY PERUMAL	21/10/2013	257615
A METHOD FOR FABRICATING FUNCTIONALLY GRADED HYBRID METAL COMPOSITES	THAZHAVILAI PONNU DEEVARAJ RAJAN, RAMAN MARIMUTHU PILLAI, BALLAMBETTU CHANDRASEKHARA PAI	05/12/2013	258123
A PROCESS FOR PREPARATION OF ION IMPRINTEDPOLYMER PARTICLES FOR PRECONCENTRATIVE SEPERATION OF PALLADIUM (II) IONS VIA SOLID PHASE EXTRACTION	SOBHI DANIEL, TALASILA PRASADA RAO	27/02/2014	259147

GRANTED IN FOREIGN COUNTRIES

TITLE	INVENTORS	GRANT DATE	PATENT NO
MULTIFUNCTUINAL ALCOHOLS FROM CARDANOL, ITS MULTIFUNCTIONAL ACRYLIC CROSS-LINKER AND HIGHLY PENDANT PHOSPHORUS FLAME RETARDANT DERIVATIVES	VADAKKETHONIPPURATHU SIVANKUTTY NAIR PRASAD, CHENNAKKATTU KRISHNA SADASIVAN PILLAI	28/06/2013	5302008
A PROCESS FOR THE SYNTHESIS OF TELECHELIC URETHANE ACRYLATE UV CURBLE PRE POLYMER MATERIALS FROM RENEWABLE RESOURCES	SYAMAKUMARI ASHA, CHENNAKKATTU KRISHNA SADASIVAN PILLAI	09/08/2013	5335436
WHITE LIGHT EMITTING ORGANOGEL AND PROCESS THEREOF	AJAYAGHOSH; AYYAPPANPILLAI (KERALA, IN), VIJAYAKUMAR; CHAKKOOTH (KERALA, IN), PRAVEEN; VAKAYIL K. (KERALA, IN)	10/09/2013	8529790
PREPARATION OF GREEN COLORANT FROM MIXED RARE EARTH AND MOLYBDENUM COMPOUNDS AND PROCESS THEREOF AS SURFACE COATINGS	MUNDLAPUDI LAKSHMIPATHI REDDY	25/09/2013	2411333
PREPARATION OF GREEN COLORANT FROM MIXED RARE EARTH AND MOLYBDENUM COMPOUNDS AND PROCESS THEREOF AS SURFACE COATINGS	MUNDLAPUDI LAKSHMIPATHI REDDY	25/09/2013	2411333
A PROCESS FOR THE PREPARATION OF NOVEL NON-TOXIC YELLOW INORGANIC COLORANT/PIGMENT FROM SAMARIUM AND MOLYBDENUM COMPOUNDS	MUNDLAPUDI LAKSHMIPATHI REDDY	08/11/2013	5404905
TRANSPARENT XYLOGLUCAN/CHITOSAN GEL AND A PROCESS FOR THE PREPARATION THEREOF	THOLATH; EMILIA ABRAHAM (TRIVANDRUM, IN), GHANDROTH; KALYAD SIMI (TRIVANDRUM, IN)	07/01/2014	8623336
A PROCESS FOR THE PREPARATION OF NOVEL NON-TOXIC YELLOW INORGANIC COLORANT/PIGMENT FROM SAMARIUM AND MOLYBDENUM COMPOUNDS	MUNDLAPUDI LAKSHMIPATHI REDDY	12/02/2014	ZL2009801 58858.8

KNOWLEDGE RESOURCE CENTRE

The Knowledge Resource Centre with its rich collection of information resources, well equipped technology infrastructure and high quality services continued to maintain its unique position in NIIST as a centre of excellence which supports the research and development activities of the parent organization. KRC continued to offer technical expertise, knowledge dissemination, information resources and a variety of services to the S & T personnel of the Institute during 2013-14 and made rapid strides.

The information resources including Books, Periodicals, CD-ROM databases, PhD Thesis and access to a host of electronic journals and databases are maintained and updated. A high speed network through dedicated leased lines on OFC link with Ethernet connectivity is provided to all researchers 24X7 with 100% throughput and >99% network uptime to cater the bandwidth for critical applications and internet browsing, data upload/ download, emails, video conferencing etc.

The in-house library operations are computerized using Libsuite, the integrated information management system which provides access to Online Public Access Catalogue (OPAC). Libsuite is shortly to be replaced with KOHA, the open source software and, groundwork and data migration for this has already started. New Institutional ID cards are designed and issued to all staff, research scholars, students and pensioners. Around 350 new wired net connections had been proposed for the state-of-art Silver Jubilee and Biotechnology buildings. KRC has taken extensive initiatives in implementing the CSIR-ERP system. The section could strengthen the infrastructure and resources and thereby provide value added services to the staff

RESOURCES:

Print collection: KRC currently houses a total print collection of 45000 plus documents which includes 13,130 Books, 10947 Standards and 11387 Bound Volumes of Periodicals. During 2013-14, 59 books were added to the collection and 67 foreign and 80 Indian periodicals were subscribed including 45 titles in online version. 11 periodicals were received gratis.

e-Resources: Online access to more than 4000 premier journals of major publishers and 6 prominent Science & Technology bibliographic and full text databases were provided to NIIST researchers during 2013-14, and these were fully utilized by the research community. Promotional programmes were carried out for enhancing the level of usage and this included regular announcements and broadcasting of messages of new facilities/ services initiated and hosting in the intranet with search links to each item. Trial access to various e-resources were also enabled for researchers through NKRC (National Knowledge Resource Consortia). The information and knowledge support offered by KRC contributes to augmenting the status of NIIST as an institute of highest caliber.

Full text journal databases of various publishers such as American Chemical Society, Elsevier, Institute of Electrical and Electronics Engineers, Nature Publishing

Group, Royal Society of Chemistry, Science Magazine, Springer, Taylor & Francis and Wiley – Blackwell were made accessible. Researchers enjoy the unlimited access to the world's largest and most reliable collection of chemistry and related science information through SCI-Finder database. Bibliographic and citation database, Web of Science - Science Citation Index Expanded was heavily used by the scholars. KRC also offered full support to the patent information requirements of the laboratory by making available patent databases *viz*. Derwent Innovations Index and Qpat. The ASTM Standards were subscribed to improve product quality and enhance safety and these were referred profusely by the scientific fraternity.

Information Technology Infrastructure: KRC contributes to the NIIST's success as a leader in R&D by bringing together information, knowledge, tools and systems for informed decision making for research and management. A high speed network through dedicated leased lines on OFC link with Ethernet connectivity is provided to all researchers. These 24X7 services with 100% throughput and >99% network uptime cater to the bandwidth of critical applications and internet browsing, data upload/download, emails, video conferencing etc. The section made significant progress both in strengthening the infrastructure, resources and in rendering services. This year the internet bandwidth enhanced from 10 Mbps to 14 Mbps on dedicated leased line to fulfill all the Internet requirements of the lab in addition to the 100mbps leased line from National Knowledge Network. Both the links are regularly monitored using web based tool that enables to gain a real-time, end-to-end view with respect to system and network performance.

All the buildings in the campus are interconnected through gigabit fiber optic backbone. Separate VLANs have been created to connect a large no of High end personal computers to the campus network. A state-of-the-art data center maintains high end servers, storage devices, UTM devices and core switches. Around 500+ internet connections are provided through wired and wireless network. Also, 350 new wired connections had been proposed for the state-of-art Silver Jubilee and Biotechnology buildings. Secured VPN connectivity to connect to NIIST network from outside office is provided to scientists. Procured licenses for deploying server grade antivirus software which provides virus-free network environment. Procured additional operating system and Microsoft office licenses. Provided assistance in ensuring Quality assurance in the acquisition of IT products and devices.

SERVICES

Library services: During the period, the in-house databases of Books, Periodicals, PhDTheses, Publications of NIIST Scientists, etc were updated regularly and made available through NIIST website and as well as through Intranet. Our resource facilities and services were extended to external users, primarily from research, industrial and academic sectors. Nearly 450 persons from institutes and universities in and around Kerala visited NIIST KRC and availed the services. Conducted regular searches from electronic databases including from Standards and Patents for scientists, scholars and students. Initiation of new members to services of KRC were done regularly. Creation of Institutional Repository of Theses and Research papers produced from NIIST is in progress. During the period 600 journal articles, 60 PhD Theses and 80 News items were added to our IR. 781 volumes of periodicals were bound during the period. Rendered Reprographic and Photographic services as a general Laboratory facility

Scientometric service: Continued the Bibliometric/Scientometric/Impact Factor Analysis of NIIST Publications using Journal Citation Report and Web of Science - Science Citation Index Expanded. Offered necessary assistance for publishing in journals with high Impact Factor. The total number of papers published by NIIST during 2013 is 209, of which **188** are SCI Papers with an average IF value of **3.03**. A few of the SCI papers are without IF.

Information Technology services: All scientist, staff and research students are provided with institutional e-mail id through open source Zimbra E-mailing system for powerful and speedy means of communication. The mail server is well equipped with adequate anti-virus, anti-spam and intrusion prevention systems. The institutional websites are developed, hosted, maintained and updated regularly in bilingual format. All the internal information, guidelines and announcements are hosted regularly on intranet website. A Conference site is developed specially for International Conference on Advanced Functional Materials (ICAFM-2014).

The smooth functioning of all desktops, laptops and other computer peripherals is ensured through an annual maintenance contract with a local agency. A help desk is maintained to help users in solving issues related to software installations, reinstallations, repairs, software updates, network and IT related issues. The lab also manages various applications like Stores and Purchase Software, D-Space for Institutional Repository, Libsuite, Chemdraw, Sigmaplot and Origin. A backup solution is also installed for generating periodic backup of the applications and also backup for mails and website contents. The unit provides printing and scanning facility through a wide variety of printers such as Heavy Duty Color Multi-Function Laser Printers and A3/A4 Scanners to all researchers.

Designed and issued Institutional ID cards to all the staff, research scholars, project students and pensioners. KRC has taken extensive initiatives in implementing the CSIR-ERP system. As a part of Official language implementation, institutional website and uploading of notices and circulars are posted in bilingual format.

Trainings organized by KRC

- Workshop-cum- training on **"SCI-Finder database", 12th April 2013.** Resource person Miss Sherin Samji, M/s Sci-Edge Information, Pune.
- Training session on **Web of Science**, **EndNote Web and Researcher ID, 9th May 2013.** Resource person Mr. Alok Poundrik from Thomson Reuters.
- Conducted **Sci-Finder Users Meet on 23rd Oct 2013**. Resource Person Miss Sherin Samji of Sci-Edge Information, Pune

LIST OF PUBLICATIONS: 2013

1 SUNEESH (C K), SANEESH BABU (P S), MADHURI (B), BETSY (M), ALBISH (K P), ASHA S NAIR, RAO (K S), SRINIVASAN (A), CHANDRASHEKAR (T K), RAO (C M), PILLAI (R) and RAMAIAH (D)
In vitro demonstration of apoptosis mediated photodynamic activity and NIR nucleus imaging through a novel porphyrin
***ACS Chemical Biology* 8(1):127-132;Jan 2013**

2 HARSHA (N), SHYAMA (P K) and SHUKLA (S)
Effect of solution-pH on Methylene blue dye adsorption on hydrogen titanate nanotubes processed via hydrothermal method.
***Advanced Science, Engineering and Medicine* 5(2):63-72;Feb 2013**

3 SINDHU (R N), ANEESH (P K) and PRASADA RAO (T)
Ultrasensitive voltammetric determination of catechol at a gold atomic cluster/poly (3,4-ethylenedioxythiophene) nanocomposite electrode
***Analyst* 138(17):5031-5038;2013**

4 ADARSH (N), SHANMUGASUNDARAM (M) and RAMAIAH (D)
Efficient reaction based colorimetric probe for sensitive detection, quantification, and on-site analysis of nitrite ions in natural water resources
***Analytical Chemistry* 85(21):10008-10012;05 Nov 2013**

5 NISHA (V R), SINDHU (R), BINOD (P) and PANDEY (A)
Development of a novel solid-state fermentation strategy for the production of poly-3-hydroxybutyrate using polyurethane foams by Bacillus sphaericus NII 0838
***Annals of Microbiology* 63(4):1265-1274;Dec 2013**

6 AGGELOPOULOS (T), BEKATOROU (A), PANDEY (A), KANELLAKI (M) and KOUTINAS (A A)
Discarded oranges and brewer's spent grains as promoting ingredients for microbial growth by submerged and solid state fermentation of Agro-industrial waste mixtures.
***Applied Biochemistry and Biotechnology* 170(8):1885-1895;Aug 2013**

7 SINGH (S K) and PANDEY (A)
Emerging approaches in fermentative production of statins
***Applied Biochemistry and Biotechnology* 171(4):927-938;Oct 2013**

8 SUCHITHRA (P S), SHADIYA (C P), PEER MOHAMED (A), VELUSAMY (P) and ANANTHAKUMAR (S)
One-pot microwave mediated growth of heterostructured ZnO@AlSi as a potential dual-function eco-catalyst for treating hazardous pollutants in water resources
Applied Catalysis B: Environmental 130:44-53;07 Feb 2013

9 MANIKANDAN (D), MANGALARAJA (R V), AVILA (R E), SIDDHESWARAN (R) and ANANTHAKUMAR (S)
Montmorillonite-carbon nanotube nanofillers by acetylene decomposition using catalytic CVD
Applied Clay Science 71:37-41;Jan 2013

10 RAJGANAPATHI (V C), JITHESHKUMAR (N), SUNDARARAJAN (M), HARIKRISHNA BHAT and VELUSAMY (S)
Grain size analysis and characterization of sedimentary environment along
Thiruchendur coast, Tamilnadu, India
Arabian Journal of Geosciences 6(12):4717-4728;Dec 2013

11 FARHA (A K), GEETHA (B S), MANGALAM S NAIR, DHANYA (S R), LATHA (P G) and REMANI (P)
Apoptosis mediated cytotoxicity induced by isodeoxyelephantopin on Nasopharyngeal carcinoma cells
Asian Journal of Pharmaceutical and Clinical Research 6(Suppl.2):51-56;2013

12 SINDHU (R), SILVIYA (N), BINOD (P) and PANDEY (A)
Pentose-rich hydrolysate from acid pretreated rice straw as a carbon source for the production of poly-3-hydroxybutyrate
Biochemical Engineering Journal 78 Spl Iss S1:67-72;15 Sep 2013

13 SAJNA (K V), RAJEEV K SUKUMARAN, JAYAMURTHY (H), REDDY (K K), SANJIT (K), PRASAD (R B N) and PANDEY (A)
Studies on biosurfactants from pseudozyma sp.NII 08165 and their potential application as laundry detergent additives
Biochemical Engineering Journal 78 Spl Issue S1:85-92;15 Sep 2013

14 LEYA THOMAS (L), LARROCHE (C) and PANDEY (A)
Current developments in solid-state fermentation
Biochemical Engineering Journal 81:146-161;15 Dec 2013

15 PANDEY (A) and SINGH (R S)
Preface
Biologia 68(6):1015-1015;Dec 2013

16 LEYA THOMAS, SINDHU (R) and PANDEY (A)
Identification and characterization of a highly alkaline and thermotolerant novel xylanase from streptomyces sp.
Biologia 68(6):1022-1027;Dec 2013

17 BINDHUMOL (I) and NAMPOOTHITI (K M)
Exposition of antitumour activity of a chemically characterized exopolysaccharide from a probiotic lactobacillus plantarum MTCC 9510
Biologia 68(6):1041-1047;Dec 2013

18 KUTTIRAJA (M), SINDHU (R), PREETI (E V), SANDHYA (S V), BINOD (P), VANI (S), PANDEY (A) and RAJEEV K SUKUMARAN
Biothanol production from bamboo (Dendrocalamus sp.) process waste
Biomass and Bioenergy 59:142-150;Dec 2013

19 SINGHANIA (R R), PATEL (A K), RAJEEV K SUKUMARAN, LARROCHE (C) and PANDEY (A)
Role and significance of beta-glucosidases in the hydrolysis of cellulose for bioethanol production
Bioresource Technology 127:500-507;Jan 2013

20 ARUMUGAM (M), AGARWAL (A), ARYA (M C) and AHMED (Z)
Influence of nitrogen sources on biomass productivity of microalgae scenedesmus bijugatus
Bioresource Technology 131:246-249;Mar 2013

21 SINDHU (R), KUTTIRAJA (M), ELIZABETH PREETI (V), VANI (S), RAJEEV K SUKUMARAN and BINOD (P)
A novel surfactant-assisted ultrasound pretreatment of sugarcane tops for improved enzymatic release of sugars
Bioresource Technology 135:67-72;May 2013

22 LALITHA DEVI (G), BINOD (P), SAJNA (K V), KUTTIRAJA (M), PANDEY (A) and RAJEEV K SUKUMARAN
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Bioresource Technology 145:182-187;Oct 2013

23 ALTHURI (A), JINCY (M), SINDHU (R), RINTU BANERJEE, PANDEY (A) and BINOD (P)
Microbial synthesis of poly-3-hydroxybutyrate and its application as targeted drug delivery vehicle
Bioresource Technology 145:290-296;Oct 2013

24 STERGIOU (P-Y), FOUKIS (A), FILIPPOU (M), KOUKOURITAKI (M), PARAPOULI (M), THEODOROU (L G), HATZILOUKAS (E), AFENDRA (A), PANDEY (A) and PAPAMICHAEL (E M)
Advances in lipase-catalyzed esterification reactions
Biotechnology Advances 31(8):1846-1859;2013

25 PRATHAPAN (A), VINEETHA (V P), ABHILASH (P A) and RAGHU (K G)
Boerhaavia diffusa L. Attenuates angiotensin II-induced hypertrophy in H9c2 cardiac myoblast cells via modulating oxidative stress and down-regulating NF-kBeta and transforming growth factor Beta 1
British Journal of Nutrition 110(7):1201-1210;14 Oct 2013

26 VINEETHA (V P), PRATHAPAN (A), SOUMYA (R S) and RAGHU (K G)
Arsenic trioxide toxicity in H9c2 Myoblasts - Damage to cell organelles and possible amelioration with Boerhavia diffusa
Cardiovascular Toxicology 13(2);123-137:Jun 2013

27 HARSHA (N), HAJARA (A) and SHUKLA (S)
Using Fenton-reaction as a novel approach to enhance the photocatalytic activity of TiO2-y-Fe2 O3 magnetic photocatalyst undergoing photo-dissolution process without silica interlayer.
Catalysis Letters 143(8):807-816;Aug 2013

28 CHAMESWARY (J) and SEBASTIAN (M T)
Butyl rubber-Ba 0.7Sr0.3TiO3 composites for flexible microwave electronic applications
Ceramics International 39(3):2795-2802;Apr 2013

29 MANU (K M), ANANTHAKUMAR (S) and SEBASTIAN (M T)
Electrical and thermal properties of low permittivity Sr2Al2SiO7 ceramic filled HDPE composites
Ceramics International 39(5):4945-4951;Jul 2013

30 NAMITHA (L K), CHAMESWARY (J), ANANTHAKUMAR (S) and SEBASTIAN (M T)
Effect of micro and nano fillers on the properties of silicone rubber alumina flexible microwave substrate
Ceramics International 39(6):7077-7087;Aug 2013

31 BISWAS (P), KUMAR (M K), RAJEASWARI (K), JOHNSON (R) and HAREESH (U S)
Transparent sub-micrometre alumina from lanthanum oxide doped common grade alumina powder
Ceramics International 39(8):9415-9419;Dec 2013

32 BALAMURUGAN (A), GUPTA (A K), BOOMISHANKAR (R), REDDY (M L P) and JAYAKANNAN (M)
Heavy atom effect driven organic phosphors and their luminescent Lanthanide metal-organic frameworks
ChemPlusChem 78(7):737-745;Jul 2013

33 SALINI (P S), HOLADAY (M G D), REDDY (M L P), SURESH (C H) and SRINIVASAN (A)
Fluorine interaction controlled AIEE phenomenon in an expanded calixbenzophyrin and its vapoluminescent response: turn on emission with volatile ketones and esters
Chemical Communications 49(22):2213-2215;2013

34 JOSEPH (J), JAROSCHIK (F), RADHAKRISHNAN (K V), VASSE (J L) and SZYMONIAK (J)
Pentafulvene-derived eta(3)- allyltitanocenes as intermediates for stereoselective functionalization of 5-membered carbocycles
Chemical Communications 49(40):4549-4551;2013

35 YAMUCHI (M), KUBOTA (S), KARATSU (T), KITAMURA (A), AJAYAGHOSH (A) and YAGAI (S)
Guided supramolecular polymerization of oligo(p-phenylenevinylene) functionalized bismelamines
Chemical Communications 49(43):4941-4943;2013

36 SALINI (P S), ANJU (K S), REDDY (M L P) and SRINIVASAN (A)
Syntheses of normal, expanded, strapped and N-confused calixbenzophyrins from a single starting material
Chemical Communications 49(51):5769-5771;2013

37 JIJY (E), PRAVEEN (P), SHIMI (M), PIHKO (P M), NAYANA JOSEPH and RADHAKRISHNAN (K V)
Rdodium catalyzed oxidative coupling of salicylaldehydes with diazabicyclic olefins: A one pot strategy involving aldehyde C-H cleavage and pi-allyl chemistry towards the synthesis of fused ring chromanones
Chemical Communications 49(66):7349-7351;2013

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Journal of Solid Mechanics and Materials Engineering 7(2):169-175;2013

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Investigation on Lead and Yttrium addition on the microstructure and mechanical properties of AZ91 Magnesium alloy
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Effect of Ca2+ substitution on the structure, microstructure, and microwave dielectric properties of Sr2Al2SiO 7 ceramic
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Journal of the American Ceramic Society 96(4):1176-1180;Apr 2013

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Crystal structure and microwave dielectric properties of LiRE9(SiO4)6 O2 ceramics (RE= La, Pr, Nd, Sm, Eu, Gd, and Er)
Journal of the American Ceramic Society 96(5):1504-1511;May 2013

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Materials Chemistry and Physics 137(3):811-815;15 Jan 2013

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Materials Letters 90:64-67;1 Jan 2013

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Microwave dielectric properties of flexible silicone rubber - Ba(Zn1/3 Ta2/3) O3 composite substrates
Materials Research Bulletin 48(11):4911-4916;Nov 2013

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Materials Research Bulletin 48(2):889-894;Feb 2013

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Effect of silver incorporation into PVDF - barium titanate composites for EMI shielding applications
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Metallurgical and Materials Transactions A - Physical Metallurgy and Materials Science 44A(5): 2285-2298;May 2013

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175 AJITH KUMAR (K K), ABHILASH (V), PILLAI (U T S), PAI (B C) and CHAKRABORTY (M)
Influence of Neodymium addition on the microstructure, mechanical and thermal properties of Mg-Si alloys.
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Creep behavior of AZ91 Magnesium alloy.
Procedia Engineering. Sp Issue on 6th International Conference on Creep, Fatigue and Creep-Fatigue interaction 55(109-113):2013

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Mechanism for grain refinement and mechanical properties of AZ91 Mg Alloy by carbon inoculation
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Effect of antimony and yttrium addition on the high temperature properties of AZ91 Magnesium alloy.
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RSC Advances 3(16):5624-5630;2013

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Photomorphogenesis of γ-globulin: Effect on sequential ordering and knock out of gold nanoparticles array
RSC Advances 3(32):13463-13469;2013

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RSC Advances 3(38):16967-16972;2013

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A hybrid sol-gel approach for novel photoactive and hydrophobic titania coatings on aluminium metal surfaces
RSC Advances 3(39):18062-18070;2013

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catalyzed ring opening of cyclopropane appended spirotricyclic olefins through C-H activation of arylboronic acids
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Value added products from renewable natural resources and agricultural/industrial wastes for societal/industrial applications Part I
Science India :20-26;Sep 2013

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Value added products from renewable natural resources and agricultural/industrial wastes for societal/industrial applications Part II
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Science of Advanced Materials 5(8):1060-1073;Aug 2013

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A near-infrared fluorescent nanosensor (AuC@Urease) for the selective detection of blood urea
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Brilliant yellow color and enhanced NIR reflectance of monoclinic BiVO4 through distortion in VO43

Solar Energy Materials and Solar Cells 112:134-143;May 2013

192 RESHMI (C P), SAVITHA PILLAI (S), SURESH (K G) and MANOJ RAAMA VARMA

Room temperature magnetocaloric properties of Ni substituted La 0.67 Sr 0.33 MnO3

Solid State Sciences 19:130-135;May 2013

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Influence od autocatalytic coating bath parameters on the formation of copper over surface treated boron carbide particles

Surface and Coatings Technology 214:77-85;15 Jan 2013

194 SINU (C R), PADMAJA (D V M), JINI (P), SEETHA LAKSHMI (K C) and VIJAY NAIR (G)

NHC-catalyzed annulation of enals to 2,4-Dien-1-ones: Efficient diastereoselective synthesis of 1,3-Diaryl-4-styrenyl cyclopentenes

Synlett 24(13):1671-1674;Aug 2013

195 AJISH (K R), NAYANA JOSEPH and RADHAKRISHNAN (K V)

Transition-metal-catalyzed regio- and diastereoselective 1,4-conjugate addition of Zerumbone using boronic acids: A simple route toward novel Zerumbone derivatives

Synthesis-Stuttgart 45(16):2316-2322;16 Aug 2013

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Synthesis of functionalized Indanes via Palladium-catalyzed carboannulation of diazabicyclic olefins with o-Iodostyrenes

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Palladium catalyzed reaction of ortho-functionalized aryl iodides with bicyclic hydrazines: Facile route toward heteroannulated cyclopentenes and azabicycles

Tetrahedron 69(1):152-159;07 Jan 2013

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Cycloaddition profile of pentafulvenes with 3-oxidopyrylium betaine: Experimental and theoretical investigations

Tetrahedron 69(46):9751-9760;18 Nov 2013

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NHC - catalysed annulation of enals to ene-1, 4 - diones:
Stereoselective synthesis of 1,3-diaryl-4-acyl cyclopentenes
Tetrahedron Letters 54(16):2046-2049;17 Apr 2013

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An unusual synthesis of 2-pyridone and 3,5-dihydroxypyridine from a carbohydrate
Tetrahedron Letters 54(25):3230-3232;19 Jun 2013

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Cascade synthesis of 1,2 dihydropyridine from dienaminodioate and an imine: A three-component approach
Tetrahedron Letters 54(29):3810-3812;17 Jul 2013

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Tetrahedron Letters 54(32):4232-4236;07 Aug 2013

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VINEETHA (V P) and RADHAKRISHNAN (K V)
Synthesis and biological evaluation of carbohydrate appended hydrazinocyclopentenes with potent glycation and alpha-glucosidase inhibition activities
Tetrahedron Letters 54(42):5682-5685;16 Oct 2013

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PIHKO (P M), SUNIL (V) and RADHAKRISHNAN (K V)
Rhodium (III)-catalyzed ring opening of strained olefins through C-H activation of O-acetyl ketoximes: An efficient synthesis of trans-functionalized cyclopentenes and spiro[2.4] heptenes
Tetrahedron Letters 54(52):7127-7131;25 Dec 2013

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Role of base assisted proton transfer in N-heterocyclic carbene-catalyzed intermolecular stetter reaction
Tetrahedron Letters 54(52):7144-7146;25 Dec 2013

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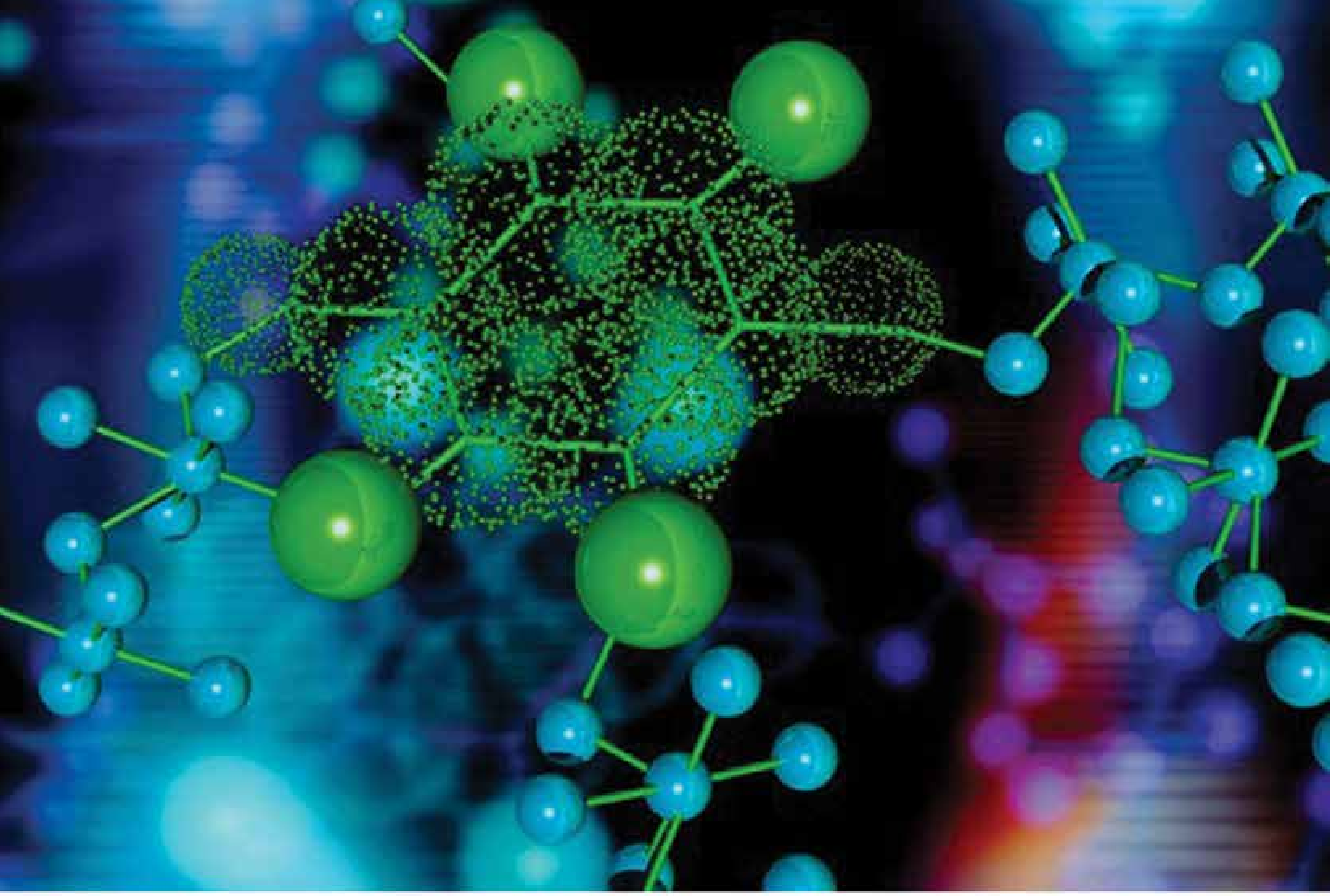
Effect of Pb addition on the discontinuous and continuous Mg17Al-12 beta precipitate during solidification of AZ91 Magnesium Alloy
Transactions of the Indian Institute of Metals 66(2):105-108;Apr 2013

207 VENDRELL (M), MAITI (K K), DHALIWAL (K) and CHANG (Y T)
Surface-enhanced Raman scattering in cancer detection and imaging
Trends in Biotechnology 31(4):249-257;Apr 2013

208 AJITH KUMAR (K K), PILLAI (U T S), PAI (B C) and CHAKRABORTY (M)
Dry sliding wear behaviour of Mg-Si alloys
Wear 303(1-2):56-64;15 Jun 2013

209 NISHANTH KUMAR, MOHANDAS (C), BALA NAMBISAN, SOBAN KUMAR (DR) and RAVI S LANKALA PALLI
Isolation of proline-based cyclic dipeptides from Bacillus sp. N strain associated with rhabitid entomopathogenic nematode and its antimicrobial properties
World Journal of Microbiology and Biotechnology 29(2):355-364;Feb 2013



GENERAL INFORMATION

CSIR - National Institute for Interdisciplinary Science & Technology

GENERAL INFORMATION

VISITS ABROAD

NAME	COUNTRY VISITED	PERIOD	PURPOSE
Dr. A. Ajayaghosh Outstanding Scientist	France	10/05/2013 - 14/05/2013	To attend Scientific meeting & 22nd Industrial Research Committee meetings at Autrans & Grenable, France.
	Taiwan	28/07/2013 - 02/08/2013	To attend and deliver a lecture at the 15th International Symposium on Novel Aromatic Compounds "ISAN-15" in Taipei, Taiwan.
	Japan	16/10/2013 - 30/10/2013	As a Guest Scientist to the National Institute for Materials Science (NIMS), Tsukuba, Japan.
	Japan	07/12/2013 - 09/12/2013	As an invited speaker at 10th Green Element Research Symposium.
	Japan	28/02/2014 - 01/03/2014	To attend 4th Phoemics International Symposium as an invited speaker.
Dr. Ajith Haridas Chief Scientist	Germany	01/09/2013 - 09/09/2013	To visit Germany at the Institute of Sanitary Engg & Waste Management, as expert on Anaerobic Technology.
Dr. Ashok Pandey Chief Scientist	Hong Kong	05/05/2013 - 09/05/2013	To participate in Captioned International Conference in Hong Kong Baptist University, Hong Kong.
	France	03/06/2013 - 28/06/2013	To work in the Blaise Pascal University under UBP fellowship.
	China	05/09/2013 - 08/09/2013	To visit China to attend Biotechnology workshop.
	Korea	29/10/2013 - 02/11/2013	To attend 6th International Conference on Environmental Science & Engg. (CESE 2013).
Dr. E.Bhoje Gowd Sr. Scientist	USA	01/03/2014 - 31/05/2014	To visit USA under IUSSTF Research Fellowship under Indo-US Science and Technology Forum Research Fellowship.

Dr. P. Binod Scientist	Italy	01/10/2013 - 20/10/2013	To visit Italy as part of collaborative project between University of Naples and CSIR-NIIST.
Dr. Madhavan Nampoothiri Principal Scientist	Germany	15/04/2013 - 30/04/2013	To visit University of Bielefeld, Germany under Indo -German bilateral Personnel visit programme sponsored by DST-DADD.
Dr. V.B.Manilal Principal Scientist	Portugal	09/06/2013 - 11/06/2013	To attend 1st International Conference of I 2013 at Guimaraes, Portugal.
Dr. K.V.Radhakrishnan Principal Scientist	Singapore	18/08/2013 - 24/08/2013	To attend 15th Asian Chemical Congress at Resort World Sentosa, Singapore.
Dr. T.P.D.Rajan Sr. Scientist	UK	16/01/2014 - 26/01/2014	To visit UK under UKERI exchange programme as Honorary Researcher.
Dr. Rajeev Kumar Sukumaran Sr. Scientist	Australia	15/09/2013 - 16/09/2013	To attend meeting of Investors for the project integrated technologies for economically sustainable biobased energy.
	Korea	23/09/2013 - 26/09/2013	To attend KORANET Bio-fuels Workshop.
	Italy	01/10/2013 - 20/10/2013	To visit Italy as part of collaborative project between University of Naples and CSIR-NIIST.
Dr. D.Ramaiah Chief Scientist	Spain	10/09/2013 - 20/09/2013	To visit Spain under Collaborative Project sponsored by DST & CSIC-ICCC, Spanish Research Council.
Dr. Satyajit Shukla Scientist	China	16/05/2013 - 19/05/2013	To attend 2nd Annual Conference on Advanced Materials (AM-2013) at Conference Center, Jiangsu University, Zhenjiang, China.
Dr. C.H.Suresh Principal Scientist	USA	27/09/ 2013 - 29/09/2013	To attend Young Investigators (YIM) Award ceremony.
	Japan	18/03/2014 - 30/03/2014	To visit Japan for attending seminars and discussions and for participating in the 94th Annual Meeting of the Chemical Society of Japan at Nagoya University as an invited lecturer.

HONOURS & AWARDS

Dr Suresh Das	Sastra- CNR Rao Award for Excellence in Chemistry & Materials, 2014
	J C Bose National Fellowship, 2013
Dr A Ajayghosh	TWAS (The World Academy of Sciences) Prize in Chemistry,2013
	CRSI Silver Medal, Chemical Research Society of India
	Honorary Fellow of Kerala Academy of Sciences, 2013
	Fellow, Royal Society of Chemistry, London, 2014
Prof Ashok Pandey	Fellow Award by the International Society for Energy and Environmental Sustainability
Dr D Ramaiah	Appointed as the Director of CSIR- NEIST, Jorhat
Dr J D Sudha	Fellow of Kerala Academy of Sciences, 2014
Dr P Prabhakar Rao	MRSI Medal
Dr E Bhoje Gowd	IUSSTF Research Fellowship by Indo- US Science and Technology Forum
Dr K G K Warrier	Life Time Achievement Award by Indian Society for Analytical Chemistry
	Sri Kishan Modi Memorial Award by Indian Ceramic Society
Dr C H Suresh	YIM-Boston Young Scientist Award
	Distinguished Lectureship Award by Japan Chemical Society in the Asian International symposium for Outstanding Young Chemists, Nagoya University, Japan, 2014
Dr C Vijayakumar	Ramanujan Fellowship
Dr S Savithri	Inspiring Women Engineer/ Scientist for the year 2014 from Engineering Watch on International Women's Day
Dr L Ravi Shankar	Kerala State Young Scientist Award, 2013
CSIR-NIIST	Rajbhasha Shield and Merit Certificate as the 3rd Best Office in Implementing Official Language Policy of the Union Government during the year 2012-2013 by Dept. of Official Language, Govt. of India
Ms Leya Thomas	Best Paper Award in the International Conference on Advances in Biotechnology and Bioinformatics

Ph.D. AWARDED

STUDENT	TITLE OF THE THESIS	SUPERVISOR	UNIVERSITY
Ajitha M J	Density functional theory studies on (S) Proline and N-heterocyclic carbine (NHC) mediated organocatalytic reactions	Dr C H Suresh	University of Kerala
Anesh G	Design, synthesis and study of p-Phenyleneethynylene based linear π -conjugated organogelators	Dr A Ajayaghosh	University of Kerala
Deepa K S	Design and property correlations in high permittivity insulator – conductor percolative composites	Dr Jose James	CUSAT
Dhanesh Thomas	Phosphate based dielectric ceramics and composites for microwave applications	Dr M T Sebastian	University of Kerala
Dhanya S	Optical and electrochemical sensors for detection and quantification of selected inorganic anions in aqueous media	Dr T Prasada Rao	University of Kerala
Fareed Bhasha Sayyed Meerasaheb	Quantification and prediction of substituent effects in aromatic molecules and cation-π complexes using molecular electrostatic potential	Dr C H Suresh	University of Kerala
Gowri Sreedevi K C	Meso-Diaryl dipyrrolic systems: Syntheses, characterization and application as a molecular keypad lock	Dr A Srinivasan	University of Kerala
Mariyam Thomas	Studies on luminescent properties of Eu3+-activated molybdate and tungstate based novel red phosphors	Dr Peter Koshy	University of Kerala
Radhakrishnan A N	Studies on structure, lattice thermal expansion and oxide ion conducting properties of some rare earth based Zirconate Pyrochlores	Dr Peter Koshy	University of Kerala
Reshmi C P	Structure, magnetic and magnetocaloric studies of some Lanthanum strontium manganites and rare earth garnets	Dr Manoj Raama Varma	University of Kerala
Retheesh K	Rim-binding interaction of N-alkylpyromellitic diimides with β-Cyclodextrin. A detailed study of the novel complexation and its utilization in the design of β-CD based ternary complexes for photo induced electron transfer and hydrogels	Dr K R Gopidas	University of Kerala

Rony Rajan Paul	Novel C-C and C-Heteroatom bond forming reactions involving homoenolate generated by organocatalysis and related chemistry	Dr G Vijay Nair and Dr A Jayalekshmy	University of Kerala
Sandhya Kumari L	Synthesis, characterization and optical properties of rare earth – transition metal based environmentally friendly red and yellow pigments	Dr P Prabhakar Rao	University of Kerala
Sanju K S	Synthesis of organic systems and study of their light emitting properties in solution and polymer matrix	Dr D Ramaiah	University of Kerala
Shyni Raphael M	Synthesis, characterization and photophysical properties of lanthanide carboxylates	Dr M L P Reddy	University of Kerala
Suchithra M V	Synthesis and applications of classical and Aza-morita-Baylis-hillman adducts of ferrocene carboxaldehydes	Dr R Luxmi Varma	University of Kerala
Suneesh C K	Design of novel sensitizers for photodynamic therapy: Synthesis, photophysical and photobiological studies of substituted porphyrin systems	Dr D Ramaiah	University of Kerala

MEMBERS OF THE RESEARCH COUNCIL

CHAIRMAN

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

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Matunga, Mumbai- 400019

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Laboratory of Membrane Biophysics
National Centre for Biological Sciences
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Bengaluru-560 065

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Indian Institute of Science
Bengaluru- 560012

Prof Gunasekaran
Vice Chancellor
Thiruvalluvar University
Serkkadu, Vellore- 632115

Dr P G Rao
Technical Consultant and Former Director,
CSIR- NEIST
Jorhat- 785006

Shri A C Shroff
Chairman & MD
Excel Industries Limited
184-87, S V Road,
Jogeshwari (West)
Mumbai- 400102

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Director
Indian Institute of Space Science
Valiamala P O
Thiruvananthapuram- 695547

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Scientist G
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Pocket-5, Vasant Kunj,
New Delhi- 110 070

DG NOMINEE

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

SISTER LABORATORY

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

CLUSTER DIRECTOR

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

DIRECTOR

Dr Suresh Das
Director
National Institute for Interdisciplinary Science
& Technology
Thiruvananthapuram-695 019

PERMANENT INVITEE

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

SECRETARY

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

MEMBERS OF THE MANAGEMENT COUNCIL

Period 01/01/2012 to 31/12/2013

CHAIRMAN

Director, NIIST

MEMBERS

Dr. Vijayamohanan K. Pillai, Director, CECRI, Karaikudi
Dr. Ajayaghosh, Outstanding Scientist, NIIST
Dr. K.R. Gopidas, Chief Scientist, NIST
Dr. M.T. Sebastain, Chief Scientist, NIIST
Dr. (Mrs) S. Savithri, Senior Principal Scientist, NIIST
Dr. T.P.D. Rajan, Senior Scientist, NIIST
Dr. B. Krishnakumar, Senior Scientist, NIIST
Sri. S. Veluswamy, Principal Technical Officer, NIIST
COFA, NIIST
Head, PPD, NIIST

MEMBER SECRETARY

AO, NIIST

Period 01/01/2014 to 31/12/2015

CHAIRMAN

Director, NIIST

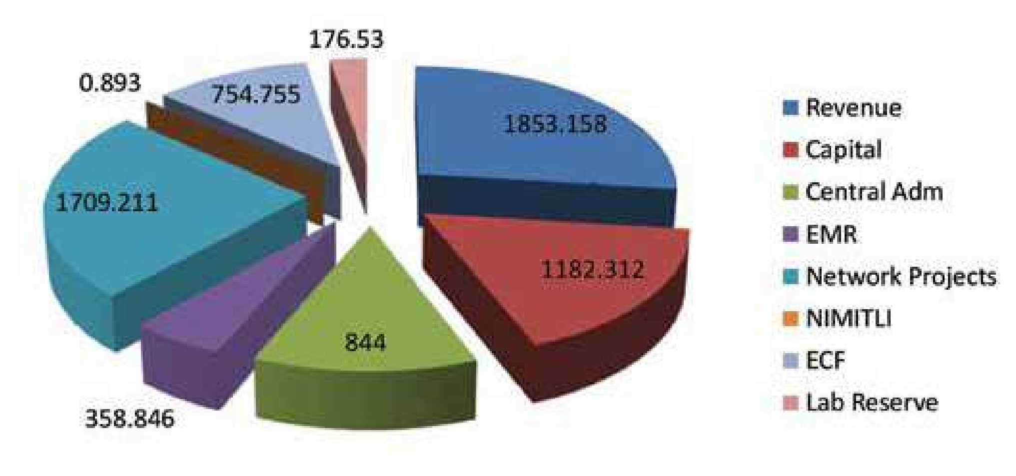
MEMBERS

Dr. Vijayamohanan K. Pillai, Director, CECRI, Karaikudi
Dr. Ajayaghosh, Outstanding Scientist, NIIST (Special Invitee)
Dr. Gangan Prathap, Outstanding Scientist, NIIST (Special Invitee)
Dr .C. Chandrasekhara Bhat, Senior Principal Scientist, NIIST
Dr. Vasundhara Mutta, Scientist, NIIST
Dr. E. Bhoje Gowd, Senior Scientist, NIIST
Dr. K. Madhavan Nampoothiri, Principal Scientist, NIIST
Sri. M. Brahmakumar, Principal Technical Officer, NIIST
Mr. M.M. Sreekumar, Head, RPBD, NIIST
Sri. T.V. Sankaran, CoFA, NIIST

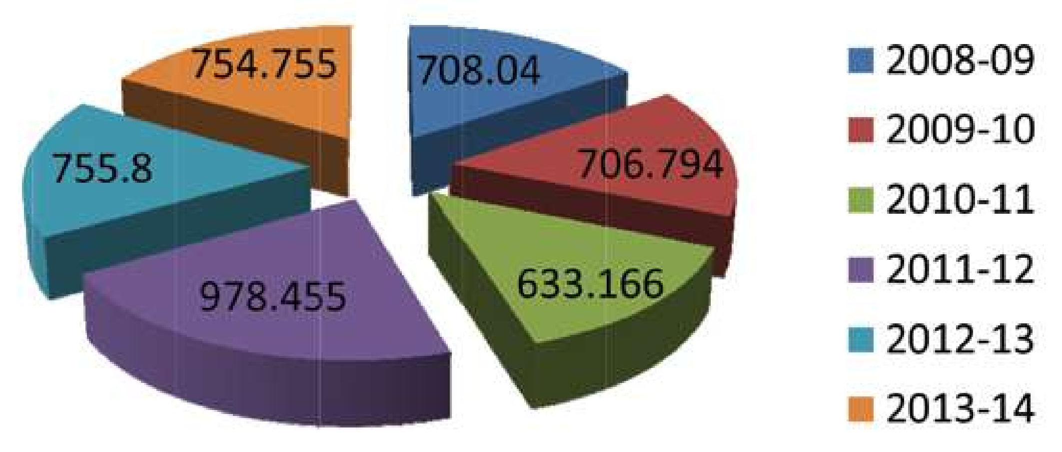
MEMBER SECRETARY

AO, NIIST

BUDGET 2013-2014 (Rs. LAKH)



ECF (Rs. lakh)



STAFF – NEW RECRUITMENTS

Dr. Narayanan Unni K. N., Principal Scientist (April 08, 2013)

Dr. Narayanan Unni K. N. received M Sc degree in Physics from School of Pure & Applied Physics, Mahatma Gandhi University with specialization in Materials Science. His Ph D work on organic semiconducting thin films was done under the guidance of Prof C. S. Menon at the same department and the degree was awarded in 2001. Then he worked with the department of Physics, Indian Institute of Technology Bombay as a post-doctoral research associate on fabrication of diamond thin films and carbon nanotubes by microwave plasma chemical vapor deposition. In 2002, he joined Prof Jean-Michel Nunzi's group as a post-doctoral fellow in LaboratoirePropriétésOptiques des Matériaux et Applications (CNRS) at University of Angers, France and worked towards developing organic field-effect transistor based memory elements and small molecule based solar cells. In 2005, he joined Samtel Color Ltd, New Delhi and was posted in Indian Institute of Technology Kanpur as a visiting Research Engineer on deputation. His group developed organic light emitting diode (OLED) based displays for the first time in India. From 2008, he was the team leader and by 2012 the group developed commercial quality prototypes. In July 2012, he joined Indian Institute of Technology Kanpur as Principal Research Engineer. In April 2013, he joined National Institute of Interdisciplinary Science and Technology as Principal Scientist in the Photosciences and Photonics group. His current research interests are efficient lighting using OLEDs, sensors using OLED and OFETS. He is also interested in organic photovoltaic cells with new device structures with plasmonic and quantum dot technologies.

Dr. V. Karunakaran, Senior Scientist (March 11, 2014)

Prior to his joining the Institute, he has worked as a quality control chemist at Ms. Tetrahedron public limited, Ambattur industrial estate, Chennai. On May 1998 he joined as a project assistant at the National Centre for Ultrafast Processes, University of Madras and continued for about five years until March 2003. During April 2003 he moved to the Humboldt Universität zu Berlin, Berlin, Germany, as a scientific co-worker and obtained Ph.D in Physical Chemistry and further continued there as a post doc until July 2007. Subsequently in August 2007 he went to the North Eastern University, Boston, USA, for carrying out his postdoctoral research work. In May 2011 he came back to India and joined at NIIST with his DST-SERB fast track scheme. He joined as a senior scientist at NIIST in the Photosciences and Photonics section, CSTD on 11th March 2014. His current area of interest include femtosecond solvation dynamics, excited state dynamics of DNA bases, low frequency vibrational dynamics of heme proteins, ultrafast dynamics involved in dye sensitized solar cell and bulk hetero-junction, polymorphism, photo responsive materials and photophysical characterization of self-aggregated molecules.

Mrs. Shana S. Nair, Staff Nurse Gr.II(1) (April 04, 2013)

Mrs. Shana S. Nair obtained her diploma in General nursing and Midwifery from Cosmopolitan School of Nursing, Thiruvananthapuram in the year 2004. Prior to joining in the Institute, she was working as a staff nurse in Cosmopolitan Hospital (2004-2013). She joined in NIIST Dispensary on 22/04/2013.

STAFF LIST AS ON 31/3/2014

DIRECTOR'S OFFICE	
DR SURESH DAS	DIRECTOR
MR S SURESHKUMAR	CHIEF SCIENTIST
MR T S SASI KUMAR	PRIVATE SECRETARY
MR A KRISHNANKUTTY	TECH GR 1-4
MR P B VIJAYAKUMAR	TECH GR 1-4
AGROPROCESSING & NATURAL PRODUCTS DIVISION	
DR A SUNDERESAN	CHIEF SCIENTIST & HEAD, ADMINISTRATIVE SERVICES
MR M M SREEKUMAR	CHIEF SCIENTIST & HEAD
DR DILEEPKUMAR B S	PRINCIPAL SCIENTIST
MRS OMANAKUTTY AMMA	PRINCIPAL SCIENTIST(Retired on 31/10/2013)
DR K G RAGHU	PRINCIPAL SCIENTIST
MR V V VENUGOPALAN	SR SCIENTIST
MRS M V RESHMA	SR SCIENTIST
DR (MRS) P NISHA	SCIENTIST
MR P JAYAMURTHY	SCIENTIST
DR RAVI SHANKAR L	SCIENTIST
DR PRIYA S	SCIENTIST
DR (MRS) BEENA JOY	PRINCIPAL TECH OFF
MR D R SOBAN KUMAR	TECH OFF
BIOTECHNOLOGY DIVISION	
DR ASHOK PANDEY	CHIEF SCIENTIST & HEAD
DR K MADHAVAN NAMPOOTHIRI	PRINCIPAL SCIENTIST
DR RAJEEVKUMAR SUKUMARAN	SR SCIENTIST
DR P BINOD	SCIENTIST
DR N RAMESH KUMAR	SCIENTIST
DR MUTHU ARUMUGAM	SCIENTIST

MR KIRAN KUMAR M	SCIENTIST
MR K M PRAKASH	SR TECHNICIAN (2)
CHEMICAL SCIENCES & TECHNOLOGY DIVISION	
DR AJAYAGHOSH	OUTSTANDING SCIENTIST
DR K R GOPIDAS	CHIEF SCIENTIST & HEAD
DR T PRASADA RAO	CHIEF SCIENTIST
DR (MRS) MANGALAM S NAIR	CHIEF SCIENTIST
DR D RAMAIAH	CHIEF SCIENTIST(Transfered on 04/10/2013)
DR (MRS) A JAYALAKSHMI	CHIEF SCIENTIST
DR (MRS) R LUXMI VARMA	SR PRINCIPAL SCIENTIST
DR K V RADHAKRISHNAN	PRINCIPAL SCIENTIST
DR C H SURESH	PRINCIPAL SCIENTIST
DR NARAYANAN UNNI K N	PRINCIPAL SCIENTIST
DR KAUSTABH KUMAR MAITI	SR SCIENTIST
DR BISWAPRIYA DEB	SR SCIENTIST
DR KARUNAKARAN VENUGOPAL	SR SCIENTIST
DR YOOSAF KARUVATH	SCIENTIST
DR JOSHY JOSEPH	SCIENTIST
DR B S SASIDHAR	SCIENTIST
DR VIJAYAKUMAR C	SCIENTIST
DR (MRS) J D SUDHA	PRINCIPAL TECH OFF
MRS S VIJI	TECH OFF
MRS SAUMINI MATHEW	TECH OFF
MR ROBERT PHILLIP	TECH OFF
MR KIRAN MOHAN	TECH OFF
MR KIRAN J S	TECH ASST
MATERIAL SCIENCES & TECHNOLOGY DIVISION	
DR M T SEBASTIAN	CHIEF SCIENTIST & HEAD
DR U SYAMAPRASAD	CHIEF SCIENTIST
DR M LAKSHMIPATHY REDDY	CHIEF SCIENTIST
DR P PRABHAKAR RAO	CHIEF SCIENTIST

DR JOSE JAMES	CHIEF SCIENTIST
MR K HARIKRISHNA BHAT	CHIEF SCIENTIST
MR M C SHAJI	SR PRINCIPAL SCIENTIST
DR U T S PILLAI	SR PRINCIPAL SCIENTIST
DR A R R MENON	SR PRINCIPAL SCIENTIST
DR MANOJ RAAMA VARMA	SR PRINCIPAL SCIENTIST
MR SWAPAN KUMAR GHOSH	SR PRINCIPAL SCIENTIST
DR M RAVI	SR PRINCIPAL SCIENTIST
MR S ANANTHAKUMAR	PRINCIPAL SCIENTIST
DR T P D RAJAN	SR SCIENTIST
DR S V SHUKLA	SR SCIENTIST
DR HAREESH U S	SR SCIENTIST
DR E BHOJE GOWD	SR SCIENTIST
DR A SRINIVASAN	SCIENTIST
MR M SUNDARARAJAN	SCIENTIST
DR K P SURENDRAN	SCIENTIST
DR SAJU PILLAI	SCIENTIST
DR (MISS) M VASUNDHARA	SCIENTIST
MR S VELUSAMY	PRINCIPAL TECH OFF
DR V S PRASAD	PRINCIPAL TECH OFF
MR M BRAHMA KUMAR	PRINCIPAL TECH OFF
MR K K RAVIKUMAR	PRINCIPAL TECH OFF
MR P PERUMAL	SR TECH OFF-2
MRS LUCY PAUL	SR TECH OFF
MR P GURUSAMI	SR TECH OFF-2(Retired on 31/07/2013)
MR M R CHANDRAN	SR TECH OFF-2
MR PEER MOHAMED A	TECH OFF
MR S SASIBHUSHANAN	TECH GR 2-4
MR T SOMAN	TECH GR 2-4
MR V ANTONY	TECH GR 2-3
MR V SREEKANTAN	TECH GR 1-4

PROCESS ENGINEERING & ENVIRONMENTAL TECHNOLOGY	
DR (MRS) ROSCHEN SASIKUMAR	CHIEF SCIENTIST(Retired on 31/05/2013)
MR AJIT HARIDAS	CHIEF SCIENTIST & HEAD
MRS ELIZABETH JACOB	SR PRINCIPAL SCIENTIST
DR (MRS) S SAVITHRI	SR PRINCIPAL SCIENTIST
DR V B MANILAL	SR PRINCIPAL SCIENTIST
MR J ANSARI	SR PRINCIPAL SCIENTIST
DR (MRS) RUGMINI SUKUMAR	PRINCIPAL SCIENTIST
DR M ANBU	PRINCIPAL SCIENTIST
DR B KRISHNAKUMAR	SR SCIENTIST
MR ABDUL HALEEM B	SCIENTIST
MR K RISHI ARVIND	SCIENTIST
MRS VIJAYA PRASAD	SR TECH OFF-2
MR V K SHAJIKUMAR	SR TECH OFF
DR S RAMASWAMY	TECH OFF
MR T P PAULOSE	SR TECHNICIAN-3
MRS SAHARUBA P M	JTA
S & T SERVICES	
ENGINEERING & SERVICES DIVISION	
MR R RAJEEV	SUP ENGG
MR K PRASAD	ASST ENGR
MR G CHANDRA BABU	AEE (CIVIL)
MR B KARTHIK	JR ENGR (CIVIL)
MR P ARUMUGAM	JR ENGR (CIVIL)
MR BASHEER T H	SR TECHNICIAN
MR N SUDHILAL	TECH GR 2-5
MR S HARIDASAN PILLAI	TECH GR 2-4
MR P M RAGHAVAN	TECH GR 2-4(Retired on 30/11/2013)
MR P V THAMPY	TECH GR 2-4
MR M JAYADEEP	TECH GR 2-2
MR K S PRAMOD	TECH GR 2-1
MR K SURESH KANNAN	TECH GR 2-1

MR U DHARANIPATHY	TECH GR 2-1
MR B VIKRAMAN	TECH GR 1-4(Voluntary Retired on 04/04/2013)
MR R SUKUMARAN	TECH GR 1-4
MR C P NARAYANAN	TECH GR 1-4
MR P SOMAN	TECH GR 1-4
MR T V SATHEESH	GR C NON-TECH (MACP)
KNOWLEDGE RESOURCE CENTRE	
DR GANGAN PRATHAP	OUTSTANDING SCIENTIST
MRS P NISHY	SR PRINCIPAL SCIENTIST& HEAD
MR V MONI	SCIENTIST
MR RIBIN JONES S B	SCIENTIST
MRS S MINI	PRINCIPAL TECH OFF
MR M RAMASAMY PILLAI	PRINCIPAL TECH OFF
MR S PUSHKIN	TECH OFF
MR G SUDHAKARAN	TECH GR 2-4(Retired on 30/11/2013)
MR G NAGASRINIVASU	SR TECHNICIAN -2
MISS T S LATHA	AST(G)GR II
MR PUSHPAKUMAR K R NAIR	GR C NON-TECH (MACP)
PLANNING & BUSINESS DEVELOPMENT	
DR V G MOHANAN NAIR	CHIEF SCIENTIST
DR C CHANDRASEKARA BHAT	SR PRINCIPAL SCIENTIST
MR D BHEEMESWAR	PRINCIPAL SCIENTIST
MR CHANDRAKANTH C K	SR SCIENTIST
MR R S PRAVEEN RAJ	SR SCIENTIST
DR M SANKARANARAYANAN	PRINCIPAL TECH OFF
MRS V J SAROJAKUMARI	SR STENO(ACP)
MR K C CHACKO	GR C NON-TECH
ADMINISTRATION	
MR N S RAJU	AO
MRS S SOBHANA	AO

MR T J BABU	SECU OFFICER
DR VIJAYNATH R	MEDICAL OFFICER
MRS K S LATHI DEVI	HINDI OFFICER
MR K F JOSEPH	SO (G)
MR M K SIVADASAN	AST(G)GR I
MR D JAYAPRASAD	AST(G)GR I(Retired on 31/10/2013)
MRS SISILY POULOSE	AST(G)GR I(Retired on 30/11/2013)
MR K P KRISHNAN	AST(G)GR I
MR V MOHANAN NAIR	AST(G)GR I
MRS JYOTHI R THAMPI	AST(G)GR II
MR G RAMABHADRAN	AST(G)GR II (Retired on 30/11/2013)
MRS MERCY JOSEPH	AST(G)GR II
MRS K SARASWATHY	AST(G)GR II(ACP)(Retired on 31/07/2013)
MR R K RAMESH KUMAR	AST(G)GR II
MRS PARVATHI RAJEEVAN	ASSISTANT
MRS ELIZABETH THOMAS	SR STENO(ACP)
MRS PADMINI P S	SR STENO (MACP)
MRS SREELETHA NAIR	SR STENO(MACP)
MR B VENUGOPAL	TECH GR 2-4
MR P N SIVANKUTTY NAIR	TECH GR 2-4
MR PRAVEEN KANNAL	TECH GR 2-2
MR B RADHAKRISHNAN	TECH GR 2-1
MRS SHANA S NAIR	STAFF NURSE
MR M P VARKEY	TECH GR 1-4
MRS M GEETHA	TECH GR 1-3
MR SASIDHARAN	BEARER(ACP)
MR K MADHU	DRIVER
MR A SREEKUMARAN	WASHBOY(ACP)
MRS S LEELA DEVI AMMA	GR C NON-TECH(Retired on 30/11/2013)
MR K UNNIKRISHNAN	GR C NON-TECH
MR B SATHEESH KUMAR	GR C NON-TECH

FINANCE & ACCOUNTS	
MR T V SANKARAN	COFA
MRS P V VIJI	SO(F&A)
MR KRISHNA KUMAR M	SO(F&A)
MR SANJEEV SADANANDAN	AST (F&A)GR I
MRS REMANI DEVARAJ	AST(F&A)GR I (MACP)
MR K G PILLAI	AST(F&A)GR I (MACP)
MRS G GEETHA	AST(F&A)GR I
MRS KOMALA SOMAN	AST(F&A)GR II
MR S RAJU	SR STENO (ACP)
MR P PARAMESWARAN PILLAI	GR C NON-TECH (MACP)
MRS R REMADEVI	RECORD KEEPER
STORES & PURCHASE	
MR M R DEVASIS	SPO
MR SANJAY SUMAN	SO
MR C M KRISHNADAS	AST(S&P)GR I
MR M ANILKUMAR	AST(S&P)GR I
MRS L LATHA	TECH GR 2-4
MR B AJAYAKUMAR	TECH GR 2-3
MR T R SURESH KUMAR	SR TECHNICIAN -2
MR T K GOPI	GR C NON-TECH
MR T K GHOSH	GR C NON-TECH
MR G BHAKTHAVALSALAM	GR C NON-TECH

MAJOR FACILITIES CREATED

X-RAY FACILITIES

Single Crystal X-ray Diffractometer and 2-Dimensional X-ray Diffractometer were inaugurated by the Director on 19th June 2013.

(a) 2-Dimensional X-ray Diffractometer (WAXS/SAXS)

2-Dimensional X-ray Diffractometer **(WAXS/SAXS)** with variable temperature attachment is a good addition for a laboratory like CSIR-NIIST, where the research activities are mainly focused in the areas of rare earths, nanomaterials, liquid crystalline materials, polymers, biological materials and metals. It covers an angular range corresponding to 0.3 to 50 nm lattice dimension, with an angular resolution of 0.01° and the large area detectors allow the user to increase the amount of scattered X-rays to obtain the complete Debye diffraction rings.

(b) Single crystal X-ray Diffractometer

The single crystal X-ray diffractometer is of Rigaku origin, Saturn version, with Saturn 724 HG detector that enables high-throughput data collection, with a 4-fold increase in readout speed (to 8 MHz total) and improved signal-to-noise and dynamic range. The four circle goniometer with κ-geometry allows a crystal to be placed and angled in the path of an X-ray beam with extreme precision. The X-ray source employed in this instrument is of sealed tube-type, with Mo K_α ($\lambda = 0.71073$ Å) as the wavelength used for the experiments. Variable X-ray collimator allows for characterizing crystals with variable sizes, ranging from 0.1 to larger dimensions, though 0.2×0.2×0.2 is the standard size recommended. The installed Oxford cryosystem enables the data collection at reduced temperature, up to 77K, making it possible to acquire data for unstable crystals.

CELEBRATIONS AND OTHER ACTIVITIES

NATIONAL TECHNOLOGY DAY CELEBRATIONS AT NIIST

The National Technology Day was celebrated in CSIR-NIIST on 10th May 2013. The lab observed open day during the morning session with students and faculty visits from various educational institutes. The main highlight of afternoon session was the National Technology Day Lecture, delivered by Chief Guest for the day, Shri. D.S. Nagesh, Scientist G and Scientist in Charge, Modeling and Prototyping Laboratory, Bio Medical Technology Wing, Shri Chitra Thirunal Institute for Medical Science and Technology (SCTIMST), Thiruvananthapuram. Shri Nagesh highlighted the transcend of SCTIMST in the area of Bio Medical Technology with the introduction of indigenously developed biomedical devices like centrifugal blood pumps, hemoconcentrator, membrane oxygenator, bubble oxygenator etc. The development in this area paved the way for bringing down the cost of imported similar biomedical devices significantly.

A glimpse of National Technology Day Celebrations- on the stage Dr. Manoj Raama Verma, Dr. Suresh Das, Chief Guest Shri. DS Nagesh.

CSIR FOUNDATION DAY CELEBRATIONS

The Institute celebrated the CSIR Foundation Day on 26th September 2013. The laboratory observed open day. The lab showcased its R & D achievements and instrumentation capabilities to the visitors who came in large numbers. The highlight of the day was the CSIR Foundation Day lecture by the renowned technocrat, academician and policy maker Prof. J.B. Joshi, ICT, Mumbai, who gave the lecture on "Wealth Generation through Research Industry partnership". He highlighted the development of entrepreneurship while imparting the training through research and development programs at ICT.

Prof. J.B. Joshi, ICT, Mumbai, giving lecture on "Wealth Generation through Research- Industry partnership"

CSIR- NIIST FOUNDATION DAY CELEBRATIONS

The CSIR -NIIST Foundation Day was celebrated on 7th October 2013. The Chief Guest on this auspicious occasion was Dr. Chandra Sekhar, Director, CEERI, Pilani. He gave the Foundation Day Lecture entitled "Advances in Electronic Systems Enabled by Physic, Chemistry and Instrumentation", highlighting the success story of interdisciplinary research. The audience comprising of the scientific and technical staff of NIIST, researchers and students from various academic institutions were enthralled while the story of developing the Country's first dedicated full custom LSI processor chip, the

Nation's first general purpose microprocessor chip the Motorola 68010 and the development of state of the art hardware description language based VLSI. Earlier during the day, there was a huge inflow of students and general public to visit the R&D and instrumentation prowess of CSIR- NIIST.

Dr. Chandrasekhar, Director, CEERI, Pilani delivering the Foundation Day Lecture

NATIONAL SCIENCE DAY CELEBRATIONS

The National Science Day was celebrated in the Institute on 28th February 2014. The chief guest for the function was Shri. C.V. Muraleedharan, Scientist/Engineer G, Division of Artificial Organs, Biomedical Wing, Shri Chitra Thirunal Institute for Medical Science and Technology, Poojappura, Trivandrum. The fascinating science of human circulatory system and management of its defects and deficiencies through advances in biomedical research in India was demonstrated by the chief guest during his lecture entitled "Advances in Cardio Vascular Implants".

There was overwhelming response to the open day visit from various educational institutes. More than 350 students and faculty from science and engineering stream visited the Institute and had interactions with scientific and technical personnel while carrying their tour inside the laboratory.

Shri. C.V. Muraleedharan Scientist/Engineer G, SCTIMST delivering the Science Day Lecture

Students from other education institutions visiting the TEM facility

WORLD ENVIRONMENTAL DAY CELEBRATIONS

Unveiling of technology products developed by the Institute by Union Minister Of State For Human Resources

Dr. Shashi Tharoor. Minister of State for Human Resource Development visited CSIR-NIIST, Thiruvananthapuram on June 5, 2013. While addressing the NIIST staff, he lauded the world class research carried out by CSIR-NIIST scientists. He added 'India is constantly criticized as being inhospitable to cutting edge science. But I'm proud and delighted that a research organization from my own constituency does quality research in frontier areas of high relevance. It is also commendable that the research conducted at CSIR-NIIST is anchored locally and oriented at finding immediate applications.' Social consciousness is the main factor which distinguishes Indian research institutes from their foreign counter parts.

Later, he unveiled the technology products developed by CSIR-NIIST under the CSIR-800 programme, an initiative of CSIR for income augmentation and improvement in quality of life of 800 million fellow Indians through interventions of science and technology. The minister expressed his happiness to launch the environment friendly products developed by CSIR-NIIST on World environment day.

Dr. Shashi Tharoor, Minister of State for Human Resource Development, Govt. of India unveiling the technology products developed by CSIR-NIIST

As a step towards making the Institute campus green, the Students Association of NIIST celebrated World Environmental Day on 5th June 2013. Students planted tree saplings in campus and scholars hostel and organised Intercollegiate Quiz Competition, 'Green Quizzard - 2013'. Later on, prizes were distributed to the winners of the Quiz Competition

Director Dr. Suresh Das planting tree sapling as part of World Environmental Day Celebrations

INTERNATIONAL CONFERENCE ON ADVANCED FUNCTIONAL MATERIALS (ICAFM - 2014)

International Conference on advanced Functional Materials (ICAFM - 2014), organized by CSIR-NIIST jointly with leading scientific societies like Indian Institute of Metals (IIM) - Trivandrum chapter, Materials Research Society of India (MRSI)- Trivandrum chapter, Indian Ceramic Society (InCerS) - Kerala Chapter and The Society for Polymer Science (India) - Trivandrum Chapter, was held from 19th to 21st Feburary, 2014 at Mascot Hotel, Thiruvananthapuram. The Conference was inaugurated by Prof. Manfred Stamm, Leibniz Institute of Polymer Research, Dresden, Germany.

After lighting the traditional lamp to formally inaugurate the 3 - day conference, Prof. Manfred emphasized the importance of materials in modern life. Conferences of this kind can create a platform for active interaction and exchange of ideas among scientific community. Dr. Suresh Das, Director, CSIR-NIIST, who chaired the meeting highlighted the necessity of developing novel functional materials to cater to the needs of energy, food health sectors. Felicitating on the occasion, Prof. Ian M. Reaney, University of Sheffield, UK said that the conference provided an opportunity for young researchers from different parts of the world to learn the trends in the field.

Dr Suresh Das Director NIIST, welcoming dignitaries for ICAFM 2014

COMPUTATIONAL MODELING: TRANSCENDING DISCIPLINES

A symposium on "Computational Modeling: Transcending Disciplines" was held on May 21, 2013 from 09.30–13.00hrs. The symposium started wih the welcome address by Shri. Ajit Haridas, Head, Process Engineering and Environmental Technology, NIIST. The Symposium stared with Dr. Roschen Sasikumar, Head, Computational Modeling & Simulation Group's talk on "Down the Memory lane". Prof. Achuthsankar S. Nair, Director, Centre for Bioinformatics, University of Kerala, Thiruvananthapuram spoke on "Computational Biology: Bird's eye view. Dr.V. V. Ranade, Outstanding Scientist, CSIR-NCL, and Pune spoke on Hydrodynamics and Process Performance: Technology status & future trends. Prof. Pradip Dutta, Head, Mechanical Engineering Department, Indian Institute of Science, Bangalore's topic of discussion was Solidification Studies: Towards process development for light weighting. The symposium concluded with the concluding remarks of Dr. A.D. Damodaran, Former Director, NIIST and Thiruvananthapuram.

5TH INDIA-KOREA JOINT WORKSHOP ON BIOENERGY INCORPORATING BIOFUELS AND BIOREFINERIES

The 5th India-Korea Joint Workshop on Bioenergy Incorporating Biofuels and Biorefineries was held at CSIR-National Institute for Interdisciplinary Science and Technology, Trivandrum during September 9-10, 2013. It was organized and supported by the Department of Science and Technology (MoST), Govt. of India, Ministry of Science, ICT and Future Planning (MSIP), Govt. of Korea, Asian Research Network, Seoul, Korea Institute of Science and Technology, Seoul and hosted by the CSIR-National Institute for Interdisciplinary Science and Technology, Trivandrum. There were about 90 delegates from Korea and India who attended the workshop. The workshop had its aim to improve the relations in science and technology between the two countries through their mutual interest in chosen themes such as bioenergy.

The workshop was inaugurated by Prof Haiwon Lee, Hanyang University, Seoul, Korea and Dr Suresh Das, Director, CSIR-NIIST. The scientific program of the workshop was divided in five technical sessions, *viz*. Algal Biofuels & Biorefinery, Microbial fuel cells, Biohydrogen, Biomass to fuels, and Lignocellulosic biomass conversion and value addition. and Advanced Biofuels and chemicals. A total of 22 lectures were presented by the eminent speakers from both the countries. A panel discussion was held to identify and recommend R&D areas/topics of mutual interest for both the countries for future collaboration in the area of bioenergy.

OBSERVANCE OF HINDI DAY/HINDI WEEK-2013

Institute celebrated September 05, 2013 as the Hindi Day and the week succeeding as Hindi Week with great zeal and enthusiasm. The formal inauguration of the Hindi Day was held on September 05, 2013. Institute Director Dr. Suresh Das presided over the function. In his Hindi Day message he told that Hindi Day is a day of pride in the history of India and Hindi is a symbol of social and cultural unity. He said that language establishes governance and accountability relations and cooperation between people. Hence, it is essential to promote Official Language Hindi in governance.

During the entire week, many competitions were organized for the staff members of the Institute including research students, project staff and their school children.

Director Dr. Suresh Das delivering the Hindi Day message. On the stage Shri N.S.Raju, AO

Valedictory function and prize distribution was held on 12.9.2013 at 4.30 PM. Hon'ble Justice M.R. Hariharan Nair, Former Justice, Kerala High Court was the Chief Guest. After the Valedictory address by the Chief Guest, Dr(Ms.) M. Vasundhara, Scientist & Member, Organising Committee made technical presentation in Hindi on " Global Warming- Greatest Threat". Later, the Chief Guest distributed prizes and certificates to the successful participants of various competitions held during the Hindi Week.

Hon'ble Justice M.R. Hariharan Nair distributed prizes and certificates to the successful participants

OBSERVANCE OF VIGILANCE AWARENESS WEEK

Vigilance Awareness Week- valedictory function- on the stage from left- Dr. Ajayaghosh, Shri. Nandakumaran Nair & Shri N.S. Raju

The Vigilance Awareness Week 2013 was observed in this institute from 28th October to 1st November 2013. The week started with administration of pledge in Hindi and English by the Director at 11.00 a.m on 28th October 2013. Various competitions on Elocution, Essay writing and Debate were conducted for staff members and students inclusive of project students during 28th October to 1st November 2013. The valedictory function and prize distribution were held on 1st November 2013. Dr. Ajayaghosh, Director-In-Charge presided over the function. Shri. Nandakumaran Nair, Additional Superintendant of Police, CBI, Thiruvananthapuram delivered the Valedictory Lecture and gave away the prize to the winners of various competitions.

ONAM CELEBRATION

On September 13, 2013 under the auspices of the Institute's Staff Recreation Club, Onam festival was celebrated with various entertainment programs.

हिंदी रूपांतर

CSIR - National Institute for Interdisciplinary Science & Technology

हिंदी रूपांतर

सामान्य सूचनाएं

विदेश में दौरा

नाम	दौरा किया देश	अवधि	उद्देश्य
डॉ. ए.अजयघोष उत्कृष्ट वैज्ञानिक	फ्रांस	10/05/2013 - 14/05/2013	औट्रांस और ग्रेनाब्ल, फ्रांस में वैज्ञानिक बैठक और 22वीं औद्योगिक अनुसंधान समिति की बैठकों में भाग लेने के लिए
	ताइवान	28/07/2013 - 02/08/2013	ताइपे, ताइवान में नूतन सुरभित यौगिकों पर आयोजित 15 वीं अंतर्राष्ट्रीय संगोष्ठी "आईएसएएन-15", में भाग लेने और व्याख्यान देने के लिए
	जापान	16/10/2013 - 30/10/2013	राष्ट्रीय पदार्थ विज्ञान संस्थान (एनआईएमएस),सुकुबा, जापान में एक अतिथि वैज्ञानिक के रूप में
	जापान	07/12/2013 - 09/12/2013	10वीं ग्रीन एलमेंट अनुसंधान संगोष्ठी में आमंत्रित वक्ता के रूप में
	जापान	28/02/2014 - 01/03/2014	एक आमंत्रित वक्ता के रूप में 4वीं फ्यूमिक्स अंतर्राष्ट्रीय सम्मेलन में भाग लेने के लिए
डॉ. अजित हरिदास मुख्य वैज्ञानिक	जर्मनी	01/09/2013 - 09/09/2013	अवायवीय प्रौद्योगिकी पर विशेषज्ञ के रूप में सैनिटरी इंजीनियरिंग और अपशिष्ट प्रबंधन संस्थान, जर्मनी की यात्रा के लिए
डॉ.अशोक पाण्डेय मुख्य वैज्ञानिक	हांगकांग	05/05/2013 - 09/05/2013	हांगकांग बैप्टिस्ट यूनिवर्सिटी, हांगकांग में इंटरनेशनल सम्मेलन में भाग लेने के लिए
	फ्रांस	03/06/2013 - 28/06/2013	यूबीपी फेलोशिप के तहत ब्लेस पास्कल विश्वविद्यालय,फ्रांस में काम करने के लिए
	चीन	05/09/2013 - 08/09/2013	जैव प्रौद्योगिकी कार्यशाला में भाग लेने के लिए चीन की यात्रा के लिए
	कोरिया	29/10/2013 - 02/11/2013	पर्यावरण विज्ञान और इंजीनियरिंग पर 6वें अंतर्राष्ट्रीय सम्मेलन में भाग लेने के लिए
डॉ. ई.भोजे गौड व. वैज्ञानिक	अमेरिका	01/03/2014 - 31/05/2014	भारत-अमेरिका विज्ञान एवं प्रौद्योगिकी फोरम रिसर्च फैलोशिप के तहत आईयूएसएसटीएफ रिसर्च फैलोशिप

डॉ.पी.बिनोद वैज्ञानिक	इटली	01/10/2013 - 20/10/2013	नेपल्स विश्वविद्यालय और सीएसआईआर-एनआईआईएसटी के बीच सहयोगात्मक परियोजना के भाग के रूप में
डॉ. माधवन नंपूतिरि प्रिंसिपल वैज्ञानिक	जर्मनी	15/04/2013 - 30/04/2013	डीएसटी -डीएएडी द्वारा प्रायोजित इंडो-जर्मन द्विपक्षीय कार्मिक यात्रा कार्यक्रम के तहत बिलेफेल्ड विश्वविद्यालय, जर्मनी की यात्रा करने के लिए
डॉ. वी.बी.मणिलाल प्रिंसिपल वैज्ञानिक	पुर्तगाल	09/06/2013 - 11/06/2013	गुइमारेस, पुर्तगाल में आईसीएनएफ 2013 के प्रथम अंतर्राष्ट्रीय सम्मेलन में भाग लेने के लिए
डॉ. के.वी.राधाकृष्णन प्रिंसिपल वैज्ञानिक	सिंगापुर	18/08/2013 - 24/08/2013	रिसॉर्ट वर्ल्ड सेंटोसा, सिंगापुर में 15वीं एशियाई रासायनिक कांग्रेस में भाग लेने के लिए
डॉ. टी.पी.डी.राजन व. वैज्ञानिक	ब्रिटेन	16/01/2014 - 26/01/2014	यूकेईआरआई विनिमय कार्यक्रम के तहत मानद शोधकर्ता के रूप में
डॉ. राजीव कुमार सुकुमारन वरिष्ठ वैज्ञानिक	ऑस्ट्रेलिया	15/09/2013 - 16/09/2013	आर्थिक रूप से स्थायी जैव आधारित ऊर्जा के लिए परियोजना एकीकृत प्रौद्योगिकियों पर निवेशकों की बैठक में भाग लेने के लिए
	कोरिया	23/09/2013 - 26/09/2013	कोरानेट जैव ईंधन कार्यशाला में भाग लेने के लिए
	इटली	01/10/2013 - 20/10/2013	नेपल्स विश्वविद्यालय और सीएसआईआर-एनआईआईएसटी के बीच सहयोगात्मक परियोजना के भाग के रूप में
डॉ. डी.रामय्या मुख्य वैज्ञानिक	स्पेन	10/09/2013 - 20/09/2013	डीएसटी और सीएसआईसी-आईसीसीसी, स्पेनिश अनुसंधान परिषद द्वारा प्रायोजित सहयोगात्मक परियोजना के तहत स्पेन की यात्रा के लिए
डॉ. सत्यजित शुक्ला वैज्ञानिक	चीन	16/05/2013 - 19/05/2013	कांफ्रेंस सेंटर, जिंग्सु विश्वविद्यालय, जहेंजींग,चीन में उन्नत सामग्री पर आयोजित 2वें वार्षिक सम्मेलन में भाग लेने के लिए (एएम-2013)
डॉ. सी.एच.सुरेश प्रिंसिपल वैज्ञानिक	अमरीका	27/09/ 2013 - 29/09/2013	युवा जांचकर्ताओं (वाईआईएम) के पुरस्कार समारोह में भाग लेने के लिए
	जापान	18/03/2014 - 30/03/2014	सेमिनार और विचार विमर्श में भाग लेने के लिए और एक आमंत्रित व्याख्याता के रूप में नागोया विश्वविद्यालय में जापान केमिकल सोसाइटी की 94 वीं वार्षिक बैठक में भाग लेने के लिए

सम्मान एवं पुरस्कार

डॉ. सुरेश दास	रसायन विज्ञान तथा पदार्थ विज्ञान में उत्कृष्टता के लिए 'शास्त्र-सी.एन.आर.राव
	जे सी बोस नेशनल फैलोशिप, 2013
डॉ. ए. अजयघोष	विज्ञान में टीडब्ल्युएएस (विश्व विज्ञान अकादमी) पुरस्कार, 2013
	सीआरएसआई रजत पदक, भारतीय केमिकल रिसर्च सोसायटी
	केरल विज्ञान अकादमी के मानद फैलो, 2013
	फैलो, रसायन विज्ञान रॉयल सोसाइटी, लंदन, 2014
प्रो. अशोक पाण्डेय	ऊर्जा, पर्यावरण और सस्टेनेबिलिटी की इंटरनेशनल सोसायटी की तरफ़ से फैलो पुरस्कार
डॉ. डी.रामय्या	सीएसआईआर-एनईआईएसटी, जोरहाट के निदेशक के रूप में नियुक्त
डॉ. जे.डी.सुधा	केरल विज्ञान अकादमी की फैलो, 2014
डॉ. पी. प्रभाकर राव	एमआरएसआई पदक
डॉ. ई. भोजे गौड	भारत-अमेरिका विज्ञान एवं प्रौद्योगिकी फोरम द्वारा आईयुएसएसटीएफ रिसर्च फैलोशिप
डॉ. के.जी.के. वार्यर	विश्लेषणात्मक रसायन विज्ञान के लिए इंडियन सोसायटी का लाइफ टाइम अचीवमेंट पुरस्कार
	भारतीय सिरेमिक सोसायटी से श्री किशन मोदी मेमोरियल पुरस्कार
डॉ. सी.एच.सुरेश	वाईआईएम-बोस्टन युवा वैज्ञानिक पुरस्कार
	उत्कृष्ट युवा केमिस्टों के लिए एशियाई अंतर्राष्ट्रीय संगोष्ठी में जापान केमिकल सोसायटी द्वारा प्रतिष्ठित लेक्चररशिप पुरस्कार, नागोया विश्वविद्यालय, जापान, 2014
डॉ. विजयकुमार	रामानुजन फैलोशिप
डॉ. एस सावित्री	अंतर्राष्ट्रीय महिला दिवस के अवसर पर इंजीनियरिंग वॉच से वर्ष 2014 के प्रेरणादायक महिला अभियंता / वैज्ञानिक
डॉ. एल.रविशंकर	केरल राज्य युवा वैज्ञानिक पुरस्कार, 2013
सीएसआईआर-एनआईआईएसटी	2012-13 के दौरान संघ सरकार की राजभाषा नीति के कार्यान्वयन के लिए राजभाषा विभाग, भारत सरकार द्वारा तृतीय सर्वश्रेष्ठ कार्यालय घोषित करके राजभाषा शील्ड और योग्यता प्रमाण पत्र
सुश्री लेया थॉमस	जैव प्रौद्योगिकी और जैव सूचना विज्ञान के क्षेत्र में एडवांसेज पर आयोजित अंतर्राष्ट्रीय सम्मेलन में बेस्ट पेपर अवार्ड

पीएच डी सम्मानित

छात्र	थीसिस का शीर्षक	पर्यवेक्षक	विश्वविद्यालय
अजिता एम जे	डेंसिटी फंक्शनल थियरी स्टडीज ओन (एस)प्रोलीन एंड एन-हेटेरो साइक्लिक कार्बाइन (एनसीएच) मेडिएटेड ओर्गनोकैटेलिटिक रिअक्शन्स	डॉ. सी.एच. सुरेश	केरल विश्वविद्यालय
अनीश जी	डिज़ाइन, सिंथेसिस एंड स्टडी ऑफ़ पी -फिनाइलीनएथीनीलेन बेस्ड लीनियर π -कन्जुगाटेड ऑर्गानोजेलेटर्स	डॉ. ए.अजयघोष	केरल विश्वविद्यालय
दीपा के.एस.	डिज़ाइन एंड प्रॉपर्टी कोर्रेलेशन्स इन हाई पेर्मिटिविटि इंसुलेटर - कंडक्टर पेरकोलटिव कंपोजिट्स	डॉ. जोस जेइम्स	कुसाट
धनेश थॉमस	फॉस्फेट बेस्ड डाईइलेक्ट्रिक सिरेमिक्स एंड कंपोजिट्स फॉर माइक्रोवेव आप्लिकेशन्स	डॉ. एम.टी. सेबास्टियन	केरल विश्वविद्यालय
धन्या एस.	ऑप्टिकल एंड इलेक्ट्रोकेमिकल सेंसर्स फॉर डिटेक्शन एंड क्वांटिफिकेशन ऑफ़ सिलेक्टेड इनऑर्गैनिक अनिओन्स इन एक्वस मीडिया	डॉ. टी. प्रसाद राव	केरल विश्वविद्यालय
फरीद भाषा सय्यद मीरसाहेब	क्वांटिफिकेशन एंड प्रेडिक्शन ऑफ़ सब्स्टिटूएंट इफेक्ट्स इन एरोमेटिक मोलेक्यूल्स एंड केटओन्स -π कोम्प्लेक्सेस यूसिंग मोलेक्यूलर इलेक्ट्रोस्टेटिक पोटेंशियल	डॉ. सी.एच. सुरेश	केरल विश्वविद्यालय
गौरी श्रीदेवी के.सी	मेसो- डयार्यल डाईपयरोलिक सिस्टम्स: सिंथेसिस, कैरेक्टराइजेशन एंड आप्लीकेशन आस ए मॉलिक्यूलर कीपैड लॉक	डॉ. ए.श्रीनिवासन	केरल विश्वविद्यालय
मरियम थॉमस	स्टडीज ओन लुमिनेसेन्ट प्रॉपर्टीज ऑफ़ ईयु3+-एक्टिवेटिड मॉलिब्डेट एंड तंगस्टेट बेस्ड नावेल रेड फॉस्फोरस	डॉ. पीटर कोशी	केरल विश्वविद्यालय
राधाकृष्णन ए.एस.	स्टडीज ओन स्ट्रक्चर, लैटिस थर्मल एक्सपेंशन एंड ऑक्साइड आयन कंडक्टिंग प्रॉपर्टीज ऑफ़ सम रेयर अर्थ बस्ड जिरकोनेट	डॉ. पीटर कोशी	केरल विश्वविद्यालय

रश्मी सी.पी	स्ट्रक्चर, मैग्नेटिक एंड मैग्नेटोकलोरिक स्टडीज ऑफ़ सम लैन्थेनम स्ट्रॉन्शियम मैगेनाइट्स एंड रेयर एअर्थ गर्नेट्स	डॉ. मनोज रामवर्मा	केरल विश्वविद्यालय
रतीश के	रिम -बाईंडिंग इंटरेक्शन ऑफ़ एन -अल्काइलपैरोमेल्लिटिक डाइइमिडेस विथ β-साइक्लोडेक्सट्रिन। ए डिटेल्ड स्टडी ऑफ़ दि नोवेल कोम्प्लेक्सेशन एंड इट्स यूटिलाइजेशन इन दि डिज़ाइन ऑफ़ β-सीडी बेस्ड टर्नरी कोम्प्लेक्सेस फॉर फोटो इन्ड्यूस्ड इलेक्ट्रान ट्रांसफर एंड हाइड्रोजेल्स	डॉ. के.आर. गोपिदास	केरल विश्वविद्यालय
रोनी राजन पॉल	नोवेल सी-सी एंड सी-हेटेरोऑटोम बांड फॉर्मिंग रिएक्शन्स इन्वोल्विंग होमोइनोलेट जनरेटेड बाइ ओर्गनोकटैलिसीस एंड रिलेटेड केमिस्ट्री	डॉ जी विजय नायर और डॉ ए जयलक्ष्मी	केरल विश्वविद्यालय
संध्या कुमारी एल	सिंथेसिस, कैरेक्टराइजेशन एंड ऑप्टिकल प्रॉपर्टीज ऑफ़ रेयर अर्थ - ट्रांजीशन मेटल बेस्ड एन्विरोंमेंटली फ्रेंडली रेड एंड येलो पिगमेंट्स	डॉ पी प्रभाकर राव	केरल विश्वविद्यालय
संजू के.एस	सिंथेसिस ऑफ़ आर्गेनिक सिस्टम्स एंड स्टडी ऑफ़ देयर लाइट एमिटिंग प्रॉपर्टीज इन सलूशन एंड पॉलीमर मैट्रिक्स	डॉ डी रामैय्या	केरल विश्वविद्यालय
सैनी राफेल एम	सिंथेसिस, कैरेक्टराइजेशन एंड फोटोफीसिकल प्रॉपर्टीज ऑफ़ लैन्थानाइड कार्बोक्सीलेट्स	डॉ एम एल पी रेड्डी	केरल विश्वविद्यालय
सुचित्रा एम.वी.	सिंथेसिस एंड आप्लिकेशन्स ऑफ़ क्लासिकल एंड अजा-मोरिटा-बेलीज़-हिल्लमान अद्दुक्ट्स ऑफ़ फेरोसेन कार्बोक्साल्डिहाइड्स	डॉ आर लक्ष्मी वर्मा	केरल विश्वविद्यालय
सुनीश सी.के.	डिज़ाइन ऑफ़ नोवेल सेंसिटाइज़ेर्स फॉर फोटोडायनामिक थेरेपी: सिंथेसिस, फोटोफीसिकल एंड फोटोबायोलॉजिकल स्टडीज ऑफ़ सब्स्टिटूटेड पोरफीरिन सिस्टम्स	डॉ डी रामैय्या	केरल विश्वविद्यालय

अनुसंधान परिषद के सदस्य

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प्रबंधन परिषद के सदस्य

(01/01/2012 से 31/12/2013 तक की अवधि)

अध्यक्ष

निदेशक, एनआईआईएसटी

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प्रधान, पीपीडी, एनआईआईएसटी

सदस्य सचिव

प्रशासन अधिकारी, एनआईआईएसटी

(01/01/2014 से 31/12/2015 तक की अवधि)

अध्यक्ष

निदेशक, एनआईआईएसटी

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डॉ. एम. वसुंधरा, वैज्ञानिक, एनआईआईएसटी
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डॉ. के.माधवन नंपूतिरि, प्रिंसिपल वैज्ञानिक, एनआईआईएसटी
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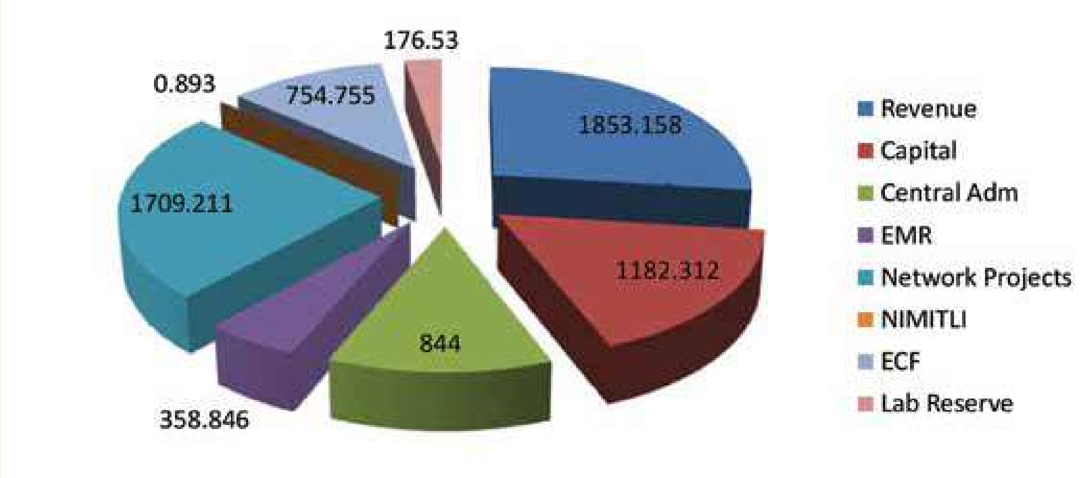
श्री एम.एम.श्रीकुमार, प्रधान, आरपीबीडी, एनआईआईएसटी
श्री टी.वी.शंकरन, वित्त एवं लेखा नियंत्रक, एनआईआईएसटी

सदस्य सचिव

प्रशासन अधिकारी, एनआईआईएसटी

बजट 2013 - 2014 (रुपये लाख)



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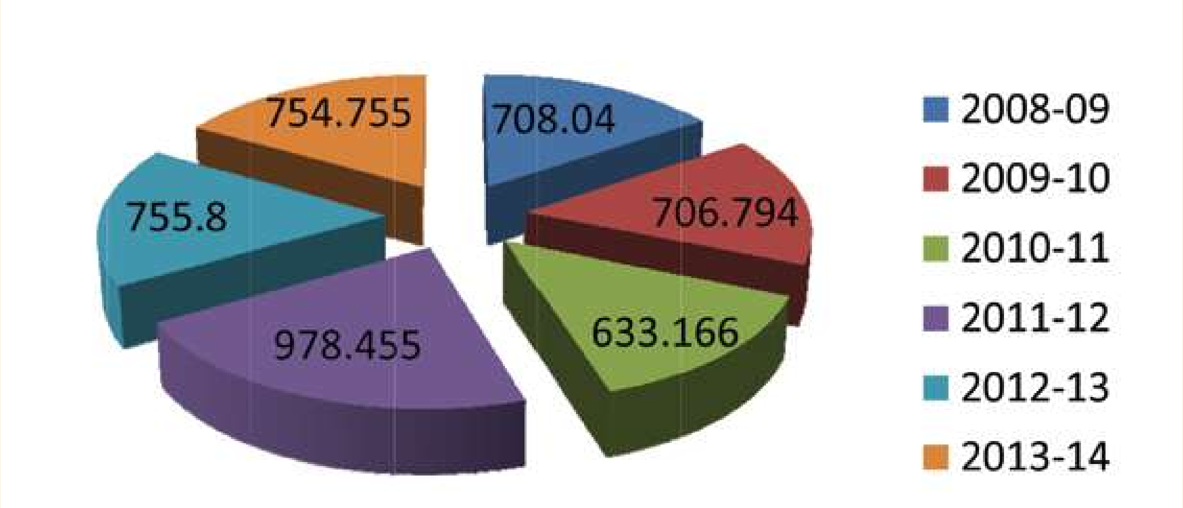

स्टाफ - नई नियुक्तियाँ

डॉ. के. एन. नारायणन उण्णि, प्रिंसिपल वैज्ञानिक (अप्रैल 08, 2013)

डॉ. के. एन. नारायणन उण्णि ने वर्ष 1993 में सामग्री विज्ञान में विशेषज्ञता के साथ महात्मा गांधी विश्वविद्यालय से भौतिकी में एमएससी की डिग्री प्राप्त की। वर्ष 2001 में आप पीएचडी से सम्मानित किये गये। आप भौतिकी विभाग, भारतीय प्रौद्योगिकी संस्थान, मुम्बई में माइक्रोवेव प्लाज्मा रासायनिक वाष्प जमाव से हीरे के पतली फिल्मों और कार्बन नैनोट्यूब के निर्माण पर पोस्ट डॉक्टरेट शोध सहयोगी के रूप में काम किये। वर्ष 2002 में आप एन्जर्स विश्वविद्यालय, फ्रांस में लबोरेटरे प्रोप्रिइटिस ओप्टिक्युस डेस मैटिरिऑक्स इट अप्पिलिकेशन्स (सीएनआरएस) में पोस्ट डॉक्टरेट एसोशियेट के रूप में प्रो. ज्यीन मैकल नन्जी के समूह में शामिल हो गए और कार्बनिक क्षेत्र प्रभाव ट्रांजिस्टर आधारित स्मृति तत्वों और छोटे अणु आधारित सौर कोशिकाओं को विकसित करने की दिशा में काम किये। वर्ष 2005 में आप भारत में लौट आए और सैमटेल कलर लिमिटेड, नई दिल्ली में शामिल हो गए और बाद में प्रतिनियुक्ति पर विजिटिंग रिसर्च इंजीनियर के रूप में भारतीय प्रौद्योगिकी संस्थान, कानपुर में आपकी तैनाती हुई। आपके समूह ने प्रोफेसर दीपक गुप्ता की देखरेख में भारत में पहली बार कार्बनिक प्रकाश उत्सर्जक डायोड (ओएलईडी) आधारित डिस्प्ले विकसित किया। वर्ष 2008 में टीम के प्रमुख के रूप में आपकी पदोन्नति हुई और वर्ष 2012 के अंत तक आपके समूह ने वाणिज्यिक गुणवत्ता प्रोटोटाइप विकसित किया। जुलाई 2012 में प्रिंसिपल रिसर्च इंजीनियर के रूप में भारतीय प्रौद्योगिकी संस्थान, कानपुर में आप शामिल हो गए और अप्रैल 2013 में संस्थान के फोटोनिक्स और फोटोसाइंस समूह में प्रधान वैज्ञानिक के रूप में शामिल हो गए। ओएलईडी का उपयोग करके कुशल प्रकाश व्यवस्था और ओएलईडी और ओएफईटीएस का उपयोग करके सेंसर का विकास अपने वर्तमान अनुसंधान के हितों में शामिल हैं। प्लैज्मोनिक और क्वांटम डॉट तकनीक के साथ नये डिवाइस संरचनाओं के साथ कार्बनिक फोटोवोल्टिक कोशिकाओं में भी आप रुचि रखते हैं।

डॉ. वी. करुणाकरन, वरिष्ठ वैज्ञानिक (मार्च 11, 2014)

संस्थान में कार्यग्रहण करने से पहले आप मेसेर्स टेट्राहेड्रोन पब्लिक लिमिटेड, अंबात्तुर औद्योगिक एस्टेट, चेन्नई में गुणवत्ता नियंत्रण केमिस्ट के रूप में काम किये। मई 1998 को आप नेशनल सेंटर फॉर अल्ट्राफास्ट प्रोसेस, मद्रास विश्वविद्यालय में एक परियोजना के सहायक के रूप में शामिल हुए और पाँच साल तक उधर जारी रखे। अप्रैल 2003 के दौरान आप हम्बोल्ट यूनिवर्सिटाट जु बर्लिन, बर्लिन, जर्मनी में वैज्ञानिक सह कार्यकर्ता के रूप में रहे और आपको भौतिक रसायन विज्ञान में पीएचडी की उपाधी मिली और आगे जुलाई 2007 तक आप पोस्ट डॉक्टरल फेलो के रूप में रहे और जुलाई 2007 को पोस्ट डॉक्टरल शोध कार्य जारी करने के लिए, उत्तर पूर्वी विश्वविद्यालय, बोस्टन, संयुक्त राज्य अमेरिका गये। मई 2011 को आप भारत वापस आये और डीएसटी-एसईआरबी फास्ट ट्रैक योजना के तहत एनआईआईएसटी में शामिल हो गए। 11 मार्च 2014 को आप एनआईआईएसटी के फोटोसाईंसस और फोटोनिक्स प्रभाग में वरिष्ठ वैज्ञानिक के रूप में शामिल हुए। आपके वर्तमान हित के क्षेत्र में फेम्टोसेकेंट सोल्वेशन गतिशीलता, डीएनए बेस के उत्तेजित अवस्था गतिशीलता, हीम प्रोटीन की कम आवृत्ति कंपन गतिशीलता, रंजक सुग्राहीकृत सौर सेल और बल्क असमलैंगिक जंक्शन में शामिल अल्ट्राफास्ट गतिशीलता, बहुरूपता, फोटो संवेदनशील सामग्री और स्वयं एकत्रित अणुओं की प्रकाश-भौतिक अभिलक्षण शामिल हैं।

श्रीमती शाना एस नायर

श्रीमती शाना एस नायर ने वर्ष 2004 में जनरल नर्सिंग एण्ड मिडवाइफरी में कॉस्मोपॉलिटन स्कूल ऑफ नर्सिंग, तिरुवनंतपुरम से डिप्लोमा प्राप्त किया। संस्थान में शामिल होने से पहले आप कॉस्मोपॉलिटन अस्पताल में स्टाफ नर्स (2004-2013) के रूप में काम कर रही थीं। आपने 22.04.2003 को एनआईआईएसटी डिस्पेंसरी में कार्यग्रहण किया।

31.03.2014 को कर्मचारियों की सूची

निदेशक का कार्यालय	
डॉ. सुरेश दास	निदेशक
श्री एस. सुरेश कुमार	मुख्य वैज्ञानिक
श्री टी.एस.शशि कुमार	निजि सचिव
श्री ए.कृष्णनकुट्टि	तकनीकी ग्रेड 1 -4
श्री पी.बी.विजयकुमार	तकनीकी ग्रेड 1 -4
कृषि संसाधन एवं प्राकृतिक उत्पादन प्रभाग	
डॉ. ए.सुन्दरेशन	मुख्य वैज्ञानिक तथा प्रधान, प्रशासनिक सेवाएं
श्री एम.एम.श्रीकुमार	मुख्य वैज्ञानिक तथा प्रधान
डॉ. दिलीपकुमार.बी.एस	प्रिंसिपल वैज्ञानिक
श्रीमती ओमनाकुट्टि अम्मा	प्रिंसिपल वैज्ञानिक(31/10/2013 को सेवानिवृत्त)
डॉ. के.जी.रघु	प्रिंसिपल वैज्ञानिक
श्री वी.वी.वेणुगोपालन	वरिष्ठ वैज्ञानिक
श्रीमती एम.वी.रेश्मा	वरिष्ठ वैज्ञानिक
डॉ. (श्रीमती) पी.निशा	वैज्ञानिक
डॉ. पी.जयमूर्ती	वैज्ञानिक
डॉ. रविशंकर.एल	वैज्ञानिक
डॉ. प्रिया एस	वैज्ञानिक
डॉ.(श्रीमती) बीना जोय	प्रिंसिपल तकनीकी अधिकारी
श्री डी.आर.शोभन कुमार	तकनीकी अधिकारी
जैव-प्रौद्योगिकी प्रभाग	
डॉ. अशोक पाण्डेय	मुख्य वैज्ञानिक तथा प्रधान
डॉ. के.माधवन नंपूतिरि	प्रिंसिपल वैज्ञानिक
डॉ. राजीवकुमार सुकुमारन	वरिष्ठ वैज्ञानिक
डॉ. पी.बिनोद	वैज्ञानिक
डॉ. एन.रमेश कुमार	वैज्ञानिक
डॉ. मुत्तु अरुमुखम	वैज्ञानिक

श्री किरन कुमार एम	वैज्ञानिक
श्री के.एम.प्रकाश	वरिष्ठ तकनीशन (2)
रसायन विज्ञान तथा प्रौद्योगिकी प्रभाग	
डॉ. ए.अजयघोष	उत्कृष्ट वैज्ञानिक
डॉ. के.आर.गोपिदास	मुख्य वैज्ञानिक तथा प्रधान
डॉ. टी.प्रसादाराव	मुख्य वैज्ञानिक
डॉ. (श्रीमती) मंगलम एस.नायर	मुख्य वैज्ञानिक
डॉ. डी.रामय्या	मुख्य वैज्ञानिक (04/10/2013 को स्थानांतरित)
डॉ. (श्रीमती) ए.जयलक्ष्मी	मुख्य वैज्ञानिक
डॉ. (श्रीमती) आर.लक्ष्मी वर्मा	वरिष्ठ प्रिंसिपल वैज्ञानिक
डॉ. के.वी.राधाकृष्णन	प्रिंसिपल वैज्ञानिक
डॉ. सी.एच.सुरेश	प्रिंसिपल वैज्ञानिक
डॉ. नारायणन उण्णि के.एन	प्रिंसिपल वैज्ञानिक
डॉ. कौस्ताभकुमार मैती	वरिष्ठ वैज्ञानिक
डॉ. बिश्वप्रिया देब	वरिष्ठ वैज्ञानिक
डॉ. करुणाकरन वेणुगोपाल	वरिष्ठ वैज्ञानिक
डॉ. यूसफ करुवात	वैज्ञानिक
डॉ. जोशी जोसफ	वैज्ञानिक
डॉ. बी.एस.शशिधर	वैज्ञानिक
डॉ. विजयकुमार सी	वैज्ञानिक
डॉ. (श्रीमती) जे.डी.सुधा	प्रिंसिपल तकनीकी अधिकारी
श्रीमती एस.विजी	तकनीकी अधिकारी
श्रीमती सौमिनी मैथ्यू	तकनीकी अधिकारी
श्री रोबर्ड फिलिप	तकनीकी अधिकारी
श्री किरण मोहन	तकनीकी अधिकारी
श्री किरण जे.एस	तकनीकी सहायक
पदार्थ विज्ञान तथा प्रौद्योगिकी प्रभाग	
डॉ. एम.टी.सेबास्टियन	मुख्य वैज्ञानिक तथा प्रधान
डॉ. यु.श्यामाप्रसाद	मुख्य वैज्ञानिक
डॉ. एम.लक्ष्मीपति रेड्डी	मुख्य वैज्ञानिक
डॉ. पी.प्रभाकर राव	मुख्य वैज्ञानिक

डॉ. जोस जेइम्स	मुख्य वैज्ञानिक
श्री के.हरिकृष्ण भट	मुख्य वैज्ञानिक
श्री एम.सी.षाजी	वरिष्ठ प्रिंसिपल वैज्ञानिक
डॉ. यु.टी.एस.पिल्लै	वरिष्ठ प्रिंसिपल वैज्ञानिक
डॉ. ए.आर.आर.मेनोन	वरिष्ठ प्रिंसिपल वैज्ञानिक
डॉ. मनोज रामावर्मा	वरिष्ठ प्रिंसिपल वैज्ञानिक
श्री स्वपनकुमार घोष	वरिष्ठ प्रिंसिपल वैज्ञानिक
डॉ. एम.रवि	वरिष्ठ प्रिंसिपल वैज्ञानिक
श्री एस.अनन्तकुमार	प्रिंसिपल वैज्ञानिक
डॉ. टी.पी.डी.राजन	वरिष्ठ वैज्ञानिक
डॉ. एस.वी.शुक्ला	वरिष्ठ वैज्ञानिक
डॉ. हरीश.यु.एस	वरिष्ठ वैज्ञानिक
डॉ. ई.भोजे गौड	वरिष्ठ वैज्ञानिक
डॉ. ए.श्रीनिवासन	वैज्ञानिक
श्री एम.सुन्दराराजन	वैज्ञानिक
डॉ. के.पी.सुरेन्द्रन	वैज्ञानिक
डॉ. सजु पिल्लै	वैज्ञानिक
डॉ. (सुश्री) एम वसुंधरा	वैज्ञानिक
श्री एस.वेलुसामी	प्रिंसिपल तकनीकी अधिकारी
डॉ. वी.एस.प्रसाद	प्रिंसिपल तकनीकी अधिकारी
श्री एम.ब्रह्माकुमार	प्रिंसिपल तकनीकी अधिकारी
श्री के.के.रविकुमार	प्रिंसिपल तकनीकी अधिकारी
श्री पी.पेरुमाल	वरिष्ठ तकनीकी अधिकारी -2
श्रीमती लूसी पॉल	वरिष्ठ तकनीकी अधिकारी
श्री पी.गुरुसामी	वरिष्ठ तकनीकी अधिकारी-2 (31/07/2013 को सेवानिवृत्त)
श्री एम.आर.चन्द्रन	वरिष्ठ तकनीकी अधिकारी- 2
श्री पीर मोहम्मद.ए	तकनीकी अधिकारी
श्री एस.शशिभूषणन	तकनीशन 2-4
श्री टी.सोमन	तकनीशन 2-4

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डॉ. (श्रीमती) रोशन शशिकुमार	मुख्य वैज्ञानिक (31/05/2013 को सेवानिवृत्त)
श्री अजित हरिदास	मुख्य वैज्ञानिक तथा प्रधान
डॉ. (श्रीमती) एलिज़बत जेकब	वरिष्ठ प्रिंसिपल वैज्ञानिक
डॉ. (श्रीमती) एस.सावित्री	वरिष्ठ प्रिंसिपल वैज्ञानिक
डॉ. वी.बी.मणिलाल	वरिष्ठ प्रिंसिपल वैज्ञानिक
श्री जे.अंसारी	वरिष्ठ प्रिंसिपल वैज्ञानिक
डॉ. (श्रीमती) रुग्मिणी सुकुमार	प्रिंसिपल वैज्ञानिक
डॉ. एम.अंबू	प्रिंसिपल वैज्ञानिक
डॉ. बी.कृष्णकुमार	वरिष्ठ वैज्ञानिक
श्री अब्दुल हलीम.बी	वैज्ञानिक
श्री के रिशि अरविन्द	वैज्ञानिक
श्रीमती विजयाप्रसाद	वरिष्ठ तकनीकी अधिकारी-2
श्री वी.के.षाजिकुमार	वरिष्ठ तकनीकी अधिकारी
डॉ. एस.रामस्वामी	तकनीकी अधिकारी
श्री टी.पी.पौलोस	वरिष्ठ तकनीशन-3
श्रीमती सहरूबा.पी.एम	कनिष्ठ तकनीकी सहायक
एस एंड टी सर्विसेज़ **इंजीनियरिंग एवं सर्विसेज़ प्रभाग**	
श्री आर.राजीव	अधीक्षण इंजिनीयर
श्री के.प्रसाद	सहायक इंजीनियर
श्री जी.चन्द्रबाबु	सहायक कार्यपालक इंजिनीयर(सिविल)
श्री बी.कार्तिक	कनिष्ठ इंजिनीयर(सिविल)
श्री पी.अरुमुगम	कनिष्ठ इंजीनियर(सिविल)
श्री बशीर टी.एच	वरिष्ठ तकनीशन
श्री एन सुधिलाल	तकनीकी ग्रेड 2-5
श्री एस.हरिदासन पिल्लै	तकनीकी ग्रेड 2-4
श्री पी.एम.राघवन	तकनीकी ग्रेड 2-4 (30/11/2013 को सेवानिवृत्त)
श्री पी.वी.तम्पी	तकनीकी ग्रेड 2-4

श्री एम जयदीप	तकनीकी ग्रेड 2-2
श्री के.एस.प्रमोद	तकनीकी ग्रेड 2-1
श्री के.सुरेश कण्णन	तकनीकी ग्रेड 2-1
श्री यु.धरणीपति	तकनीकी ग्रेड 2-1
श्री बी.विक्रमन	तकनीकी ग्रेड 1-4 (04/04/2013 को स्वैच्छिक सेवानिवृत्ति)
श्री आर.सुकुमारन	तकनीकी ग्रेड 1-4
श्री सी.पी.नारायणन	तकनीकी ग्रेड 1-4
श्री पी.सोमन	तकनीकी ग्रेड 1-4
श्री टी.वी. सतीश	ग्रुप सी- गैर तकनीकी (एमएसीपी)

नॉलिज रिसोर्स सेंटर

डॉ. गंगन प्रताप	उत्कृष्ठ वैज्ञानिक
श्रीमती पी.निशी	वरिष्ठ प्रिंसिपल वैज्ञानिक तथा प्रधान
श्री वी.मणी	वैज्ञानिक
श्री रिबिन जोन्स.एस.बी	वैज्ञानिक
श्रीमती एस.मिनी	प्रिंसिपल तकनीकी अधिकारी
श्री एम.रामसामि पिल्लै	प्रिंसिपल तकनीकी अधिकारी
श्री एस.पुश्किन	तकनीकी अधिकारी
श्री जी.सुधाकरन	वरिष्ठ तकनीशन 2-4 (30/11/2013 को सेवानिवृत्त)
श्री जी.नागश्रीनिवासु	वरिष्ठ तकनीशन(2)
सुश्री टी.एस.लता	सहायक(सा)ग्रेड II
श्री पुष्पकुमार.के.आर.नायर	ग्रुप सी गैर तकनीकी (एमएसीपी)

योजना तथा व्यवसाय विकास प्रभाग

डॉ. वी.जी.मोहनन नायर	मुख्य वैज्ञानिक
डॉ. सी.चन्द्रशेखरा भट	वरिष्ठ प्रिंसिपल वैज्ञानिक
श्री डी.भीमेश्वर	प्रिंसिपल वैज्ञानिक
श्री चन्द्रकान्त सी.के	वरिष्ठ वैज्ञानिक
श्री आर.एस.प्रवीण राज	वरिष्ठ वैज्ञानिक
डॉ. एम.शंकरानारायणन	प्रिंसिपल तकनीकी अधिकारी
श्रीमती वी.जे.सरोजाकुमारी	वरिष्ठ आशुलिपिक(एसीपी)
श्री के.सी.चाक्को	ग्रुप सी गैर तकनीकी

प्रशासन	
श्री एन.एस.राजु	प्रशासन अधिकारी
श्रीमती एस.शोभना	प्रशासन अधिकारी
श्री टी.जे.बाबु	सुरक्षा अधिकारी
डॉ. विजयनाथ आर	चिकित्सा अधिकारी
श्रीमती के.एस.लतीदेवी	हिन्दी अधिकारी
श्री के.एफ.जोसफ	अनुभाग अधिकारी(सा)
श्री एम.के.शिवदासन	सहायक(सा) ग्रेड।
श्री डी.जयप्रसाद	सहायक(सा) ग्रेड।(31/10/2013 को सेवानिवृत्त)
श्रीमती सिसिली पौलोस	सहायक(सा) ग्रेड। (30/11/2013 को सेवानिवृत्त)
श्री के.पी.कृष्णन	सहायक(सा) ग्रेड।
श्री वी मोहनन नायर	सहायक(सा) ग्रेड।
श्रीमती ज्योति आर.तम्पी	सहायक(सा) ग्रेड।।
श्री जी.रामभद्रन	सहायक(सा) ग्रेड।।(30/11/2013 को सेवानिवृत्त)
श्रीमती मेर्सी जोसफ	सहायक(सा) ग्रेड।।
श्रीमती के.सरस्वती	सहायक(सा) ग्रेड।।(एसीपी)(31/07/2013 को सेवानिवृत्त)
श्री आर.के.रमेशकुमार	सहायक(सा) ग्रेड।।
श्रीमती पार्वती राजीवन	सहायक (सा) ग्रेड।
श्रीमती एलिज़बेत थॉमस	वरिष्ठ आशुलिपिक (एसीपी)
श्रीमती पद्मिनी.पी.एस	वरिष्ठ आशुलिपिक(एमएसीपी)
श्रीमती श्रीलता नायर	वरिष्ठ आशुलिपिक(एमएसीपी)
श्री बी.वेणुगोपाल	तकनीकी ग्रेड 2-4
श्री पी.एन.शिवनकुट्टि नायर	तकनीकी ग्रेड 2-4
श्री प्रवीण कण्णाल	तकनीकी ग्रेड 2-2
श्री बी.राधाकृष्णन	तकनीकी ग्रेड 2-1
श्रीमती शाना एस नायर	स्टाफ नर्स
श्री एम.पी.वर्की	तकनीकी ग्रेड 1-4
श्रीमती एम.गीता	तकनीकी ग्रेड 1-3
श्री शशिधरन	बेयरर(एसीपी)
श्री के.मधु	ड्राइवर

श्री ए.श्रीकुमारन	सफाईवाला (एसीपी)
श्रीमती एस.लीलादेवी अम्मा	ग्रुप सी गैर तकनीकी (30/11/2013 को सेवानिवृत्त)
श्री के.उण्णिकृष्णन	ग्रुप सी गैर तकनीकी
श्री बी.सतीशकुमार	ग्रुप सी गैर तकनीकी
वित्त एवं लेखा विभाग	
श्री टी.वी.शंकरन	वित्त एवं लेखा नियंत्रक
श्रीमती पी.वी.विजी	अनुभाग अधिकारी(वित्त एवं लेखा)
श्री कृष्णकुमार.एम	अनुभाग अधिकारी(वित्त एवं लेखा)
श्री संजीव सदानन्दन	सहायक (वित्त एवं लेखा) ग्रेड।
श्रीमती रमणी देवराज	सहायक(वित्त एवं लेखा) ग्रेड। (एमएसीपी)
श्री के.जी.पिल्लै	सहायक(वित्त एवं लेखा) ग्रेड। (एमएसीपी)
श्रीमती जी.गीता	सहायक(वित्त एवं लेWखा) ग्रेड।
श्रीमती कोमला सोमन	सहायक (वित्त एवं लेखा) ग्रेड।।
श्री एस.राजु	वरिष्ठ आशुलिपिक (एसीपी)
श्री पी.परमेश्वरन पिल्लै	ग्रुप सी गैर तकनीकी (एमएसीपी)
श्रीमती आर.रमादेवी	रेकोर्ड कीपर
भण्डार एवं क्रय	
श्री एम.आर.देवासीस	भण्डार एवं क्रय अधिकारी
श्री संजय सुमन	अनुभाग अधिकारी
श्री सी.एम.कृष्णदास	सहायक(भण्डार एवं क्रय) ग्रेड।
श्री एम.अनिलकुमार	सहायक(भण्डार एवं क्रय) ग्रेड।
श्रीमती एल.लता	तकनीकी ग्रेड 2-4
श्री बी.अजयकुमार	तकनीकी ग्रेड 2-3
श्री टी.आर.सुरेश कुमार	वरिष्ठ तकनीशन-2
श्री टी.के.गोपी	ग्रुप सी गैर तकनीकी
श्री टी.के.घोष	ग्रुप सी गैर तकनीकी
श्री जी.भक्तवल्सलम	ग्रुप सी गैर तकनीकी

निर्मित प्रमुख सुविधाएं

एक्स-रे सुविधा

19 जून 2013 को निदेशक द्वारा एक्स-रे सुविधाओं (सिंगल क्रिस्टल एक्स-रे डिफ्फ्रक्टोमीटर और दो आयामी एक्स-रे डिफ्फ्रक्टोमीटर) का उद्घाटन किया गया।

क) दो-आयामी एक्स-रे डिफ्फ्रक्टोमीटर (डब्ल्युएएक्सएस / एसएएक्सएस)

सीएसआईआर-एनआईआईएसटी, जैसी प्रयोगशाला के लिए चर तापमान अनुलग्नक के साथ दो -आयामी एक्स-रे डिफ्फ्रक्टोमीटर (डब्ल्युएएक्सएस / एसएएक्सएस) एक अच्छा परिवर्धन है, जहॉ अनुसंधान गतिविधियॉ मुख्य रूप से रेअर अर्थ्स, नैनो सामग्री, तरल क्रिस्टलीय सामग्री, पॉलिमर, जैविक सामग्री और धातु के क्षेत्रों में केंद्रित कर रही हैं। यह 0.01 डिग्री के कोणीय रेसोलुशन के साथ, 0.3 से 50 एनएम लैटिस आयाम सदृश्य कोणीय रेंज को शामिल करता हैं और इसलिये बड़े क्षेत्र डिटेक्टरों के उपयोगकर्ता को पूरा डिबाई विवर्तन वलय प्राप्त करने के लिए बिखरे हुए एक्स-रे की मात्रा में वृद्धि करने के लिए अनुमति देती हैं।

(ख) सिंगल क्रिस्टल एक्स-रे डिफ्फ्रक्टोमीटर

सिंगल क्रिस्टल एक्स-रे डिफ्फ्रक्टोमीटर रिगाकु मूल की है और 724 एचजी डिटेक्टर के साथ सैटर्न वर्शन है, जो पढ़ने की चार गुना क्षमता (8 मेगाहर्ट्ज तक कुल) और सिग्नल-टू -नॉइज़ एंड डायनामिक रेंज में सुधार के साथ उच्च संवेश-प्रवाह डेटा संग्रह के लिए सक्षम है । के-ज्यामिति के साथ चार चक्र गोनियोमीटर चरम परिशुद्धता के साथ एक एक्स-रे किरण की राह में एक क्रिस्टल को रखा जाने के लिए और कोनेदार करने के लिए अनुमति देती है । प्रयोगों के लिए इस्तेमाल तरंगदैर्ध्य के रूप में Mo Kα (λ = 0.71073 ए) के साथ इस उपकरण में नियोजित एक्स-रे स्रोत सील्ड ट्यूब प्रकार की है। हालांकि सिफारिश किया गया मानक आकार 0.2 × 0.2 × 0.2 है, चर एक्स-रे कोलीमटर 0.1 से लेकर बड़े आयामों तक चर आकार के क्रिस्टल निर्स्पक के लिए अनुमति देता है।

समारोह और अन्य गतिविधियॉ

एनआईआईएसटी में राष्ट्रीय प्रौद्योगिकी दिवस समारोह का आयोजन

संस्थान में 10 मई, 2013 को राष्ट्रीय प्रौद्योगिकी दिवस मनाया गया। सुबह के सत्र के दौरान विभिन्न शैक्षिक संस्थानों से छात्रों और संकायों के प्रयोगशाला के दौरे के साथ खुला-दिन मनाया गया। दोपहर के सत्र का मुख्य आकर्षण समारोह के मुख्य अतिथि श्री डी एस नागेश, वैज्ञानिक जी और प्रभारी वैज्ञानिक, मॉडलिंग और प्रोटोटाइप प्रयोगशाला, जैव चिकित्सा प्रौद्योगिकी विंग, श्री चित्रा तिरूनल आयुर्विज्ञान तथा प्रौद्योगिकी संस्थान (एससीटीआईएमएसटी), तिरुवनंतपुरम के द्वारा दिया गया राष्ट्रीय प्रौद्योगिकी दिवस व्याख्यान था। श्री नागेश ने जैव चिकित्सा प्रौद्योगिकी के क्षेत्र में देश ही में विकसित जैव चिकित्सीय उपकरणों जैसे सेन्ट्रीफ्यूगल रक्त पंप, हेमोकांसट्रेक्टोर, मेम्ब्रेन ऑक्सिजनेटर, बबल ऑक्सिजनेटर आदि के परिचय के साथ जैव चिकित्सीय क्षेत्र में एससीटीआईएमएसटी की उत्कृष्टता पर प्रकाश डाला। इस क्षेत्र में प्राप्त विकास ने आयातित जैव चिकित्सा उपकरणों की लागत को कम करने के लिए मार्ग प्रशस्त किया।

राष्ट्रीय प्रौद्योगिकी दिवस समारोह की झलक- मंच पर डॉ. मनोज रामवर्मा, डॉ.सुरेश दास तथा मुख्य अतिथि श्री डी एस नागेश

सीएसआईआर स्थापना दिवस समारोह

संस्थान में 26 सितम्बर 2013 को सीएसआईआर स्थापना दिवस मनाया गया । स्थापना दिवस को खुले दिन के रूप में मनाया गया । बड़ी संख्या में आए दर्शकों को प्रयोगशाला की अनुसंधान और विकास उपलब्धियों और इंस्ट्रूमेंटेशन क्षमताओं का प्रदर्शन किया गया ।

प्रोफेसर जे.बी जोशी, आईसीटी, मुंबई " अनुसंधान- उद्योग साझेदारी के माध्यम से धनार्जन" विषयक व्याख्यान देते हुये

समारोह का मुख्य आकर्षण प्रसिद्ध टेक्नोक्रेट, विद्वान तथा नीति निर्माता प्रोफेसर जे.बी जोशी, आईसीटी, मुंबई के "अनुसंधान- उद्योग साझेदारी के माध्यम से धनार्जन" विषयक सीएसआईआर स्थापना दिवस व्याख्यान था। उन्होंने अपने भाषण में अनुसंधान एवं विकास कार्यक्रमों के माध्यम से प्रशिक्षण प्रदान करते हुए आईसीटी में उद्यमिता पर किये जा रहे विकास पर प्रकाश डाला।

सीएसआईआर-एनआईआईएसटी स्थापना दिवस समारोह

7अक्तूबर 2013 को सीएसआईआर-एनआईआईएसटी स्थापना दिवस मनाया गया। इस अवसर पर डॉ. चंद्रशेखर, निदेशक, सीईईआरआई, पिलानी मुख्य अतिथि थे । उन्होंने अंतर्विषयी अनुसंधान की सफलता की कहानी पर प्रकाश डालते हुये , "भौतिकी, रसायन विज्ञान और इंस्ट्रूमेंटेशन सक्षम इलेक्ट्रॉनिक प्रणालियों के क्षेत्र में उन्नति " विषय पर स्थापना दिवस व्याख्यान दिया । देश का पहला समर्पित पूरा कस्टम एलएसआई प्रोसेसर चिप, देश का पहला

सामान्य प्रयोजन माइक्रोप्रोसेसर चिप मोटोरोला 68010 और वीएलएसआई आधारित अत्याधुनिक हार्डवेयर वर्णन भाषा के विकास की कहानी सुनकर श्रोतागण के रूप में शामिल एनआईआईएसटी के वैज्ञानिक तथा तकनीकी कर्मचारियों, विभिन्न शैक्षणिक संस्थानों से छात्रों और शोधकर्ताओं मंत्र मुग्ध हो गये। इससे पहले आम दिवस के दौरान, अनुसंधान एवं विकास तथा सीएसआईआर –एनआईआईएसटी के इंस्ट्रुमेंटेशन कौशल के दर्शन के लिए छात्रों और आम जनता की एक बड़ी प्रवाह हुई थी।

डॉ. चंद्रशेखर, निदेशक, सीईईआरआई,पिलानी सीएसआईआर-एनआईआईएसटी स्थापना दिवस व्याख्यान देते हुए

राष्ट्रीय विज्ञान दिवस समारोह

28 फरवरी 2014 को संस्थान में राष्ट्रीय विज्ञान दिवस समारोह मनाया गया। श्री मुरलीधरन सीवी, वैज्ञानिक / अभियंता जी, कृत्रिम अंग प्रभाग, बायोमेडिकल विंग, श्री चित्रा थिरूनल आयुर्विज्ञान तथा प्रौद्योगिकी संस्थान, पूजप्पूरा, तिरुवनंतपुरम समारोह में मुख्य अतिथि थे। विज्ञान दिवस व्याख्यान का शीर्षक था " एडवांसेज इन कार्डिओ वैस्कुलर इम्प्लांट्स " । अपने व्याख्यान में उन्होंने मानव परिसंचरण तंत्र के आकर्षक विज्ञान और उनके दोषों और कमियों के प्रबंधन में भारत में जैव चिकित्सा अनुसंधान के क्षेत्र में हासिल की गयी प्रगति के बारे में बताया। विभिन्न शैक्षिक संस्थानों से आम दिवस के लिए भारी प्रतिक्रिया हुई थी । विज्ञान तथा इंजीनियरिंग स्ट्रीम से 350 से ज्यादा छात्रों और संकाय ने संस्थान का दौरा किया और अपने प्रयोगशाला के दौरे पर उन्होंने वैज्ञानिक और तकनीकी कर्मियों के साथ बातचीत की थी।

श्री सी.वी.मुरलीधरन वैज्ञानिक / अभियंता जी,
श्री चित्रा थिरूनल आयुर्विज्ञान तथा प्रौद्योगिकी
संस्थान विज्ञान दिवस व्याख्यान देते हुए।

अन्य शैक्षणिक संस्थाओं से छात्रों द्वारा टीईएम
सुविधा का दर्शन करते हुए ।

विश्व पर्यावरण दिवस का आयोजन

राज्य मंत्री, मानव संसाधन विकास, भारत सरकार ने संस्थान द्वारा विकसित प्रौद्योगिकी उत्पादों का अनावरण किया

मानव-संसाधन विकास के राज्य मंत्री डॉ. शशि थरूर ने 5 जून 2013 को संस्थान का दौरा किया। एनआईआईएसटी के कर्मचारियों को संबोधित करते हुए

उन्होंने सीएसआईआर - एनआईआईएसटी के वैज्ञानिकों द्वारा किए गए विश्व स्तर के अनुसंधान की सराहना की। उन्होंने कहा कि विज्ञान के अत्याधुनिक क्षेत्रों में अशरण्य होने के रूप में भारत की लगातार आलोचना की जाती है। लेकिन मुझे गर्व और खुशी है कि अपने निर्वाचन क्षेत्र से एक अनुसंधान संगठन उच्च प्रासंगिकता के अग्रणी क्षेत्रों में गुणवत्ता अनुसंधान करता है। यह भी सराहनीय है कि सीएसआईआर-एऩआईआईएसटी द्वारा किए गए शोध स्थानीय स्तर पर कार्यान्वित है और तत्काल आवेदन खोजने में उन्मुख है। सामाजिक चेतना, भारतीय अनुसंधान संस्थानों को अपने विदेशी समकक्षों से भेद दिखाने का मुख्य कारक है।

डॉ. शशि थरूर, राज्य मंत्री, मानव संसाधन विकास, भारत, संस्थान द्वारा विकसित प्रौद्योगिकी उत्पादों का अनावरण करते हुये

संस्थान के कैंपस को हरा बनाने की दिशा में एनआईआईएसटी के छात्र संघ ने 5 जून 2013 को संस्थान में विश्व पर्यावरण दिवस मनाया। छात्रों ने कैंपस और शोधार्थी छात्रावास में पेड़-पौधे लगाए और विश्व पर्यावरण दिवस के उपलक्ष्य में, 'ग्रीन क्विजजाड़ - 2013' विषय पर इंटरकॉलेजिएट प्रश्नोत्तरी प्रतियोगिता आयोजित की गयी। बाद में क्विज प्रतियोगिता के विजेताओं को पुरस्कार वितरित किए गए।

विश्व पर्यावरण दिवस समारोह के भाग के रूप में निदेशक डॉ. सुरेश दास पेड़ पौधा का रोपण करते हुए

उन्नत कार्यात्मक सामग्री पर अंतर्राष्ट्रीय सम्मेलन (आईसीएएफएम-2014)

सीएसआईआर-एनआईआईएसटी, तिरुवनंतपुरम ने भारतीय धातु संस्थान (आईआईएम), तिरुवनंतपुरम चैप्टर, भारतीय सामग्री रिसर्च सोसायटी (एमआरएसआई), तिरुवनंतपुरम चैप्टर, भारतीय सिरेमिक सोसायटी (आईएनसीईआरएस), केरल चैप्टर और पॉलिमर विज्ञान सोसायटी (भारत), तिरुवनंतपुरम चैप्टर, जैसे प्रमुख वैज्ञानिक सोसायटी के साथ संयुक्त रूप से मस्केट होटल, तिरुवनंतपुरम में 19-21 फरवरी 2014 के दौरान उन्नत कार्यात्मक सामग्री (आईसीएएमएफ-2014) पर अंतर्राष्ट्रीय सम्मेलन आयोजित किया। आईपीएफ, ड्रेसडेन, जर्मनी के प्रोफेसर मैनफ्रेड स्टाम्म ने सम्मेलन का उद्घाटन किया।

पारंपरिक दीप प्रज्जवलित करके तीन दिवसीय सम्मेलन का औपचारिक उद्घाटन करने के बाद प्रो मैनफ्रेड ने आधुनिक जीवन में सामग्रियों के महत्व पर प्रकाश डाला। इस तरह का सम्मेलन वैज्ञानिक समुदाय के बीच सक्रिय संपर्क और विचारों के आदान-प्रदान के लिए मंच बना सकता है। डॉ सुरेश दास, निदेशक, सीएसआईआर-एनआईआईएसटी जिन्होंने बैठक की अध्यक्षता की, ऊर्जा, खाद्य और स्वास्थ्य क्षेत्रों की जरूरतों को पूरा करने के लिए नूतन कार्यात्मक सामग्री

विकसित करने की आवश्यकता पर प्रकाश डाला । इस अवसर पर बधाई देते हुये प्रो इयान एम रैनी, शेफील्ड विश्वविद्यालय, ब्रिटेन ने बताया कि सम्मेलन इस क्षेत्र के रुझानों को जानने के लिए दुनिया के विभिन्न भागों से आये युवा शोधकर्ताओं के लिए अवसर प्रदान किया है ।

डॉ सुरेश दास निदेशक, एनआईआईएसटी, आईसीएएफएम-2014 में गणमान्य व्यक्तियों का स्वागत करते हुये

कम्प्यूटेशनल मॉडलिंग: पार विषय

दिनांक 21 मई, 2013 के पूर्वाह्न 9.30 से मध्याह्न 1.00 बजे तक "कम्प्यूटेशनल मॉडलिंग: पार विषय" पर संगोष्ठी आयोजित की गयी। श्री अजित हरिदास, प्रधान, प्रोसेस इंजीनियरिंग और पर्यावरण प्रौद्योगिकी, एनआईआईएसटी के स्वागत भाषण के साथ संगोष्ठी शुरू हुयी। डॉ. रोशन शशिकुमार, प्रधान, कम्प्यूटेशनल मॉडलिंग और सिमुलेशन समूह ने "डाउन दि मेमोरी लेन" पर अपना व्याख्यान प्रस्तुत किया। प्रो अच्चुतशंकर एस नायर, निदेशक, जैव सूचना विज्ञान केंद्र, केरल विश्वविद्यालय, तिरुवनंतपुरम ने "कम्प्यूटेशनल बायोलॉजी : विहंगम दृश्य" पर बात की। डॉ.वी वी. रानडे, उत्कृष्ट वैज्ञानिक, सीएसआईआर-एनसीएल, पुणे ने हाइड्रो-डैनमिक्स और प्रक्रिया निष्पादन: प्रौद्योगिकी स्थिति और भविष्य रुझान पर व्याख्यान दिया। प्रो प्रदीप दत्ता, प्रमुख, मैकेनिकल इंजीनियरिंग विभाग, भारतीय विज्ञान संस्थान, बंगलौर के चर्चा का विषय था - सम्पिण्डन अध्ययन: हल्के वज़न के लिए प्रक्रिया विकास की ओर। डॉ. ए डी दामोदरन, पूर्व निदेशक, एनआईआईएसटी तिरूवनंतपुरम के समापन भाषण के साथ संगोष्ठी संपन्न हुयी।

जैव- ईंधन और जैव रिफाइनरियों को शामिल करके जैव -ऊर्जा पर 5वीं भारत - कोरिया संयुक्त कार्यशाला

संस्थान में 9-10 सितंबर 2013 के दौरान जैव- ईंधन और जैव रिफाइनरियों को शामिल करके जैव- ऊर्जा पर 5वीं भारत - कोरिया संयुक्त कार्यशाला आयोजित की गयी। इसका आयोजन और समर्थन विज्ञान तथा प्रौद्योगिकी विभाग (डीएसटी), भारत सरकार, विज्ञान मंत्रालय, आईसीटी एवं भविष्य योजना (एमएसआईपी), कोरिया सरकार, एशियाई अनुसंधान नेटवर्क, सियोल, कोरिया विज्ञान तथा प्रौद्योगिकी इंस्टीट्यूट, सियोल द्वारा किया था। कोरिया और भारत से लगभग 90 प्रतिनिधियों ने कार्यशाला में भाग लिया। जैव-ऊर्जा जैसे चुने विषयों में आपसी हित के माध्यम से दोनों देशों के बीच विज्ञान और प्रौद्योगिकी के क्षेत्र में संबंधों में सुधार करना कार्यशाला का उद्देश्य था।

प्रो. हैवन ली, हाँ यंग विश्वविद्यालय, सियोल, कोरिया तथा डॉ. सुरेश दास, निदेशक, सीएसआईआर - एनआईआईएसटी द्वारा 9 सितम्बर 2013 के पूर्वाह्न 09.30 बजे कार्यशाला का उद्घाटन किया गया। कार्यशाला के वैज्ञानिक कार्यक्रम पांच तकनीकी सत्रों में विभाजित किया गया था- शैवाल जैव- ईंधन और जैव रिफाइनरी, माइक्रोबियल ईंधन कोशिकाओं, जैव-हाइड्रोजन बायोमास से ईंधन, और लिग्नोसेलुलोसिक बायोमास रूपांतरण और मूल्य संवर्धन और उन्नत जैव ईंधन और रसायन।

प्रो हैवन ली, हाँ यंग विश्वविद्यालय, सियोल, कोरिया, कार्यशाला का औपचारिक उद्घाटन करते हुये

दोनों देशों के प्रख्यात वक्ताओं द्वारा कुल 22 व्याख्यान प्रस्तुत किए गए। कार्यशाला में जैव ऊर्जा के क्षेत्र में भविष्य के सहयोग के लिए दोनों देशों के आपसी हित के अनुसंधान और विकास के क्षेत्रों/विषयों का पहचान और सिफारिश तथा पैनल चर्चा भी आयोजित की गयी थी।

हिंदी दिवस एवं हिंदी सप्ताह -2013 मनाया गया

संस्थान में दिनांक 05 सितंबर 2013 को हिंदी दिवस के रूप में तथा बाद के एक सप्ताह को हिंदी सप्ताह के रूप में अत्यंत जोश एवं उत्साह के साथ मनाया गया। 5 सितंबर सुबह 10.00 बजे हिंदी दिवस समारोह शुरु हुआ। संस्थान के निदेशक डॉ. सुरेश दास ने समारोह की अध्यक्षता की। अपने हिंदी दिवस संदेश में उन्होंने बताया कि भारत के इतिहास में हिंदी दिवस गौरव का दिवस है और हिंदी सामाजिक और सांस्कृतिक एकता का प्रतीक है। उन्होंने कहा कि भाषा से शासन और आम आदमी के बीच सहयोग और जवाबदेही का संबंध स्थापित होता है। इसलिए शासन के कामकाज में भी राजभाषा हिंदी को बढ़ावा देना अत्यंत आवश्यक है।

पूरे सप्ताह के दौरान परियोजना स्टाफ, अनुसंधान छात्र, आदि सहित संस्थान के संपूर्ण स्टाफ सदस्यों तथा उनके स्कूली छात्रों के लिए अनेक प्रतियोगिताएं आयोजित की गयीं ।

हिंदी दिवस संदेश देते हुए निदेशक डॉ. सुरेश दास। मंच पर बैठे है श्री एन.एस. राजु, प्रशासन अधिकारी

समापन समारोह व पुरस्कार वितरण दिनांक 12.9.2013 शाम 4.30 बजे आयोजित किया गया । केरल उच्च न्यायालय के पूर्व न्यायाधीश माननीय न्यायाधीश एम आर हरिहरन नायर समारोह में मुख्य अतिथि थे। मुख्य अतिथि के अध्यक्षीय भाषण के बाद डॉ. (सुश्री) एम. वसुंधरा, वैज्ञानिक व सदस्य, हिंदी सप्ताह आयोजन समिति द्वारा " ग्लोबल वार्मिंग, सबसे बडा खतरा " विषय पर हिंदी में एक प्रस्तुति दी गयी।

बाद में, मुख्य अतिथि ने हिंदी सप्ताह के दौरान आयोजित विभिन्न प्रतियोगिताओं के सफल भागीदारों को पुरस्कार एवं प्रमाण पत्र वितरित किये।

पुरस्कार वितरित करते हुये केरल उच्च न्यायालय के पूर्व न्यायाधीश माननीय न्यायाधीश एम आर हरिहरन नायर

सतर्कता जागरूकता सप्ताह मनाया गया

संस्थान में तारीख 28 अक्तूबर से 1 नवंबर 2013 तक सतर्कता जागरूकता सप्ताह आयोजित किया गया। सतर्कता जागरूकता सप्ताह का प्रारंभ तारीख 28 अक्तूबर 2013 को 11.00 बजे पूर्वाह्न निदेशक द्वारा स्टाफ सदस्यों को हिंदी और अंग्रेजी दोनों भाषाओं में सतर्कता जागरूकता प्रतिज्ञा दिलाने के साथ हुआ । 28 अक्तूबर से 1 नवंबर 2013 तक परियोजना छात्रों सहित स्टाफ सदस्यों एवं अनुसंधान छात्रों के लिए निबंध लेखन, वक्तृता तथा वाद-विवाद पर प्रतियोगितायें आयोजित की गयी।

समापन समारोह- मंच पर बैठे हैं- बाएं से डॉ. ए. अजयघोष, श्री नन्दकुमारन नायर, तथा श्री एन.एस. राजु

1 नवम्बर 2013 को समापन समारोह तथा पुरस्कार वितरण संपन्न हुआ । डॉ. ए.अजयघोष, निदेशक इ्प्रभारी ने समारोह की अध्यक्षता की । श्री नन्दकुमारन नायर, अपर पुलिस अधीक्षक, सीबीआई ने समापन भाषण दिया और विभिन्न प्रतियोगिताओं के विजेताओं को पुरस्कार प्रदान किया गया ।

ओणम महोत्सव

संस्थान के स्टाफ रिक्रिएशन क्लब के तत्वावधान में 13 सितंबर 2013 को विभिन्न मनोरंजक कार्यक्रम के साथ ओणम महोत्सव मनाया गया ।

समारोह की कुछ झलकें:-