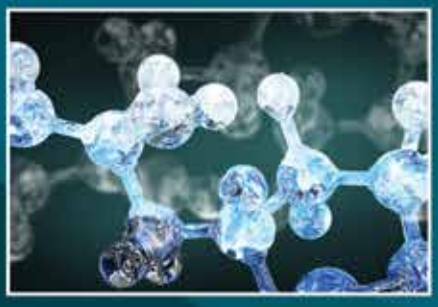
# वार्षिक प्रतिवेदन 2012-2013

# Annual Report 2012-2013




**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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| Published by | : | The Director,<br>National Institute for Interdisciplinary Science & Technology<br>Thiruvananthapuram |
| Editorial Committee | : | **Dr Suresh Das**<br>**Mr M M Sreekumar**<br>**Dr Ashok Pandey**<br>**Dr D Ramaiah**<br>**Dr M T Sebastian**<br>**Dr Ajit Haridas**<br>**Dr U Syamaprasad**<br>**Mr C K Chandrakanth**<br>**Dr V G Mohanan Nair** |
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| Design & Printing | : | Akshara Offset, Thiruvananthapuram |


CSIR - National Institute for Interdisciplinary Science & Technology


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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 of the Institute for the period 2012-2013. Our Institute has continued to excel in various spheres of its activities, thanks to the coordinated efforts of all the members of the NIIST family. This year marks the beginning of the twelfth five year plan period for which we have initiated several new research programmes with the aim of improving both the quality of our basic research and relevance of our work to society/industry. I am happy to state that our institute will be co-ordinating five major research programmes for the CSIR during this period, dealing with molecular diagnostics (M2D), sustainable use of rare earths (SURE), organic light emitting diodes (OLEDs), specialty materials based on engineered Clays (SPECS) and development of functional foods and their formulations for the health benefits of the common man (FUNHEALTH). In order to ensure the success of these projects, the Institute has also initiated an ambitious program for improving its infrastructure, both in terms of built up laboratory space and instrumental facilities. This year as usual, several of our scientists and students have been recipients of numerous awards and recognitions, the most prestigious of which being the 2012 Infosys Prize in the physical sciences category awarded to Dr. Ajayaghosh. I congratulate all of them for having brought recognition to our institute through their endeavors. I also thank all the members of the NIIST family for having worked in a dedicated and harmonious manner which has contributed to sustaining the strong growth momentum and improved national and international visibility of our institute.

**Dr. Suresh Das**
**Director**

# प्राक्कथन

वर्ष 2012-2013 की अवधि के लिए संस्थान की वार्षिक रिपोर्ट प्रस्तुत करना मेरे लिए अत्यंत खुशी और सौभाग्य की बात है । हमारे संस्थान ने अपनी गतिविधियों के विभिन्न क्षेत्रों में उत्कृष्टता प्राप्त करने के प्रयास को जारी रखा है । एनआईआईएसटी परिवार के सभी सदस्यों के समन्वित प्रयासों के लिए धन्यवाद । बारहवीं पंचवर्षीय योजना अवधि की शुरुआत को चिह्नित करनेवाले इस साल में हमारे बुनियादी अनुसंधान की गुणवत्ता और समाज / उद्योग को हमारे काम की प्रासंगिकता, दोनों में सुधार लाने के उद्देश्य से हम ने कई नए शोध कार्यक्रम शुरू किये हैं । मुझे यह कहने में खुशी है कि संस्थान द्वारा, सीएसआईआर के लिए, इस अवधि के दौरान पांच प्रमुख अनुसंधान कार्यक्रमों का समन्वय किया जाएगा -आणविक निदान (M2D), दुर्लभ पृथ्वी के सतत उपयोग (SURE), कार्बनिक प्रकाश उत्सर्जक डायोड (OLEDs), इंजीनिकृत क्ले पर आधारित स्पेशलिटी सामग्री (SPECS), आम आदमी के स्वास्थ्य लाभ के लिए कार्यात्मक खाद्य पदार्थों और उनके योगों का विकास (FUNHEALTH)। इन परियोजनाओं की सफलता सुनिश्चित करने के लिए संस्थान ने प्रयोगशाला भवन और सहायक सुविधा, दोनों मामलों के संदर्भ में अपने बुनियादी ढांचे में सुधार के लिए महत्वाकांक्षी कार्यक्रम शुरू किया है। हमेशा की तरह, इस वर्ष में भी हमारे वैज्ञानिकों और छात्रों को कई पुरस्कार और मान्यताएं प्राप्त हैं, जिनमें से सबसे प्रतिष्ठित पुरस्कार है- भौतिक विज्ञान की श्रेणी में डॉ. अजयघोष को प्राप्त 2012 इंफोसिस पुरस्कार। अपने प्रयासों के माध्यम से हमारे संस्थान को मान्यता लाये उन सभी को मैं बधाई देता हूँ। मैं एनआईआईएसी परिवार के सभी सदस्यों को भी धन्यवाद देता हूँ जिन्होंने समर्पित और सौहार्दपूर्ण ढंग से काम करके संस्थान के मजबूत विकास की गति को बनाए रखने में तथा संस्थान के राष्ट्रीय और अंतरराष्ट्रीय दृश्यता में सुधार के लिए योगदान दिया है ।

**डॉ सुरेश दास**
**निदेशक**


# CSIR - National Institute for Interdisciplinary Science & Technology

# SIGNIFICANT ACHIEVEMENTS

The year 2012-13 was significant to CSIR-NIIST as the laboratory entered into the XII Five Year Plan period. The projects devised were of interdisciplinary nature with multi laboratory participation. For four projects, CSIR-NIIST is the nodal laboratory and the institute is participating in 27 other network projects during the current plan period. The institute's performance showed a steady measurable performance growth with 187 publications having an average impact factor of 2.927. According to the 2012 July report of NESTA, a UK based organization, CSIR-NIIST publishes the highest proportion of world-class papers from any institute in India. To further improve the quality and relevance of the research and to help to meet the goals outlined in the CSIR vision document, the Institute has inducted a number of young scientists and brought about significant improvements in the infrastructure. A brief report on significant achievements accomplished during the reporting period is presented below:

## 1. Business Development and Contract Research

The Institute signed nineteen agreements with major industries, small scale industries, government as well as societal organizations and entrepreneurs in connection with know-how transfer and research collaborations. Eight of these agreements were for direct know-how transfer and one agreement for setting up a Technology Business Incubation Centre. The Institute joined hands with the international ceramic company Noritake Co. Limited, Nagoya, Japan in the development of adsorbents for the separation, purification and storage of gas molecules. The 3-year collaborative research program titled "Rational design of materials, porous nanostructures and surface chemistry" involves a direct research contribution of Rs. 33 lakhs from Noritake in addition to the in-kind contributions worth more than Rs. 1.75 crore. The expertise of CSIR-NIIST in the processing of a variety of ceramic nanomaterials will complement very well with Noritake team's expertise in gas and liquid separation using membranes. Virtual Casting, a software package developed by NIIST for the simulation of solidification process of industrial castings, was integrated with AutoCAST-X of 3D Foundry Tech and released as AutoCAST X1 which now has the capability to predict both flow related and solidification defects like misruns, cold shuts and shrinkage porosity. This software was launched during IFEX -2013 at Kolkatta. Virtual Casting won the second place in the Computer Society of India IT Excellence Awards for 2012 at Kolkata in the Engineering Solutions and Product Manufacturing Category.

## 2. Progress in R&D Programs

Agro-processing and natural products division is offering engineering assistance in the setting up of fresh Ginger processing facility on behalf of the Department of Agriculture, Government of Kerala. The facility is for processing farm fresh ginger and makes value added products and the unit will have a capacity to process 7.5 tonnes per day fresh ginger at a project cost of Rs.193.00 Lakhs. The Institute in association with Kottakkal Arya Vaidyasala has initiated a programme for the recovery of bioactives from spent botanicals generated during the preparation of Ayurvedic medicines. A process for palm neera based health drink has been developed. The product developed maintains consistence in quality and there is a six percent increase in yield.

Studies on the molecular cloning, over-expression and biochemical characterization of hypothetical betalactamases of *M. tuberculosis* (Rv2068c, Rv0406c and Rv3677c) revealed the possibility of more than one gene in *M. tuberculosis*, encoding proteins having beta-lactamase or beta-lactamase-like activity, giving wide spectrum of resistance against beta-lactams. Studies on the mutation of cloned L-asparaginase II gene from *E. coli* by site-directed mutagenesis and expression and purification of the mutants showed that compared to the wild enzyme and positively charged control mutant, K139A and K139D had tolerance towards $70^0$C and 20% more activity retention on thermal stability at $50^0$C. A novel super acid treatment using Nafion has been developed, which selectively solubilized the cellulose and hemicelluloses of lignocellulosic biomass and the hydrolyzate obtained after this treatment was devoid of fermentation inhibitors such as HMF and furfural. Exploration of the microbial resources resulted in the isolation of a new Gram-negative, aerobic, halophilic, non-motile and rod-shaped bacterial strain, P2E16$^T$, from a mangrove rhizosphere and it has been named as *Zunongwangia mangrovi sp.*

Photoresponsive "smart" supramolecular assemblies of oligomers/polymers having light and heat controlled helicity and switchable morphologies were developed. It was found that the helicity of supramolecular assemblies associated with a specific chirality can be reversibly switched to the opposite helical sense through a chiral-center-controlled photoisomerization of the attached azobenzene moieties. Bismelamines-functionalized with oligo(phenylenevinylene) is found to self-aggregate in nonpolar solvent to form short nanorods by helical π-π stacking. This inherent self-aggregation can be guided to a supramolecular polymerization pathway by complexing with a cyanurate, leading to gel-forming elongated nanotapes lacking helical sense of the π-conjugated moieties.

EMI shielding materials were developed from composites of nano structured polyaniline-polyhydroxy iron-clay (PPIC) and polycarbonate through solution blending process which can also be used for encapsulation of electronic devices as an electrostatic dissipation material.

Rapid, precise and reliable monitoring of traces of nitrite is very important in environmental samples and food materials. Test strip sensor by the entrapment of rhodamine 6G for the determination of nitrite in different types of environmental samples, silver nanocluster film modified silver electrodes for trace level sensing of nitrate in aqueous media by potentiostatic method, and virtually specific UV-molecular probe for nitrite sensing based on monotonous increase in absorbance of rhodamine 6G were developed and demonstrated.

Photo active titanium oxide nano coatings were developed on solar cell glass covers to remove the contaminants getting deposited from the environment. A demonstration set-up consists of commercial solar cell panel assembly with glass covers coated with high photoactive nano $TiO_2$ on the top was fabricated and installed. An online, computer control monitoring unit was also integrated. Initial results indicated considerable improvement in efficiency on coated panels.

A novel and cost effective self healing Low-k silica based dielectric ink which is screen printable on flexible substrates successfully was synthesized at lab scale for high frequency printed electronic applications. Crystallographically oriented samarium based iron pnictide superconducting material with high critical field was also developed. The results strongly indicate the scope for development of SmFeAsO based practical conductors with higher current carrying capacity.

Al-12Si-Mg-Cu-Ni piston alloys having low thermal expansion coefficient, high wear resistance, high strength at room and elevated temperatures were developed. The mechanical properties of the castings made by squeeze casting technique were found to be significantly higher due to the faster solidification, fine structure and lesser casting defects.

Virtual Casting software developed by the Institute for the simulation of solidification process of industrial castings integrated with AutoCAST-X software of 3D Foundry Tech Pvt. Ltd., and released as AutoCAST X1. With the addition of Virtual Casting, AutoCAST XI has the capability to predict both flow related and solidification defects like misruns, cold shuts and shrinkage porosity.

The feasibility of continuous cultivation of autoflocculant, high-lipid content marine microalgae in outdoor seawater raceway reactor was established. A consortium containing a species of lightly silicified diatom and another shelled brown algae got selected under the conditions applied. A biosorption tank was installed to supply nutrient only to suspended biomass which reduced the attached algal growth.

The Institute carried out analysis of a large number of samples from Periyar to test for pesticide and other contamination, as ordered by the Kerala High Court. Environmental impact assessment studies for different agencies were also undertaken and CSIR-NIIST has been accredited by Government of India for EIA studies in the mining sector.

## 3. Awards and Honours

Prof. A. Ajayaghosh, CSIR outstanding Scientist, has been awarded the prestigious Infosys Prize 2012 in the physical science category for his pioneering research in the construction of supra molecular functional materials for photonic and electronic applications. He also received the 26th Khwarizmi International Award of IROST, Tehran, Iran and the CRSI Silver Medal of Chemical Research Society of India. Dr. Suresh Das, Director, has been conferred the Asian and Oceanian Photochemistry Association (APA) Award 2012 for his distinguished contributions to Photochemistry through investigations on photoresponsive materials. In addition, Dr Das received the MRSI Distinguished Lectureship Award during the reporting period. Dr. M.L.P. Reddy and Dr. C.H. Suresh received CRSI Bronze Medal and CRSI Young Scientist award of Chemical Research Society of India respectively. Dr. Joshy Joseph and Dr. C. Vijayakumar were awarded Ramanujam Fellowship of DST. Several research students received awards for Best Paper and Best Oral presentaions.

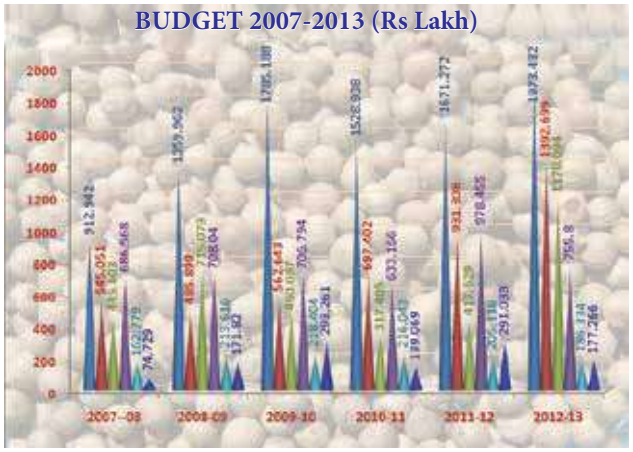
## 4. Other Activities

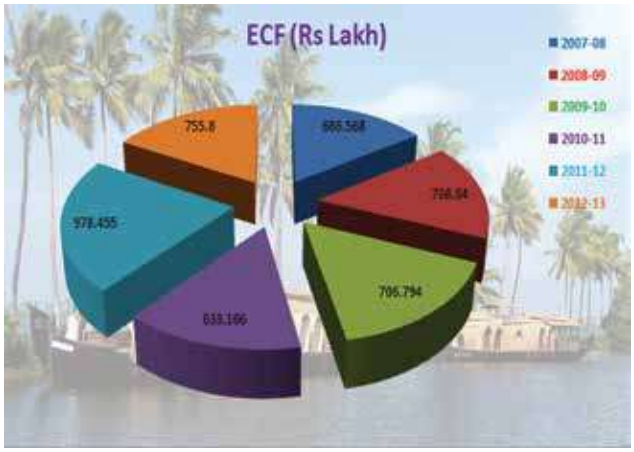
The Institute continued to render instrumentation support for its in house R&D programmes as well as to external clientele ranging from industries to academics. A series of lectures, seminars, training programmes were organized giving an opportunity for the staff to improve their understanding of the subjects concerned and to interact with other participants. As in the past, on the CSIR Foundation Day, the NIIST Foundation Day the and National Science Day, the institute observed Open Day and students from educational institutes were allowed to visit the laboratory.

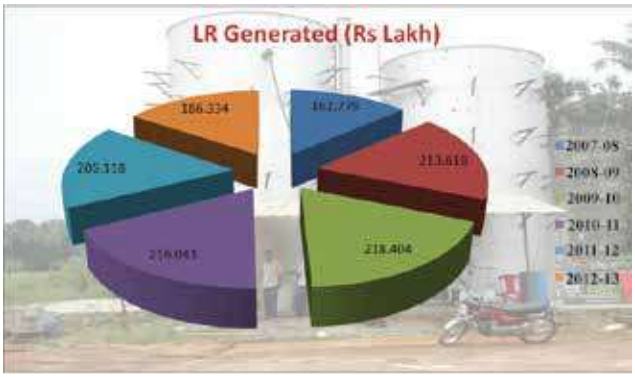
On 4th October, 2012 a programme was organized to facilitate M.Sc. students who participated in the OSDD Outreach programme. Prof. Samir K. Bramachari, DGSIR, who interacted with these students, highlighted the importance and success stories of the OSDD programme. Workshops on 'National knowledge network', 'Patent searching and mapping using QPAT', 'Patinformatics for research planning and commercialization' and 'How to get published in research journals' were the important training-cum-workshop functions organized.

A pilot plant for the production of bioethanol from biomass has been set up and was inaugurated by Dr. T. Ramasamy, Secretary, DST on 23rd April, 2012. A fully automated drinking water plant with a capacity of 500 liter per hour was also installed in the Institute. The long cherished dream of the staff to have an institutional dispensary was fulfilled on 21st December, 2012 by the opening of a NIIST Dispensary.

# PERFORMANCE AT A GLANCE





# महत्वपूर्ण उपलब्धियॉ

बारहवीं पंचवर्षीय योजना में प्रवेश के रूप में वर्ष 2012-13 सीएसआईआर - एनआईआईएसटी के लिए महत्वपूर्ण था। प्रकल्पित परियोजनाएं बहु प्रयोगशाला भागीदारी के साथ अंतर्विषयी प्रकृति की थीं । वर्तमान योजना अवधि के दौरान चार परियोजनाओं के लिए सीएसआईआर - एनआईआईएसटी नोडल प्रयोगशाला है और संस्थान 27 अन्य नेटवर्क परियोजनाओं में भाग ले रहे हैं । 2.927 के औसत प्रभाव कारक युक्त 187 प्रकाशनों के साथ संस्थान के निष्पादन ने एक स्थिर औसत दर्जे का निष्पादन विकास प्रदर्शित किया । नेस्टा, एक ब्रिटेन आधारित संगठन की जुलाई 2012 की रिपोर्ट के अनुसार, भारत में किसी भी संस्थान की तुलना में सीएसआईआर -एनआईआईएसटी द्वारा विश्व स्तर के कागजात के उच्चतम अनुपात प्रकाशित करते हैं । अनुसंधान की गुणवत्ता और प्रासंगिकता में आगे सुधार करने के लिए और सीएसआईआर विज़न दस्तावेज में उल्लिखित लक्ष्यों को पूरा करने में मदद करने के लिए संस्थान ने युवा वैज्ञानिकों को शामिल किया है और बुनियादी ढांचे में महत्वपूर्ण सुधार लाया है । समीक्षाधीन अवधि के दौरान प्राप्त महत्वपूर्ण उपलब्धियों पर एक संक्षिप्त रिपोर्ट नीचे प्रस्तुत है:

## 1. व्यवसाय विकास और अनुबंध अनुसंधान

संस्थान ने तकनीकी जानकारी के हस्तांतरण और अनुसंधान सहयोग के सिलसिले में प्रमुख उद्योगों, लघु उद्योगों, सरकार, साथ ही साथ सामाजिक संगठनों तथा उद्यमियों के साथ उन्नीस समझौतों पर हस्ताक्षर किए। इन समझौतों में से आठ समझौते प्रत्यक्ष तकनीकी जानकारी के हस्तांतरण के लिए और एक प्रौद्योगिकी व्यापार ऊष्मायन केन्द्र की स्थापना के लिए किये गये थे । संस्थान ने गैस के अणुओं की जुदाई, शोधन और भंडारण के लिए अवशोषक के विकास के लिए अंतरराष्ट्रीय सिरेमिक कंपनी - नोरिटेक कंपनी लिमिटेड, नागोया, जापान के साथ समझौता ज्ञापन पर हस्ताक्षर किए है । "सामग्रियों के रैशनल डिजाइन, झरझरा नैनोस्ट्रचेर्स और सतह रसायन शास्त्र" शीर्षक तीन वर्षीय सहयोगात्मक अनुसंधान कार्यक्रम के माध्यम से नोरिटेक से 33 लाख रुपये का प्रत्यक्ष योगदान के अलावा 1.75 करोड़ रुपये से अधिक मूल्य के खास तरह के योगदान भी प्राप्त है। सिरेमिक नैनोमैटेरियल्स की एक किस्म के प्रसंस्करण में सीएसआईआर- एनआईआईएसटी की विशेषज्ञता, झिल्ली का उपयोग करके गैस और तरल जुदाई में नोरिटेक टीम की विशेषज्ञता के साथ अच्छी तरह से पूरक होगी । वर्चुअल कास्टिंग, जो औद्योगिक कास्टिंग की सम्पिण्डन प्रक्रिया के अनुकरण के लिए एनआईआईएसटी द्वारा विकसित सॉफ्टवेयर पैकेज है, को 3 डी फाउंड्री टेक. के ऑटोकास्ट-X के साथ एकीकृत किया गया और इसे अब ऑटोकास्ट-XI नाम से जारी किया गया है । इसको मिस्रन्स, ठंड बन्द, सिकुड़न सरंध्रता जैसे प्रवाह संबंधित और सम्पिण्डन दोष दोनों की भविष्यवाणी करने की क्षमता है । आईएफईएक्स 2013 के दौरान कोलकाता में इस सॉफ्टवेयर का शुभारंभ किया गया था । कोलकाता में आयोजित वर्ष 2012 की भारतीय कम्प्यूटर सोसायटी के आईटी उत्कृष्टता पुरस्कार में इंजीनियरिंग समाधान और उत्पाद विनिर्माण श्रेणी में वर्चुअल कास्टिंग ने दूसरा स्थान जीता ।

## 2. अनुसंधान और विकास कार्यक्रमों में प्रगति

कृषि प्रसंस्करण और प्राकृतिक उत्पाद प्रभाग, केरल सरकार के कृषि विभाग की तरफ़ से ताज़ा अदरक प्रसंस्करण सुविधा की स्थापना में इंजीनियरिंग सहायता प्रदान कर रहा है। सुविधा की स्थापना खेत के ताजा अदरक के प्रसंस्करण के लिए है और इसमें मूल्य वर्धित उत्पादों का निर्माण होता है और इकाई को प्रतिदिन 7.5 टन ताजा अदरक की प्रसंस्करण क्षमता होगी और परियोजना लागत, 193.00 लाख रुपए हैं। संस्थान ने कोट्टक्कल आर्य वैद्यशाला के सहयोग से आयुर्वेदिक दवाओं की तैयारी के दौरान वनस्पति के मुक्त शेष से उत्पन्न जैवसक्रियों की वसूली के लिए एक कार्यक्रम शुरू किया है। पॉम नीरा आधारित स्वास्थ्य पेय के लिए एक प्रक्रिया विकसित की गयी है। विकसित उत्पाद गुणवत्ता में सामंजस्य बनाया रखता है और उपज में छह प्रतिशत की वृद्धि हुई है।

*एम. ट्यूबरकुलोसिस* (Rv2068c, Rv0406c एवं Rv3677c) के परिकल्पित बीटा लैक्टामेज़स के आणविक क्लोनिंग, अति अभिव्यक्ति और जैव रासायनिक अभिलक्षण पर किये गये अध्ययन ने *एम. ट्यूबरकुलोसिस* में एक से अधिक जीन, बीटा लैक्टामेज़ या बीटा लैक्टामेज़ के तरह की गतिविधि होनेवाले एन्कोडिंग प्रोटीन की संभावना को व्यक्त किया है, जो बीटा लैक्टम्स के खिलाफ प्रतिरोध के लिए व्यापक स्पेक्ट्रम दे रहे हैं ।

साइट निर्देशित उत्परिवर्तजनन द्वारा *ई. कोलाई* से क्लोन किये एल- ऐस्पैरजाइनेस II जीन के उत्परिवर्तन पर किये अध्ययन तथा म्यूटेंट की अभिव्यक्ति और संशुद्धि ने सूचित किया है कि जंगली एंजाइम तथा घन आविष्ट नियंत्रण उत्परिवर्ती की तुलना में, के 139ए तथा के 139डी को $70^0$ सें. की ओर सहिष्णुता है और $50^0$ सें. थर्मल स्थिरता पर 20% ज्यादा गतिविधि प्रतिधारण है। नाफीऑन का उपयोग करके एक नूतन सुपर एसिड उपचार विकसित किया गया, जिसने लिग्नोसेलूलोज़िक बायोमास से सेलूलोज़ और हेमीसेलूलोज़ का चयनात्मक विलेयीकरण किया है और इस उपचार के बाद प्राप्त जल-अपघटज एचएमएफ, फ़रफ्यूरल जैसे किण्वन अवरोधकों से रहित था। सूक्ष्म जैविक संसाधनों के अन्वेषण ने एक मैन्ग्रोव राइजोस्फियर से नूतन ग्राम -नेगेटिव, एरोबिक,लवणरागी, गैर-गतिशील एवं छड़ के आकार का बैक्टीरियल स्ट्रेन P2E16$^T$, के अलगाव में परिणत हुआ और इसे *जुनोंग्वानिया मन्ग्रोवी* स्पीशीज़ नाम दिया गया ।

रोशनी और गर्मी नियंत्रित कुंडलता और स्विचनीय आकारिकी युक्त ऑलिगोमेर्स/पॉलिमरों के प्रकाशानुक्रियाशील "स्मार्ट" अतिआण्विक समुच्चयों का विकास किया। यह पाया गया था कि एक विशिष्ट किरेलिटी के साथ जुड़े अतिआण्विक समुच्चयों की कुंडलता, संलग्न ऐजोबेन्जीन मॉइटी की एक किरेल-केंद्र नियंत्रित फोटो आइसोमेरेसेशन के माध्यम से विपरीत हेलिकल संवेदन को उत्क्रमणीय स्विचन किया जा सकता है। यह पाया गया है कि ऑलिगो के साथ प्रकार्यीकृत बिसमेलामाइन्स, (फेनिलिनवाइनिलिन) कुंडलिनी $\pi$-$\pi$ स्टैकिंग से छोटे नैनो छड़ों के रूप ग्रहण करने के लिए अध्रुवी विलायक में स्व-एकत्रीकरण करता है। यह निहित स्व- एकत्रीकरण को एक सायन्यूरेट के साथ सम्मिश्रण द्वारा अतिआण्विक ध्रुवण के मार्ग के लिए निर्देशित किया जा सकता है, जिससे $\pi$ संयुग्मित मॉइटी के हेलिकल संवेदन से मुक्त जेल के लम्बी नैनो टेप का गठन हो सकता है ।

विलयन सम्मिश्रण प्रक्रिया के माध्यम से नैनो संरचित पॉलीऐनिलिन-पॉली हाइड्रोक्सी- लौह मिट्टी (पीपीआईसी) और पॉली कार्बोनेट के कंपोजिट से ईएमआई परिरक्षण सामग्री विकसित की गयी, जिसे एक इलेक्ट्रोस्टैटिक अपव्यय सामग्री के रूप में इलेक्ट्रॉनिक उपकरणों के संपुटन के लिए इस्तेमाल किया जा सकता है।

पर्यावरणीय नमूने और खाद्य सामग्री में नाइट्राइट की तेजी, सटीक और विश्वसनीय निगरानी अत्यंत महत्वपूर्ण है। विभिन्न पर्यावरण नमूनों में नाइट्राइट के निर्धारण के लिए रोडैमीन 6जी के फंसाने से टेस्ट स्ट्रिप सेंसर, पोटेन्शियोस्टैटिक विधि द्वारा जलीय मीडिया में नाइट्रेट के ट्रेस स्तर संवेदन का पता लगाने के लिए सिल्वर नैनोक्लस्टर फिल्म संशोधित सिल्वर इलेक्ट्रोड, और रोडैमीन 6 जी के अवशोषण में एकरूपक वृद्धि के आधार पर नाइट्राइट संवेदन के लिए वस्तुतः विशिष्ट यूवी आणविक प्रोब का विकास और प्रदर्शन किया गया।

पर्यावरण से जमा हो रहे दूषित पदार्थों को दूर करने के लिए सौर सेल कांच आवरणों पर फोटो सक्रिय टाइटेनियम ऑक्साइड नैनो कोटिंग्स विकसित किये गये। शीर्ष पर उच्च प्रकाश सक्रिय नैनो टाइटेनियम डाइऑक्साइड लेपित गिलास कवर्स के साथ वाणिज्यिक सौर सेल पैनल असेंबली शामिल एक प्रदर्शन सेट अप् का फैब्रिकेशन और संस्थापना की गयी । एक ऑनलाइन, कंप्यूटर नियंत्रण निगरानी इकाई भी एकीकृत की गयी थी । प्रारंभिक परिणाम ने लेपित पैनलों की क्षमता में काफी सुधार का संकेत दिया ।

उच्च आवृत्तिवाले मुद्रित इलेक्ट्रॉनिक अनुप्रयोगों के लिए प्रयोगशाला पैमाने पर एक नूतन स्वत: हीलिंग और लागत प्रभावी कम- के सिलिका आधारित डाइइलेक्ट्रिक स्याही सफलतापूर्वक संश्लेषित की गयी,जो लचीले क्रियाधारों पर स्क्रीन प्रिंट करने योग्य है । उच्च क्रांतिक क्षेत्र के साथ, क्रिस्टल संरचनात्मकता उन्मुख समैरियम आधारित लोहा प्निक्टिड अतिचालक सामग्री विकसित की गयी । परिणाम से उच्च वैद्युत वाहन क्षमता के साथ SmFeAsO आधारित व्यावहारिक कंडक्टर के विकास के लिए गुंजाइश का संकेत मिलता है ।

कम थर्मल विस्तार गुणांक, उच्च कट फट प्रतिरोध, कमरे और ऊंचे तापमान पर उच्च शक्ति युक्त Al-12Si-Mg-Cu-Ni पिस्टन मिश्र विकसित किया गया । तेजी सम्पिण्डन, सूक्ष्म संरचना और कम कास्टिंग दोष की बजह से निचोड़ कास्टिंग तकनीक द्वारा निर्मित कास्टिंग के यांत्रिक गुणों में काफी वृद्धि पायी गयी है ।

सम्पिण्डन प्रक्रिया के अनुकरण के लिए एनआईआईएसटी द्वारा विकसित वर्चुअल कास्टिंग सॉफ्टवेयर को 3 डी फाउंड्री टेक. के ऑटोकास्ट-X के साथ एकीकृत किया गया और इसे अब ऑटोकास्ट-XI नाम से जारी किया गया है । वर्चुअल कास्टिंग के संयोजन से ऑटोकास्ट XI में मिस्रन्स, ठंड बन्द, सिकुड़न सरंध्रता जैसे प्रवाह संबंधित और सम्पिण्डन दोष, दोनों की भविष्यवाणी करने की क्षमता है ।

आउटडोर समुद्री जल नाला रिएक्टर में ऑटोफ्लोक्कुलंट, उच्च लिपिड सामग्री युक्त समुद्री सूक्ष्मशैवाल की निरंतर खेती की व्यवहार्यता स्थापित की गयी। लागू शर्तों के तहत हल्के सिलिकीभूत डायटम की एक प्रजाति और भूरे रंग के एक अन्य खोलीदार शैवाल युक्त कंसोर्शियम का चयन किया गया। केवल निलंबित बायोमास को पोषक तत्वों की आपूर्ति करने के लिए एक जैवअवशोषण टैंक स्थापित किया गया, जिसने संलग्न बायोमास के विकास को कम कर किया।

केरल उच्च न्यायालय के आदेश के अनुसार संस्थान ने कीटनाशक और अन्य संक्रमण का परीक्षण करने के लिए पेरियार से नमूनों की एक बड़ी संख्या का विश्लेषण किया । विभिन्न एजेंसियों के लिए पर्यावरण प्रभाव मूल्यांकन अध्ययन भी किए गए थे और सीएसआईआर - एनआईआईएसटी को भारत सरकार द्वारा खनन क्षेत्र में ईआईए अध्ययन के लिए मान्यता दी गयी है ।

## 3. पुरस्कार एवं सम्मान

प्रो. ए.अजयघोष, सीएसआईआर उत्कृष्ट वैज्ञानिक को भौतिक विज्ञान की श्रेणी में फोटोनिक और इलेट्रॉनिक अनुप्रयोगों के लिए सुप्रा आणविक कार्यात्मक सामग्रियों के निर्माण में अग्रणी अनुसंधान के लिए, प्रतिष्ठित इंफोसिस

पुरस्कार-2012 से सम्मानित किया गया । उनको आईआरओएसटी, तेहरान, ईरान के 26 वें ख्वारिज्मी अंतर्राष्ट्रीय पुरस्कार और भारतीय केमिकल रिसर्च सोसायटी का सीआरएसआई सिल्वर मेडल भी प्राप्त हैं । डॉ. सुरेश दास, निदेशक, को प्रकाश अनुक्रियाशील सामग्री पर जांच के माध्यम से फोटो रसायन विज्ञान के क्षेत्र में अपने विशिष्ट योगदान के लिए एशियाई और औशेयनियन प्रकाश रसायनविज्ञान एसोसिएशन (ए पी ए) पुरस्कार 2012 से सम्मानित किया गया । इसके अलावा, डॉ. दास को रिपोर्टिंग अवधि के दौरान एमआरएसआई विशिष्ट लेक्चरशिप पुरस्कार प्राप्त है । डॉ. एम एल पी रेड्डी तथा डॉ. सी.एच. सुरेश को क्रमशः सीआरएसआई कांस्य पदक और भारतीय केमिकल रिसर्च सोसायटी का सीआरएसआई युवा वैज्ञानिक पुरस्कार प्राप्त है । डॉ. जोशी जोसफ और डॉ. सी. विजयकुमार को डीएसटी रामानुजम फैलोशिप से सम्मानित किया गया । कई शोध छात्रों को बेस्ट पोस्टर, बेस्ट मौखिक प्रस्तुति, बेस्ट पेपर, आदि के लिए पुरस्कार प्रदान किये गये ।

## 4. अन्य गतिविधियां

संस्थान ने अपने आन्तरिक अनुसंधान एवं विकास कार्यक्रमों के साथ ही साथ उद्योगों से लेकर शिक्षाविदों तथा बाहरी ग्राहकों के लिए अपने इंस्ट्रूमेंटेशन समर्थन देने का कार्य जारी रखा। अपने विषय के संबंध में कर्मचारियों को बेहतर समझ पाने के लिए तथा प्रतिभागियों के बीच इंटरैक्शन के लिए अवसर देने के लिए संस्थान में व्याख्यान, सेमिनार तथा प्रशिक्षण कार्यक्रमों की एक श्रृंखला आयोजित की गयी । पिछले वर्षों जैसे, सीएसआईआर स्थापना दिवस, एन आई आई एस टी स्थापना दिवस और राष्ट्रीय विज्ञान दिवस के अवसरों पर खुले दिन मनाये गये और शैक्षिक संस्थानों से छात्रों को प्रयोगशाला के दौरे की अनुमति दी गई ।

4 अक्टूबर 2012 को ओएसडीडी आउटरीच कार्यक्रम में भाग लेने वाले एमएससी के छात्रों को सहूलियत देने के लिए एक कार्यक्रम आयोजित किया गया। प्रोफेसर समीर के. ब्रह्मचारी, डीजीएसआईआर ने इन छात्रों के साथ बातचीत की और ओएसडीडी कार्यक्रम के महत्व और सफलता पर प्रकाश डाला । 'राष्ट्रीय ज्ञान नेटवर्क', 'क्युपीएटी का उपयोग कर पेटेंट खोज और मानचित्रण', 'अनुसंधान योजना और व्यावसायीकरण के लिए पेटइन्फोर्माटिक्स, 'शोध पत्रिकाओं में कैसे प्रकाशन पा सकते है" आदि समीक्षाधीन अवधि के दौरान आयोजित कुछ महत्वपूर्ण प्रशिक्षण व कार्यशालाएं थीं।

बायोमास से बायोइथेनॉल के उत्पादन के लिए एक प्रायोगिक संयंत्र स्थापित किया गया और डॉ. टी. रामासामी, सचिव, डीएसटी द्वारा 23 अप्रैल 2012 को इसका उद्घाटन किया गया। प्रति घंटे 500 लीटर की क्षमता के साथ पूरी तरह से स्वचालित पीने के पानी का संयंत्र भी संस्थान में स्थापित किया गया। एक संस्थागत औषधालय होने का कर्मचारियों के लंबे समय का सपना 21 दिसंबर, 2012 को एनआईआईएसटी औषधालय के उद्घाटन के द्वारा पूरा हो गया ।

# AGROPROCESSING & NATURAL PRODUCTS DIVISION

The focus of Agroprocessing and natural products division is in the development of technologies in the area of oil seeds, spices and agricultural produce of the region. TEAM AGRO consists of Chemical Engineers, Food technologists, Microbiologists, Biologists and Chemists. Excellent analytical and pilot plant facilities offer unique opportunities in developing technologies, scale up and its transfer to the industry. A technology Business Incubator is operational under the division and it has taken up programme to develop a process for the drying of 14 tons per day, fresh turmeric. The commercial facility at Radour, Haryana is expected to go on stream during 2013- 14.

Besides its technology related activities, the Division is actively involved in the Biology – Chemistry interface programmes contributing significantly in the natural products chemistry and biological areas. The programmes initiated with the Kottakkal Aryavaidyasala and the isolation of active ingredients using enzymes are in progress. The highlight of the activities undertaken during this period are:

- Initiated activities for setting up a 7.5 tons per day Fresh ginger processing plant at Wynad
- Determination of new parameters for arriving at Indian specification for value added products from North East ginger
- Process for Neera based health drink developed
- Studies on Acrylamide formation in fried foods and TFA in bakery food products
- Bioactives from plant sources
- Synthesis of novel compounds

# कृषि प्रसंस्करण तथा प्राकृतिक उत्पाद प्रभाग

कृषि प्रसंस्करण तथा प्राकृतिक उत्पाद प्रभाग का ध्यान इस क्षेत्र के तिलहन, मसाले और कृषि उत्पादों के क्षेत्र में प्रौद्योगिकी विकास पर केंद्रित है। टीम एग्रो में केमिकल इंजीनियरों, खाद्य प्रौद्योगिकीविदों, सूक्ष्म जीव विज्ञानियों, जीव विज्ञानियों और कैमिस्टों शामिल हैं। संस्थान में उपलब्ध उत्कृष्ट विश्लेषणात्मक और पायलट संयंत्र सुविधाएं प्रौद्योगिकियों के विकास, स्केल अप् और उद्योगों को उन्हें हस्तांतरण करने के लिए अद्वितीय अवसर प्रदान करती हैं। प्रभाग के तहत एक प्रौद्योगिकी व्यापार इनक्यूबेटर कार्य कर रहा है और इसके द्वारा प्रति दिन 14 टन ताजा हल्दी को सुखाने के लिए प्रक्रिया विकास का कार्यक्रम लिया गया है। वर्ष 2013-14 के दौरान राडोर, हरियाणा में वाणिज्यिक सुविधा क्रियान्वित होने की उम्मीद है।

प्रौद्योगिकी से संबंधित अपनी गतिविधियों के अलावा, जीवविज्ञान- रसायन विज्ञान इंटरफेस कार्यक्रम में सक्रिय रूप से शामिल होकर प्रभाग द्वारा प्राकृतिक उत्पाद रसायन विज्ञान एवं जैविक क्षेत्रों में उल्लेखनीय योगदान दे रहा है। कोट्टय्ककल आर्यवैद्यशाला के साथ शुरू कार्यक्रम तथा एंजाइमों का उपयोग कर सक्रिय सामग्री के अलगाव के लिए शुरू कार्यक्रम प्रगति पर हैं। इस अवधि के दौरान किए गए कार्यकलापों का मुख्य आकर्षण हैं :-

- वायनाड में प्रति दिन 7.5 टन ताजा अदरक प्रसंस्करण संयंत्र की स्थापना के लिए गतिविधियॉ शुरू की।
- पूर्वोत्तर क्षेत्र के अदरक के मूल्य वर्धन के लिए भारतीय विनिर्देश पर पहुंचने के लिए नए मानकों का निर्धारण।
- नीरा आधारित स्वास्थ्य पेय के लिए प्रक्रिया विकसित की गयी।
- तले हुए खाद्य पदार्थों में एक्रिलामाइड तथा बेकरी में टीएफए के गठन पर अध्ययन।
- वनस्पति स्रोतों से जैवसक्रियों।
- नूतन यौगिकों के संश्लेषण।

## Technology Business Incubation Centre in Agroprocessing (TBIC)

CSIR NIIST in collaboration with the Department of Agriculture, Govt. of Kerala have launched a programme to develop and transfer technologies for value addition of the agricultural produce of the state. Sharing of specialized infrastructure facilities, offering technical expertise to prospective entrepreneurs for product development, scale up, test marketing etc. and providing consultancy services to industries, form part of the venture, named as Technology Business Incubator in Agroprocessing (TBIC–A). The Institute is currently involved in the development of certain processes for clients under TBIC platform. Development of process to enhance the colour of the turmeric powder and to facilitate the modernization of the existing unit in Haryana are being taken up as major programmes of TBIC – A during 2013/14.

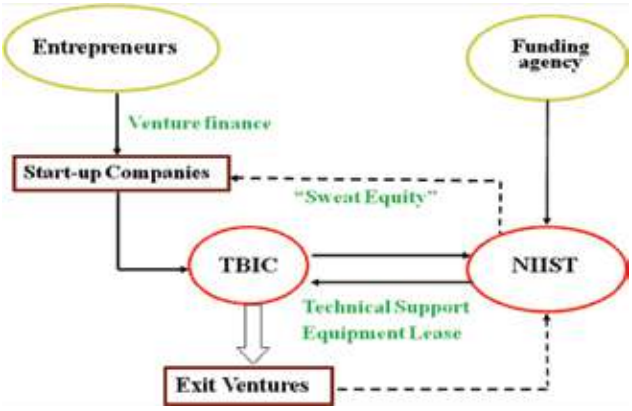



*Fig 1. TBIC - A pictorial representation*

## Fresh ginger processing unit at Wyanad

A fresh Ginger processing facility is being set on behalf of the Department of Agriculture, Government of Kerala and the Division is offering engineering assistance in the setting up of the venture. The facility is for processing farm fresh ginger and makes value added products like cleaned/ waxed ginger, ginger powder. Conventional artificial drying of ginger powder results in loss of aroma and the new facility employ state of the art refrigeration dehumidification drying. The unit will have a capacity to process 7.5 tonnes per day fresh ginger at a project cost of Rs.193.00 Lakhs. Detailed engineering, technical consultancy, wetting the specifications for plant machinery, identification of machineries, erection, commissioning, training of plant personnel etc. form part of the assistance offered by the division.

## Development of Indian Standards for North East Ginger

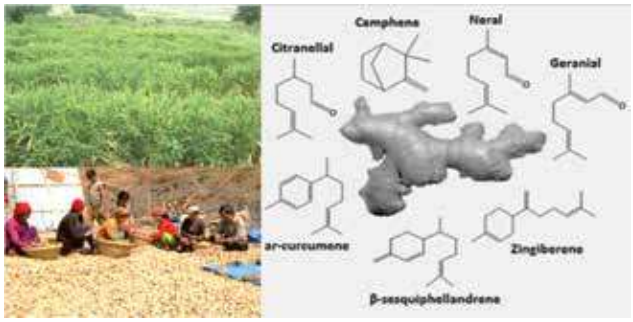



*Fig 2. Ginger cultivation in NE and compounds from ginger extracts*

The objective of this project is to develop a database on oil content and physico-chemical composition of various fresh ginger cultivars grown in seven states of North East (NE) and to arrive at a revised IS specification for NE ginger and its value added products. The project taken up under the sponsorship of the Bureau of Indian Standards (BIS) aimed at collecting 3 sets of major cultivars of fresh ginger samples at different stages of maturity from seven North East states and to determine the physico chemical characteristics of all the cultivar samples. The study investigated the variation in the essential oil composition and oleoresin and [6]-gingerol content in different fresh ginger cultivars harvested at 6- and 9-month maturity from five different states of NE. Monoterpenes, sesquiterpenes, and citral composition in the

essential oil isolated were evaluated to ascertain their variation during the stages of maturity.

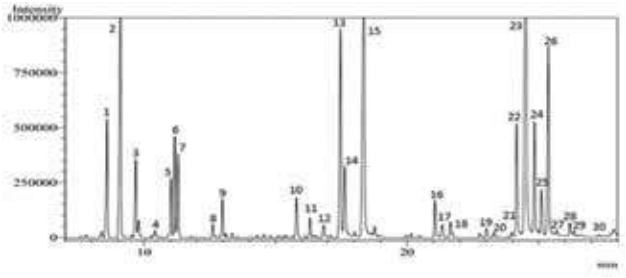


*Fig 3. Typical GC-MS/GC profile of Ginger essential oil from NE*

*1.α-pinene; 2.Camphene; 3.β-pinene; 4.p-cymene; 5.D-Limonene; 6.β-Phelleandrene; 7.Cineole; 8.Linalool oxide; 9.Linalool; 10.Citranellol; 11.Borneol; 12.α-Terpeniol; 13.Neral; 14.Citranellal; 15.Geranial; 16.Undecanone; 17.Copaene; 18.β-Elemene; 19.Thuzopsene; 20.Caryophyllene; 21.allo-Aromadendrene; 22.ar-Curcumene; 23.Zingeberine; 24.β-Bisabolene; 25.γ-Caolinene; 26.β-sesquiphellandrene; 27.Eudesmene; 28.Neroldiol; 29.Caryophyllene oxide; 30.Elemol*

Except for Mizoram Thinglaidum, Mizoram Thingria, Nagaland Nadia, and Tripura I ginger cultivars, all other cultivars showed an increase in the citral content during the maturity. HPLC profiling of all the cultivars for screening major bioactives like gingerols and shoagols were also conducted. The database developed provide valuable information for farmers and entrepreneurs in identifying superior varieties of ginger for cultivation and processing, which will yield higher volatile oil and oleoresin.

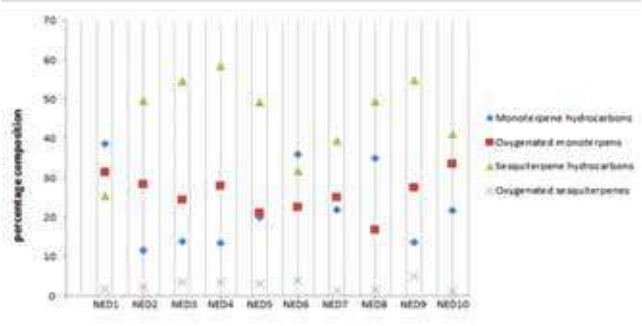


*Fig 4. Percentage composition of monoterpenes & sesquiterpenes from NE Cultivars*

- *NED1,2 3…. Etc represent various ginger cultivars from NE*

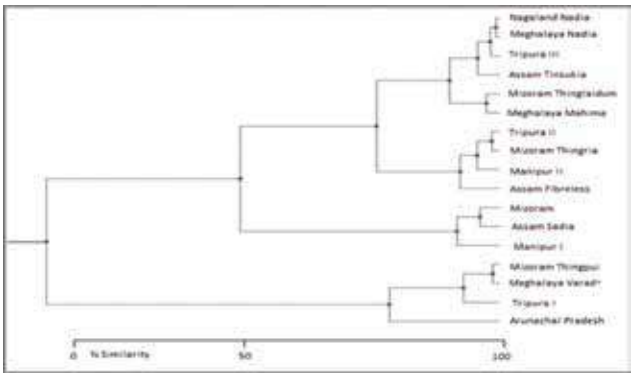


*Fig 5. Clustering of Ginger genotypes with respect to Gingerols & Shogaols*

Comparitive evaluation of various samples from NE states is graphically represented in the dendogram shown above. This data have significant commercial value because it helps the industry to source the right raw material for processing for oil and oleoresin.

## 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


*Fig 6. The partners of the programme*

The Institute in association with Kottakkal Arya Vaidyasala initiated a programme for the recovery of bioactives from spent botanicals generated during the preparation of Ayurvedic medicines. Since most of the Ayurvedic preparations are either mechanical or aqueous extracts, substantial quantities of bioactives are left behind in the spent material. Currently, the spent plant materials are discarded and the recovery of active phytochemicals from them can lead to generation of substantial revenue for the Ayurveda industry.

Another aspect of the study is aimed at finding an alternate to the current practice of using the roots of

plants, which lead to the distruction of the species, during the manufacture of Ayurvedic products. The present effort is to explore the possibility of replacement of herbal roots used in traditional ayurvedic preparations by substituting it with other plant parts. One such study was done in *Aegle marmelose* which is one of the major raw materials used by the industry for manufacturing more than 50 classical formulations including Dasamoola preparations. The study involves detailed chemical and biological evaluation of extracts isolated from various parts of this plant. The picture below (Fig 7) shows the HPTLC finger printing of extracts from various parts of *Aegle marmelose* with umbeliferone as the marker compound.

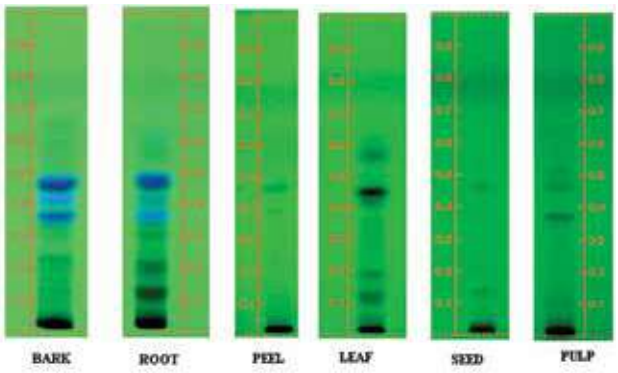



*Fig 7. HPTLC plate views of different Aegle marmelose extracts and umbeliferone at 254nm*

## Bioprocessing of botanicals for active ingredient isolation: Enzymatic route

From the soil samples collected from the different region of Kerala, 164 bacterial and 14 fungals strains were isolated. Nutrient agar, potato dextrose agar, Actinomycete isolation agar and Pseudomonas isolation agar were the media used for isolation of the organisms. Bacterial strains and fungal strains were maintained in nutrient agar and potato dextrose agar slants respectively for further studies.

All the fungal strains were screened for cellulase enzyme and four of them found to be potential cellulase producers. Sixty four bacterial strains were also screened for amylase enzyme and 20 of them showed good amylase production. The ability of the organisms to produce pectinase, lipase and protease are under investigation. Selection of organisms for active ingradient isolation is also under progress. The efforts are directed towards finding a commercial viable route for the production of enzymes which will facilitate the recovery of active ingredients from botanicals.

## Development of value added products from Neera of Palmyra

This project aims at developing a shelf stable, crystal free palm syrup which has application as a healthy sweetener. This Palm Neera Syrup is a substitute for palm jaggery with all its natural nutrients unlike the latter where processing is done under extreme conditions. Another advantage of the new product is that it dispenses the difficulties in the melting and filtering operations. It also is a substitute for table sugar, providing some of the antioxidant, vitamin and mineral requirement along with calories. The present product developed also maintains consistence in quality. In addition, there is a 6% increase in yield of the product which is attractive from the commercial point of view. Thus, the new product besides helping the artisans in getting better returns, provide the consumer with a healthy product with superior quality. Physicochemical studies of palm Neera, standardization of brix content (TSS), microbiology studies, storage and stability studies, physicochemical characteristics, total phenol content, total flavanoid content and antioxidant studies of palm syrup were also done under this programme.

The studies brought out the potential antioxidant activity of palm syrup owing to the presence of polyphenolic compounds, flavanoids, maillard reaction products and caramalization products. The value added products from palm based raw materials can help the sustenance of palm industries which are otherwise uneconomical due

to low returns and shortage of labour. An offshoot of this study was the development of coconut neera syrup and cane sugarcane juice syrup. The studies carried out brought out the health benefits of these products as well.

## Production of trans fatty acids (TFA) in hydrogenated vegetable oil products and their health implications in the context of Indian food habits

This project aims at assessing the trans fat (TFA) content in Indian foods. TFA intake among middle and upper income groups is on the increase contributing to the high prevalence of diet – related chronic disease. The foods selected for the study were Kerala Parotta, Masala Dosa, Nan, Bhatura, Poori, Biriyani, Bread, Bun, Burger, Rolls, Cakes, Pastries, Cutlet, Puffs, Samosa, Noodles, Namkeen, Biscuits, Chocobar, Ice Cream, Ladu, Jilebi, Jamun, Peda and Choclates.

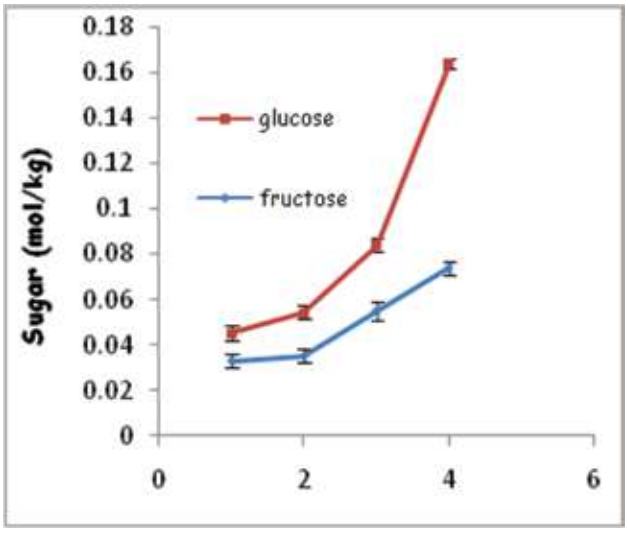
Elaidic acid was the major TFA seen in the food products analyzed with high levels in puffs followed by cakes and pastries. Most of the other food items studied showed presence of TFA. Products with low TFA content had higher SFA content which is another risk factor to coronary heart disease. The study brought out the significance of laying regulation for controlling TFA content in products sold in bakeries, hotels and kiosks. The study also brought out the absence of quality control in these products with respect to colour, oil quality, total fat, TFA content, microbiological standards, etc. A survey conducted as part of the study revealed that most of the Indian consumers and vendors were unaware about TFA and related health risk. Field level dissemination of the findings was also carried out as part of the programme. Attempts were also made in formulating composite flour blends to develop functional cakes using TFA free fat. Composite flour was formulated by incorporating banana powder/arrow root powder at an optimum level to develop cakes with good textural properties. The study revealed that high baking temperature did not induce TFA formation in cakes.

## Correlating fruit maturity and the formation of acrylamide in deep fried jack chips

Acrylamide is a toxic and potentially carcinogenic industrial chemical. Presence of acrylamide has been reported in foods subjected to very high temperature processing such as frying and baking. The primary means through which acrylamide is formed in foods is by reaction between asparagine (an amino acid) and reducing sugars at higher temperatures (baking and frying) and in low moisture conditions, *via* Maillard reaction. The levels of these precursors are influenced by the maturity of raw materials, which is very important as far as the formation of acrylamide/mitigation strategies is concerned. India with its diverse food habits, consumes a large variety of deep fried and high temperature processed foods (chips of different kind, puri, tandoori products etc). Chips which are prepared by deep frying of different vegetable crops such as tubers (potato, tapioca, colocasia) and raw vegetables (plantain, jackfruit) are some of the most popular snack items in India. These chips are very important from the viewpoint of acrylamide exposure assessment, either because they may contain much higher levels of acrylamide compared to other foods or they are a part of the normal diet for the general population, thus have a high consumption rate. No studies have been done on the analytical quantification of acrylamide in deep fried jack chips, which is a popular snack food, and the variation of acrylamide content based on maturity of the raw material. Therefore the present study was undertaken to study the correlation between the precursors and formation of acrylamide in chips made from jackfruit at different stages of maturation. A modified HPLC/DAD method was optimized

and adopted for the quantification of acrylamide. Four stages of fruit were identified based on the fruit maturity cycle, *ie*. 45 (stage 1), 60 (stage 2), 75 (stage 3) and 90 (stage 4) days from the day the fruit is set. The proximate composition and physio-chemical properties of the raw materials were analyzed.

Fructose and glucose are reducing sugars, which are important for Maillard reaction and formation of acrylamide. Glucose and the fructose contents in jack fruit were quantified by using the HPLC technique by running standards. Asparagine content in raw jackfruits was quantified by using HPTLC technique. Both the reducing sugars (glucose and fructose) and asparagine showed a marked increase during maturation.



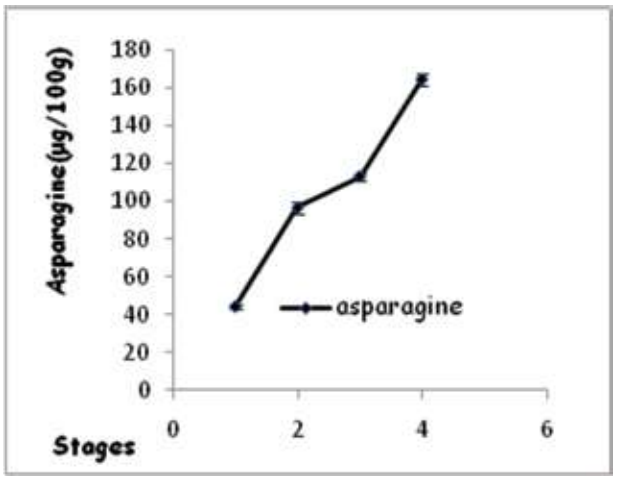




*Fig 8. Graphs showing the variation of reducing sugar and the asparagine content at four different maturity stages of jackfruit*

The frying experiments were conducted using an electric fryer with 3 L of coconut oil. 500 gm of jackfruit slices (all the four stages) were fried at a temperature of 160°C for about 7 minutes. The jack chips were air cooled for 5 min and was stored under vacuum for extraction and quantification of acrylamide. The acrylamide concentrations in four different maturity stages of jack chips were 1348, 2680, 3318, 4245 µg/kg, respectively. Chips made from all the stages contained significant level of acrylamide where the chips prepared from stage 4 showed the highest level of acrylamide.

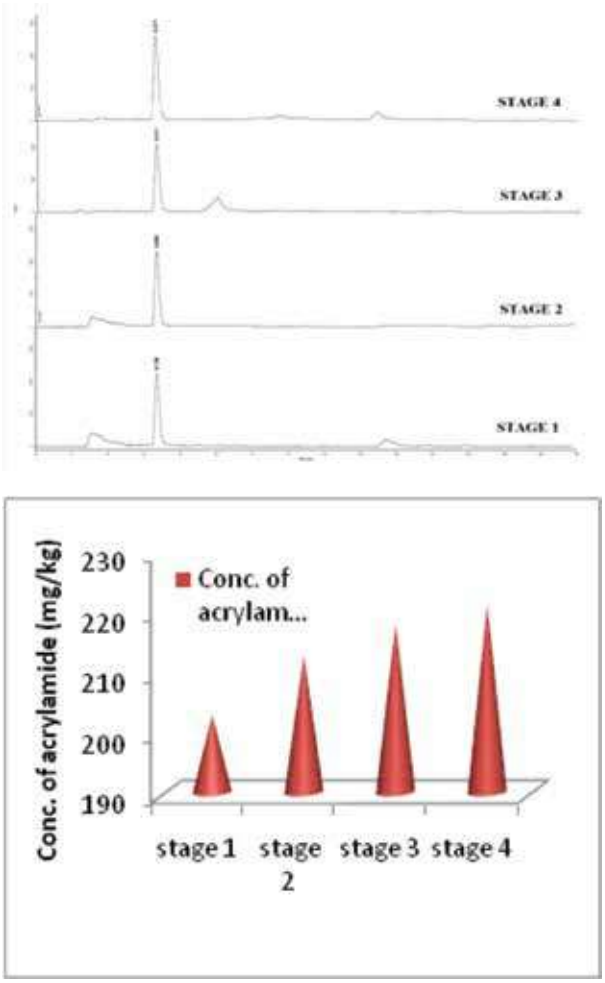



*Fig 9. HPLC Chromatogram and level of acrylamide in chips made from jackfruit at four at four different maturity stages*

The correlations between acrylamide formation and the precursors (sugars and asparagine) during the maturation of jackfruit were examined by using the correlation coefficient calculated from the regression analysis of the plot of the concentration of precursors against acrylamide content. The increase in the level of reducing sugars and asparagine correlated well with the formation of acrylamide where correlation coefficient for glucose, fructose and asparagine with acrylamide were 0.8, 0.82 and 0.989, respectively.

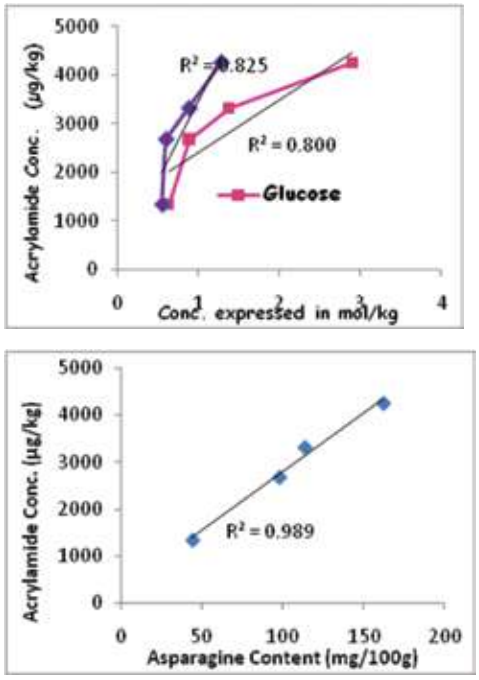



*Fig 10. Correlation of the precursors and acrylamide formation in fried chips as on increasing fruit maturity*

From a chemical point of view, glucose as an aldohexose sugar was expected to generate more acrylamide from asparagine monohydrate, due to its higher chemical reactivity provided by the more reactive aldehyde group compared to the ketohexose fructose. However, results from the study indicated that both similarly influenced the formation of acrylamide. By means of labeling experiments it has been shown that the entire carbon skeleton of acrylamide originates from asparagine which is confirmed by the highest correlation between the acrylamide formation and asparagine content in the present study. The concentration of acrylamide in jack chips was enhanced by the increase in the concentration of the reducing sugars- glucose and fructose- and asparagine with the increase in the maturity stages of jackfruit. This finding demonstrated that the acrylamide concentration is strongly dependent on the concentration of precursors in the case of jackfruit. Therefore, by selecting the proper maturity stage during the chip making process, the formation of acrylamide can be effectively controlled. The study also helps to increase the public awareness on the toxicity of acrylamide and the importance of strategies to minimize the formation as well as the exposure of acrylamide.

## Synthetic attempts towards aza-galactosphingolipid

Glycolipids are carbohydrates conjugated to lipids. They received prominence as adjuvants which enhance body's immune response. The mechanism of action involves stimulation of NKT cells which in turn release signaling peptides/ proteins called as cytokines which play a vital role against cancers, autoimmune diseases, and infectious diseases. Among the entire gamut of carbohydrates D-galactose conjugates are well studied as glycolipids. Structural modification of these glycolipids in the carbohydrate portion is less studied, so the division is attempting to make an unnatural aza-glycolipid and study their cytokine releasing ability. During the studies it was serendipitiously discovered that an advanced intermediate of a carbohydrate under basic reaction conditions can undergo elimination reaction to produce heteroaromatic structures. Recently, an unusual synthesis of pyridone and pyridine heteroaromatic compound formation from an advanced intermediate of D-galactose was reported. (Tetrahedron Lett. 2013, 54, 3230-

3232). In the recent finding it was found that one of the lipidated pyridine derivatives (pyridine conjugated with lipid) was shown to inhibit matrix metalloproteinases MMP2 and MMP9 which are implicated in cancer.

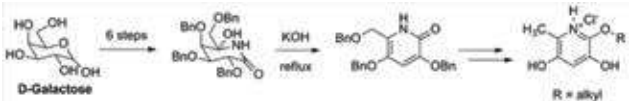



*Fig 11. Synthesis of 3,5-dihydroxy pyridine derivatives with lipid conjugation*

## Synthesis of 1,2-dihydropyridine from dienaminodioate

Pyridines play a prominent role as important moieties in several pharmaceutical drugs. Among pyridines, 1,4-dihydropyridines (1,4-DHPs) are well known scaffolds in pharmaceuticals as calcium channel modulating agents *viz.* nifedipine, lacidipine, amlodipine, etc. However, its structural isomer 1,2-DHP is relatively unexplored for its biological property. Therefore, there has been huge interest as evident from recent publications in synthesis of 1,2-DHP. A new method was developed in synthesis of 1,2-DHP by a milder approach in a one-pot cascade reaction. Using this approach, a diverse array of 1,2-DHPs have been synthesized and submitted to CDRI, Lucknow for biological screening against tuberculosis and malaria. (Tetrahedron Lett. 2013 DOI:10.1016/j.tetlet.2013.05.037).

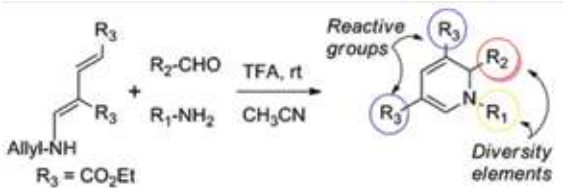



*Fig 12. Synthesis of 1,2-dihydropyridines from dienaminodioate*

## Structure elucidation of natural products derived from *Bacillus* strain

Identification of a molecule from a natural source is as challenging as finding a needle in the haystack, using analytical tools such as NMR and Mass Spectrometry. In this pursuit, several cyclic dipeptides have been identified from *Bacillus* strain associated with an entomopathogenic nematode which were shown to have good antibacterial and antifungal efficacy. The structure-activity relations of cyclic dipeptides were elucidated by synthesizing monopeptide and found that they lose their antimicrobial potential in absence of peptide bond which was recently communicated to Bioorganic and Medicinal Chemistry Letters. Similarly, semi-synthetic derivatives of abundantly available natural products isolated from plant sources were also synthesized to investigate their biological efficacies. (World J Microbiol Biotechnol. 2013, 29, 355-364, Nat. Prod. Res. 2013 DOI:10.1080/14786419.2013.796466).

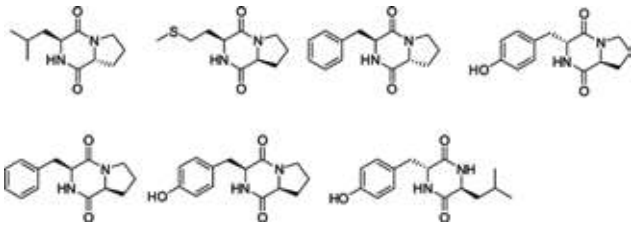


*Fig 13. Isolation of cyclic dipeptides from Bacillus strain*

## Antioxidant and antidiabetic activity of Lichens (*Parmotrema* sp.)

Lichens, the combination of algae and fungi, are abundantly available in different parts of Kerala and they have not been much exploited for medicinal purposes. Various lichen samples were collected from Palode, Trivandrum and Wayanad. The specimens were subjected to extraction with hexane and ethyl acetate. In addition, two alcoholic fractions of lichen-A1/12 and A2/12 were obtained from CSIR-CDRI Lucknow. The antioxidant efficacy of all the extractions/fractions were screened in terms of total phenolic content, total flavonoid content, DPPH and ABTS radical scavenging efficacy.

**Table 1. Total phenolic & flavonoid content of various fractions of lichen**

| | F-15 | A1/12 | A2/12 |
|---|---|---|---|
| Total phenolic content | 3.489 mgGAE/g | 4.388 mgGAE/g | 1.749 mg GAE/g |
| Total flavanoid content | 1.52 mgQE/g | 2.16 mgQE/g | 0.66 mgQE/g |

**Table 2. Antioxidant activities of various fractions of lichen**

| | F-15 | A1/12 | A2/12 |
|---|---|---|---|
| DPPH radical scavenging (IC50) | 629 µg/ml | 569 µg/ml | 833µg/ml |
| ABTS radical scavenging (IC50) | 1.09 mg/ml | 1.04 mg/ml | 1.42 mg/ml |

## Aldose reductase inhibitors as an emerging target for diabetic retinopathy

Aldose reductase (ALR2) is a multifunctional enzyme that converts glucose into sorbitol through polyol pathway and has been implicated in diabetic-induced secondary complications such as diabetic retinopathy. As of today, there is no drug available in the market against aldose reductase. In this regard, *Parmotrema* sp. collected from Wayanad has shown 59.73% inhibition in comparison to Zopolrestat as positive control (94.49%). The preliminary results were interesting and further studies on isolated molecules from the extract were recommended.

## Effect of punicic acid on lipid accumulation in adipocytes and glucose uptake

Punicic acid is reported to have PPARγ modulatory activity. The effect of punicic acid on adipogenesis and glucose uptake in 3T3 L1 adipocytes were analyzed and was found that the compound dose -dependently enhanced adipogenesis and basal and insulin-stimulated glucose uptake. Rosiglitazone was used as positive control. GW9662 was used as an inhibitor of PPARγ.

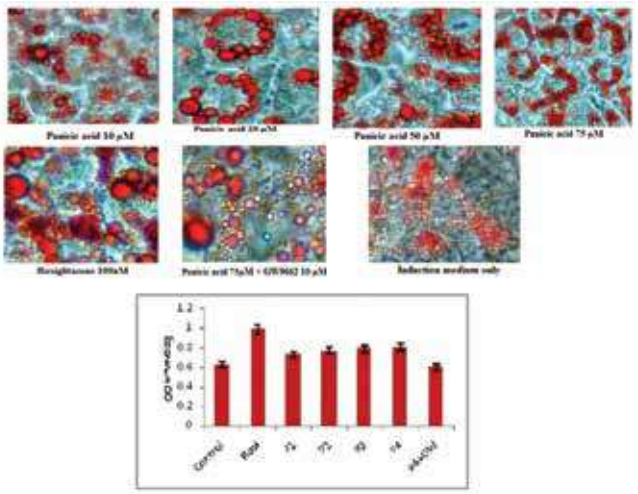


*Fig 14. Lipid accumulation in adipocytes: dose- dependent effect of punicic acid*

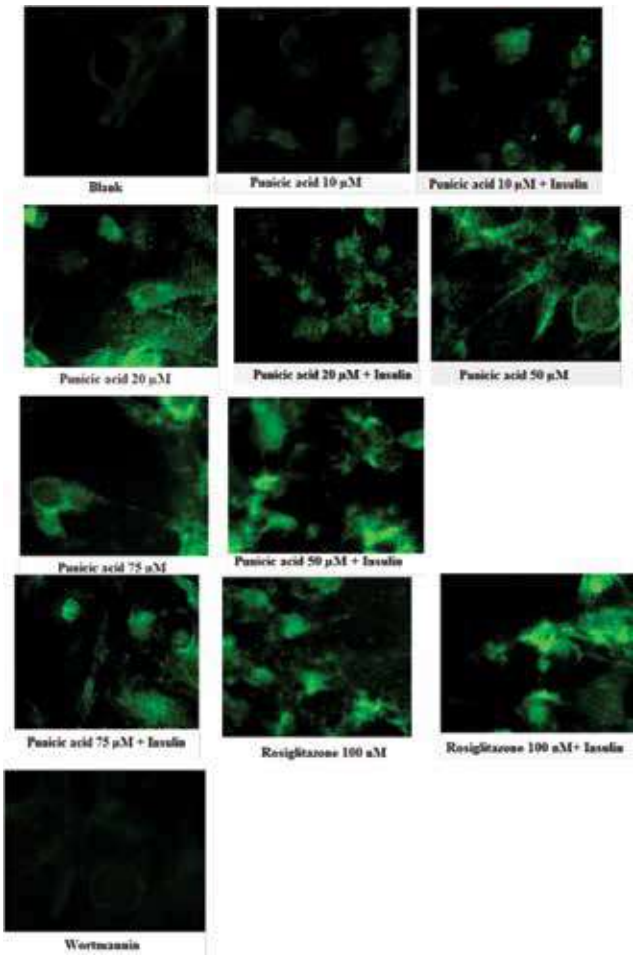



*Fig 15. Effect of Punicic acid on glucose uptake in adipocytes*

## Antioxidant properties of apple peel extract and its protective effect on arsenic trioxide induced toxicity in cardiomyocytes

Long term use of arsenic trioxide (ATO) for the treatment of acute promyelocytic leukemia (APL) leads to QT prolongation by increasing the intracellular calcium level and reactive oxygen species (ROS). To minimize the effects of ATO on cardiac cells, it is important to treat the cells with an antioxidant/calcium channel blocker to regulate the intracellular calcium level. The study evaluated the antioxidant activity of water extract of apple peel (AWE) and methanolic extract of apple peel (AME) in terms of TPC, TFC, DPPH, TRP, superoxide anion and hydroxyl scavenging assays. The effects of the extracts on ATO- stimulated H9c2 cells were studied by evaluating glutathione peroxidase, gluthathione, thioredoxin reductase, xanthine oxidase, caspase-3 activities, ROS generation and intracellular calcium. AWE showed greater antioxidant activity in *in vitro* biochemical assays, whereas AME was more effective in *in vitro* cell line based studies by reducing ROS and calcium overload. Thus, apple peel extract has significant protective effect on ATO induced cardiac toxicity.

## Involvement of mitochondrial superoxide in isoproterenol (ISO)-induced cardiomyoblast hypertrophy

Involvement of mitochondrial ROS in ISO-induced cardiomyoblast hypertrophy was detected by dihydroethidium labeling of cells in the presence of inhibitors of mitochondrial uniporter and mitochondrial pore opening. The flow chart given below shows the presumed mechanism of hypertrophying in ISO-treated cells. Moreover, mitochondrial superoxide production was measured using Mitosox red that distinctly labels mitochondria alone. Antimycin A, inhibitor of mitochondrial Complex III, increases mitochondrial superoxide formation in H9c2 cells and was used as the positive control. The relative fluorescence in ISO – treated H9c2 cells was found to be higher than control and antimycin- treated cells. This indicates the involvement of mitochondrial ROS in ISO-induced hypertrophy. Pretreatment with *Desmodium gangeticum* extract (DG) reduced Mitosox fluorescence in ISO- treated cells.

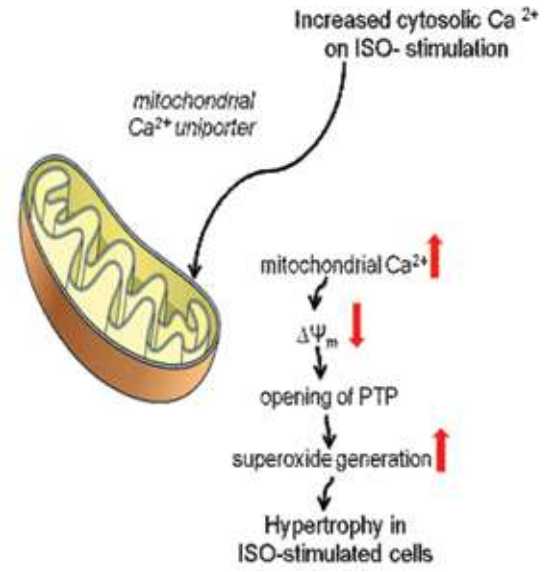



*Fig 16. Flow chart showing the presumed mechanism of hypertrophying in ISO-stimulated cells*

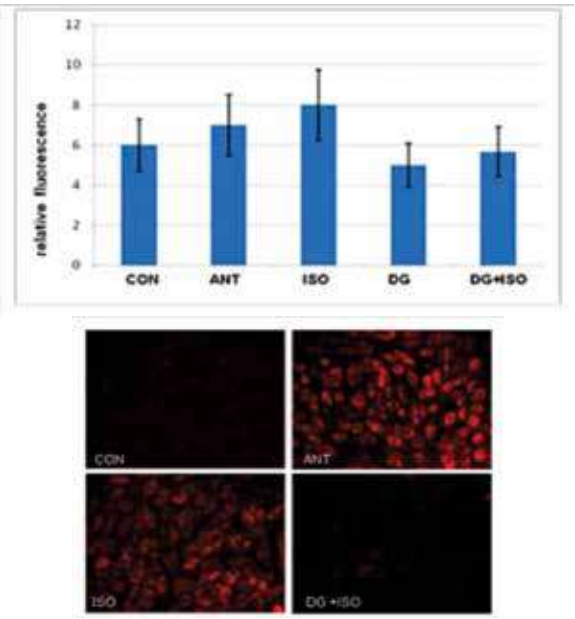



*Fig 17. A: Mitosox red fluorescence: Statistical graph showing relative fluorescence of control, antimycin (ANT), ISO, DG and DG+ISO; B: Confocal images of Mitosox red fluorescence*

## Antioxidant potential of vanadium encapsulated guar gum nanoparticle (GVN)

Synthesis, characterization and cell line based studies of GVN were carried out. The nanoparticles were prepared by the method of nanoprecipitation. *In vitro* antioxidant assays revealed the potent antioxidant efficacy of GVN when compared to guar gum nanoparticle and vanadium. GVN was subjected to different characterization studies like SEM, TEM and particle size analysis to confirm the characteristics of nanoparticle and encapsulation of vanadium. Physical characterization by particle size analysis revealed that GVN possess a size of 239 nm which was approximately 148 nm larger than guar gum nanoparticles, confirming vanadium encapsulation. The antioxidant property of GVN against tertiary butyl hydrogen peroxide- induced oxidative stress in H9c2 cell lines was carried out. Treatment with GVN protected cardiomyoblasts from the adverse effects of ROS generation, especially at 5nM and 25nM. Taken as a whole, GVN was found to be a potent ROS scavenger.

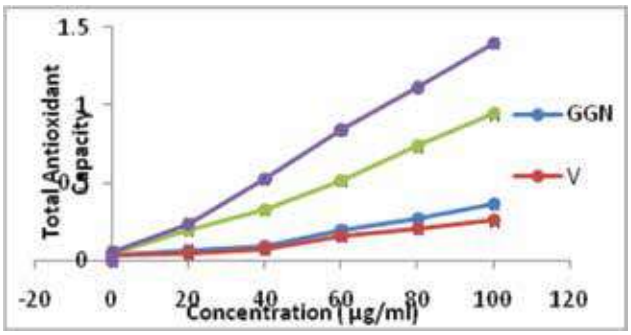
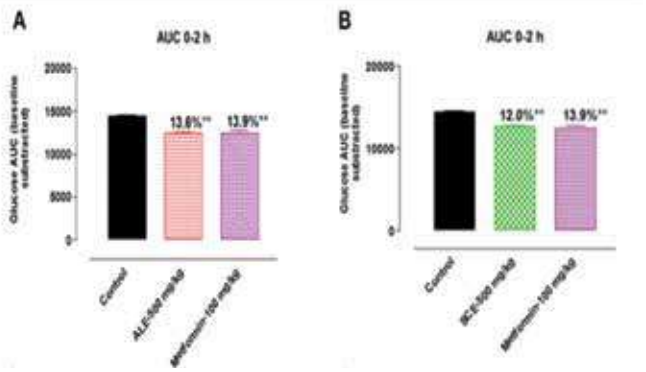



*Fig 18. Total Antioxidant Capacity of guar gum nanoparticle, vanadium encapsulated guar gum nanoparticle (GGN) and vanadium (V)*

## Evaluation of antihyperglycemic effect of selected medicinal plant extracts in *in vivo* diabetic models

***Experiments in Sucrose loaded rat model (SLM):*** Male albino rats of Sprague Dawley strain were selected for the study. The blood glucose level of each animal was checked using glucometer after 16 h starvation. Animals with blood glucose levels <270mg/dl were selected for the study. Animals of experimental group were administered suspension of the *Aerva lanata* (ALE) and *Symplocos cochinchinensis* (SCE) extracts made in 1.0% gum acacia (100, 250 and 500 mg/kg body weight) or 1.0% gum acacia orally. A sucrose load (10.0 g/kg) was given to each animal orally after 30 min administration of the test sample/vehicle. Blood glucose profile of each rat was again determined at 30, 60, 90 and 120 min post-administration of sucrose. Quantitative glucose tolerance of each animal was calculated by area under curve (AUC) method. AUC of experimental and control groups determined the percentage of antihyperglycemic activity.

***Experiments in Sucrose-challenged streptozotocin-induced diabetic rat model (STZ-S):*** Streptozotocin was injected intraperitoneally to overnight fasted Sprague Dawley rats (60mg/kg). Blood glucose level was checked after 72 h and animals showing blood glucose values >270mg/dl were selected and termed diabetic. Sample administration was carried out similar to that of the previous rat model. The results confirmed the antihyperglycemic effect of *Aerva lanata* (ALE) and *Symplocos cochinchinensis* (SCE). ALE exhibited 13.6% and 17.5% decrease of plasma glucose while SCE showed 12% and 23% decrease in SLM & STZ models, respectively.



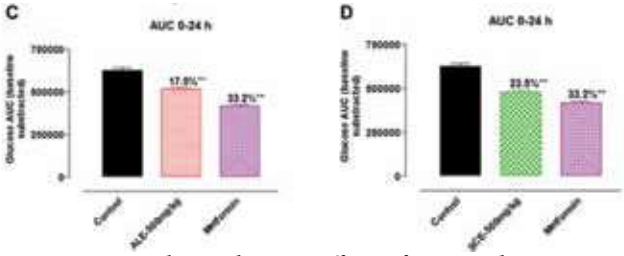



*Fig 19. Anti hyperglycemic effects of ALE and SCE. A & B shows the OSTT data for ALE and SCE in SLM rat model respectively. C & D depicts the OSTT data in STZ-S rat model*

## Studies on therapeutic effects of *Syzygium cumini*

The evergreen *Syzygium cumini* (Jamun) plant is abundantly found in Indonesia and India. *Syzygium cumini* is one of the widely used medicinal plants in the treatment of various diseases, in particular, diabetes. Due to the lack of strong scientific evidence, there is a need for further investigation to isolate active principles which confer the pharmacological action. In addition, detailed analysis is required to find out the mechanism through which these active compounds act against various diseases. Therefore, the present study evaluated the potential of *Syzygium cumini* seeds in the management of lifestyle associated diseases namely diabetes and CVD. Three wild varieties of *Syzygium cumini* seeds were collected from Trivandrum, Kerala, India (TVM variant), Trichy, Tamilnadu, India (TCH variant) and from Malampuzha, Kerala, India (MPA variant). Results of the study revealed that all extracts of *Syzygium cumini* seed showed potent anti oxidant capacity due to their high phenolic content. Total phenolic content increased in the following order for both the varients: Hexane< Ethyl acetate< Methanol< 70% Methanol. All these seed extracts showed significant α-glucosidase inhibitory activity, a potent target for controlling post prandial increase in glucose in diabetics. When compared with standard, acarbose (IC50 45.2 µg), all the varients showed potent antidiabetic activity. Methanol-TCH and 70% Methanol TCH extract showed significant antiglycating property when compared with the standard, ascorbic acid. Efficacy against CVD was evaluated by LDL oxidation inhibition assay. Except hexane extract, all other extracts showed significant LDL oxidizing inhibitory property.

## Flavonoids stimulates glucose uptake in L6 myotubes under oxidative stress induced by teritary butyl hydrogen peroxide

Oxidative stress plays a pivotal role in the development of diabetes complications. Evidence suggests that oxidative stress occurs in diabetes and its prolonged exposure may cause insulin resistance by triggering an alteration in cellular redox balance. The present study evaluates the antidiabetic potential of the flavonoids, Quercetin and Rutin using L6 myotubes under oxidative stress induced by teritary butyl hydrogen peroxide (tbhp). The results demonstrated that ROS generated by tbhp decreased markedly in the cells on preincubation with flavonoids in a dose dependent manner. Pretreatment of both compounds remarkably retrieved the GSH level which was drastically decreased on oxidative challenge. In addition, these flavonoids were found to prevent lipid peroxidation in L6 myoblast. Flavonoids increased glucose uptake in a dose dependent manner following chronic and acute pretreatment in the presence of oxidative stress induced by tbhp. GLUT4 expression was found to be upregulated significantly after quercetin and rutin pretreatment. It is proposed that in cellular model of skeletal muscle, chronic treatment of flavonoids, quercetin and rutin, imparts hypoglycemic effects by inducing GLUT4 expression under the influence of oxidative stress.

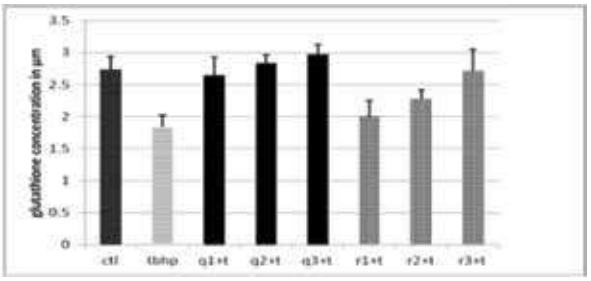



*Fig 20. Glutathione concentration after preincubation of quercetin and rutin (1µM, 10µM, 100µM) for 3 hours*

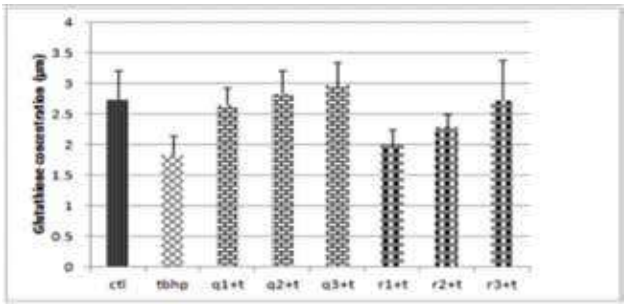



*Fig 21. Glutathione concentration after preincubation of quercetin and rutin (1µM, 10µM, 100µM) for 24 hours*

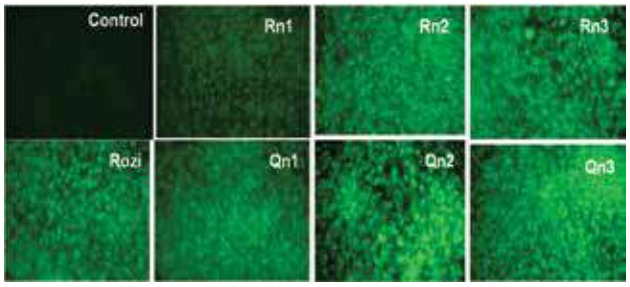



*Fig 22. Confocal images of differentiated L6 myoblast exposed to 2-NBDG: Control, Rozi, Rn1, Rn2, Rn3, Qn1, Qn2, Qn3 represents untreated, rosiglitazone, Rutin (1 µM, 10 µM, 100 µM), Quercetin (1µM, 10 µM, 100 µM), respectively.*

These findings suggest that quercetin and rutin posses the potential to reduce oxidative stress associated with diabetes either directly or indirectly by enhancing glutathione concentration. The results from the present study suggests that flavonoids in near future can be considered as an additional strategy in the treatment of Type2 diabetes imparting an optimal control in glucose level in parallel to improve diabetes related impairments.

## Anticancer and antioxidant potential of rice and wheat bran extracts

Free radical-induced oxidative stress is the basis of many of the chronic human diseases. Cell's antioxidant mechanism fails to quench the excess free radicals generated during diseased conditions. Free radical damage to DNA may lead to cancer owing to the unregulated cell division. Due to the adverse effects of synthetic antioxidants, naturally occurring antioxidant supplements from plants are vital to counter the oxidative damage in cells. Bran is the hard outer layer of grain and is a rich source of natural antioxidants which can be used as free radical scavengers. The main objective of the present study was to evaluate and compare the antioxidant and anticancer potential of rice and wheat bran. In the present study, the defatted bran was extracted with ethyl acetate and methanol. The rice bran extracts showed maximum yield when compared to wheat bran extracts. The antioxidant potential of the extracts was assessed in terms of TPC, CUPRAC, DPPH and NO scavenging activity assays. The phenolic content was higher for methanolic extract of rice bran and wheat bran (6.5 and 4.7% respectively). The cupric ion reducing capacity was higher for methanolic extracts of rice bran and wheat bran (10.51 and 5.91in terms of TEAC, respectively). In the case of DPPH radical scavenging activity, the ethyl acetate extract of rice bran was found to be more active (IC50- 249.97µg). In the case of NO radical scavenging activity, the ethyl acetate extract of rice bran extract exhibited maximum activity (IC50- 349.35µg). The extracts were further evaluated for their anticancer potential in terms of MTT, LDH and Comet assays using HT29 colon cancer cell line. The cytotoxic effect of extracts was evaluated using MTT assay. The result showed that the toxicity is time and dosage dependent and it was found that 99.16µg of RB ethyl extract was sufficient to inhibit 50% cells at 24h incubation. The effect of extracts on membrane integrity of HT29 cell line was evaluated using LDH assay. The LDH release was maximum for ethyl acetate extract of rice bran. Only ethyl acetate extract of rice bran and wheat bran were studied for comet assay. The rice bran extract was found to be more active. From the present study it is clear that the rice bran and wheat bran are rich in phytochemicals having antioxidant and anticancer potential. These results form a good basis for selection of the rice bran and wheat bran for further phytochemical and pharmacological investigation.

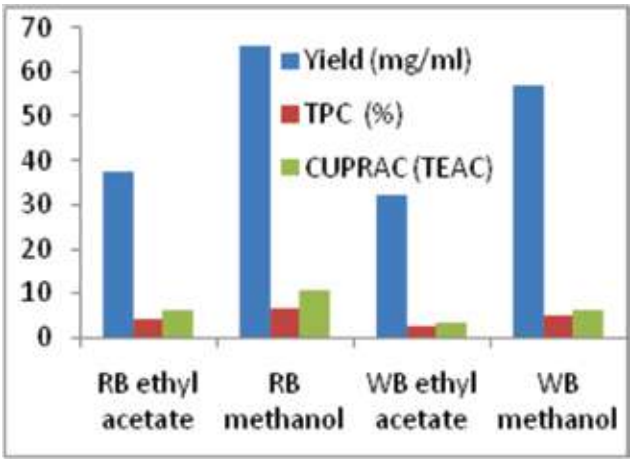



*Fig 23. The yield, TPC and CUPRAC of different extracts of RB and WB*

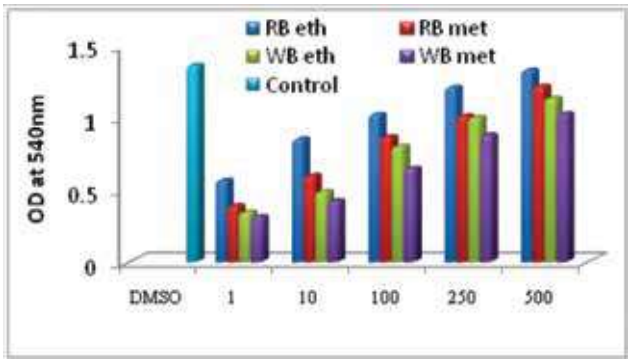



*Fig 24. LDH release assay of the extracts*

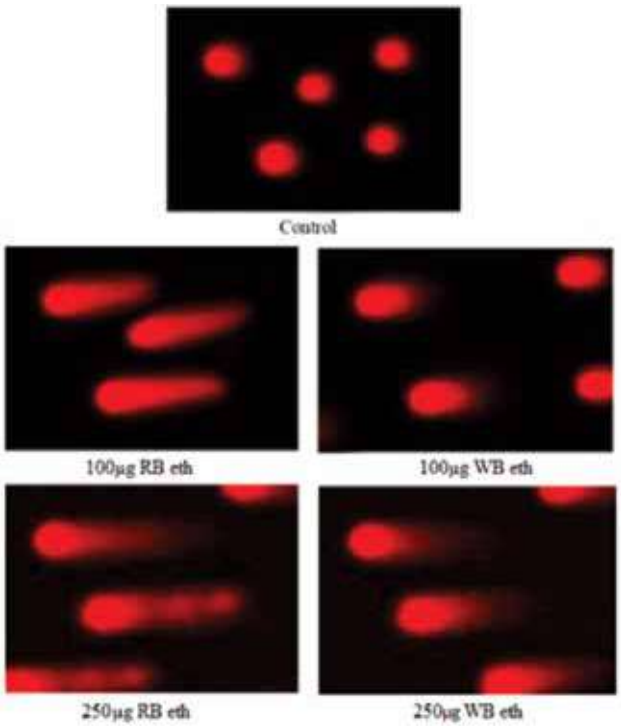



*Fig 25. Comet assay for rice bran and wheat bran ethyl acetate extracts*

## A comparative evaluation of antioxidant and antidiabetic potential of potato peels at different stages of maturity

Antioxidant and antidiabetic potentials of potato peels at two stages of maturity (young and mature) were evaluated and compared in the present study. The peels of young and matured potatoes (YP and MP) were extracted sequentially with hexane (HMP, HYP), ethyl acetate (EMP, EYP) and methanol (MMP, MYP). Ethyl acetate extract of the peels were found to possess highest total phenolic content (TPC) (83.2 and 44.14 mg GAE/g dry weight for EMP and EYP, respectively). Ethyl acetate and methanol fractions of the peels showed maximum radical scavenging efficacy for different antioxidant assays performed. EYP demonstrated better α-glucosidase inhibition activity (IC50-197.13µg), intra cellular ROS scavenging and also induced glucose uptake by the L6 rat skeletal muscle cells indicating the presence of significant antioxidant and antidiabetic potential. Presence of phenolic compounds (gallic, caffeic, ferulic and chlorogenic acids) in the active extracts were established using HPLC. The study indicated that YP exhibited better bioactive potential as compared to MP, which could be a good source of bioactive phytochemicals with antioxidant and antidiabetic potential.

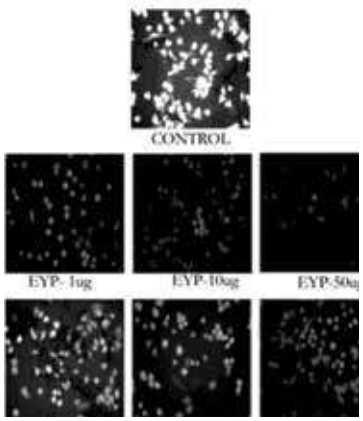



*Fig 26. Confocal images of intracellular ROS scavenging by ethyl acetate (EYP) and methanol (MYP) extracts of young potato peel*

# BIOTECHNOLOGY DIVISION

The Biotechnology Division is actively involved in research and technological development in the focussed areas for bioprocesses and products development, exploring and exploiting the microbial resources, isolated chiefly from the Western ghats in Kerala. The research is focussed on the fundamental and applied aspects for the production of industrial enzymes, biofuels, amino acids, biopolymers, biosurfactants, etc for industrial applications. The Division has undertaken several new projects under the 12th Five Year Plan in collaboration with several other institutes of CSIR and also inter-divisional collaboration in the institute in the areas of affordable health and energy. The Division is participating in the projects under the Chemical Sciences Cluster as well as Biological Sciences Cluster of CSIR.

During 2012-13, two new scientists have joined the Division, who have expertise in the areas of microbiology (microbial biodiversity and taxonomy) and biochemical engineering (bioreactor design and operation). The Division has undertaken an important industrial project on 'Bioprocesses Development for Industrial Products' in partnership with a leading industry in the country and another major project on 'Sorghum biomass based biorefinery' as a multi-institutional collaborative project supported by the Ministry of New and Renewable Energy.

Followings are the highlights of Divisional R&D activities:

- Under the Centre for Biofuels, the pilot plant for the production of bioethanol from lignocellulosic biomass has been put up.
- Studies on the molecular cloning, over-expression and biochemical characterization of hypothetical betalactamases of *M. tuberculosis* (Rv2068c, Rv0406c and Rv3677c) revealed the possibility of more than one gene in *M. tuberculosis,* encoding proteins having beta-lactamase or beta-lactamase-like activity, giving wide spectrum of resistance against beta-lactams.
- *Lactobacillus plantarum* (NIIST isolate) produced an EPS with prominent characteristic groups corresponding to polyhydric alcohols. The degradation temperature (Td) of the polysaccharide was found to be 260°C, which consisted of a trisaccharide repeating unit of α-D-glucose, β-D-glucose and α-D-mannose.
- Studies on the mutation of cloned L-asparaginase II gene by site-directed mutagenesis and expression and purification of the mutants showed that compared to the wild enzyme and positively charged control mutant, K139A and K139D had tolerance towards 70°C and 20% more activity retention on thermal stability at 50°C.
- In order to develop thermo stable and low pH tolerant phytase from *Aspergillus niger* using site-directed mutagenesis, phytase A from *A. niger* NII 08121 was recombinantly expressed in *Kluyveromyces lactis*.
- A novel *Streptomyces* sp produced cellulase-free xylanase, which was optimally active at pH 8.0 and temperature of 50°C. The enzyme was stable at high alkalinity (up to pH 12.0).
- A novel surfactant-assisted ultrasound pretreatment was developed, which could effectively remove hemicelluloses and lignin and improve the reducing sugar yield from sugarcane tops.
- A novel super acid treatment using Nafion was developed, which selectively solubilized the cellulose and hemicelluloses of lignocellulosic biomass, and the hydrolyzate obtained after this treatment was devoid of fermentation inhibitors such as HMF and furfural.
- A novel ustilaginomycetes yeast, *Pseudozyma* sp. NII08165 produced exopolysaccharide which had typical polymer structure of carbohydrate, with monomers of glucose, galactose and mannose in the ratio of 2.4:5.0:2.6, respectively.
- A new Gram-negative, aerobic, halophilic, non-motile and rod-shaped bacterial strain, P2E16T, isolated from a mangrove rhizosphere and named as *Zunongwangia mangrovi sp*.

# जैव प्रौद्योगिकी प्रभाग

जैव प्रौद्योगिकी प्रभाग, जैवप्रक्रियाओं और उत्पादों के विकास के लिए ध्यान केंद्रित क्षेत्रों में अनुसंधान तथा तकनीकी विकास, मुख्यतः केरल के पश्चिमी घाट से अलग किए माइक्रोबियल संसाधनों की खोज और संदोहन में सक्रिय रूप से लगे हुए है। औद्योगिक अनुप्रयोगों के लिए औद्योगिक एंजाइमों, जैव ईंधन, अमीनो एसिड, जैवपॉलिमरों, जैव सर्फेक्टेंट, आदि के उत्पादन के लिए मौलिक और अनुप्रयुक्त पहलुओं पर अनुसंधान केंद्रित है। प्रभाग ने सस्ती स्वास्थ्य और ऊर्जा के क्षेत्र में 12वीं पंचवर्षीय योजना के तहत कई अन्य सीएसआईआर संस्थानों के सहयोग से और संस्थान में अंतर- प्रभागीय सहयोग से कई नई परियोजनाएं शुरू की हैं। प्रभाग सीएसआईआर के रासायनिक विज्ञान क्लस्टर तथा जीव विज्ञान क्लस्टर के तहत परियोजनाओं में भाग ले रहे हैं।

वर्ष 2012-13 के दौरान, माइक्रोबायोलॉजी (माइक्रोबियल जैव विविधता और वर्गीकरण) और जैव रासायनिक इंजीनियरिंग (बायोरिएक्टर डिजाइन और आपरेशन) के क्षेत्रों विशेषज्ञता प्राप्त दो नए वैज्ञानिक प्रभाग में शामिल हो गए। प्रभाग ने देश के एक प्रमुख उद्योग के साथ साझेदारी में 'औद्योगिक उत्पादों के लिए जैवप्रक्रियाओं के विकास' पर एक महत्वपूर्ण औद्योगिक परियोजना तथा नवीन और नवीकरणीय ऊर्जा मंत्रालय द्वारा समर्थित 'सोरगम बायोमास आधारित जैव रिफाइनरी' नामक एक अन्य प्रमुख बहु संस्थागत सहयोगी परियोजना शुरू की है।

प्रभागीय अनुसंधान एवं विकास गतिविधियों के मुख्य आकर्षण निम्न हैं:

- जैव ईंधन केंद्र के तहत लिग्नोसेलूलोज़िक बायोमास से जैवइथेनॉल के उत्पादन के लिए प्रायोगिक संयंत्र स्थापित कर दिया गया है।
- *एम. ट्यूबरकुलोसिस* (Rv2068c, Rv0406c and Rv3677c) के परिकल्पित बीटा लैक्टामेज़स के आणविक क्लोनिंग, अति अभिव्यक्ति और जैव रासायनिक अभिलक्षण पर किये गये अध्ययन ने *एम. ट्यूबरकुलोसिस* में एक से अधिक जीन, बीटा लैक्टामेज़ या बीटा लैक्टामेज़ के तरह की गतिविधि होनेवाले एन्कोडिंग प्रोटीन की संभावना को व्यक्त किया है, जो बीटा लैक्टम्स के खिलाफ प्रतिरोध के लिए व्यापक स्पेक्ट्रम दे रहे हैं।
- *लैक्टोबैसिलस प्लान्टारम* (एनआईआईएसटी इसोलेट) ने प्रमुख विशेषता समूहों के साथ पॉलीहाइड्रिक एल्कोहॉल सदृश एक्सोपोलीसैकेराइड (ईपीएस) का उत्पादन किया। पॉलीसैकेराइड का गिरावट तापमान (टीडी) $260^0$ सें. पाया गया, जिसमें $\alpha$-D-ग्लूकोज, $\beta$-D-ग्लूकोज और $\alpha$-D- मन्नोस की एक ट्राइसैकेराइड दोहराई जाने वाली इकाई शामिल थी।
- साइट निर्देशित उत्परिवर्तजनन द्वारा क्लोन किये एल- ऐस्पैरजाइनेस II जीन के उत्परिवर्तन पर किये अध्ययन तथा म्यूटेंट की अभिव्यक्ति और संशुद्धि ने सूचित किया है कि जंगली एंजाइम तथा घन आविष्ट नियंत्रण उत्परिवर्ती की तुलना में, के 139ए तथा के 139 डी को $70^0$ सें. की ओर सहिष्णुता है और $50^0$ सें. थर्मल स्थिरता पर 20% ज्यादा गतिविधि प्रतिधारण है ।
- साइट निर्देशित उत्परिवर्तजनन का उपयोग करके *ऐस्पर्जिलस नाइजर* से थर्मो स्थिर और कम पीएच सहिष्णु फाइटेस को विकसित करने के लिए *क्लुवेरोमइसेस लाक्टिस* में *ऐस्पर्जिलस नाइजर* एन II 08121 से फाइटेस ए का पुनर्योगज रूप में अभिव्यक्त किया गया ।
- एक नूतन *स्ट्रेप्टोमइसीज़* स्पीशीज़ ने सेलुलेज़ मुक्त जाइलानेज़ का उत्पादन किया, जो पीएच 8.0 तथा $50^0$ सें. तापमान में बेहतर सक्रिय था। उच्च क्षारीयता 12.0 (पीएच तक) पर एंजाइम स्थिर था।
- एक नूतन सर्फैक्टेंट से सहायता प्राप्त करके एक अल्ट्रासाउंड पूर्वोपचार विकसित किया गया, जिसके माध्यम से हेमीसेलुलोज़ और लिग्निन प्रभावी ढंग से हटाया जा सकता है और गन्ना टॉप से चीनी की उपज की कमी को सुधार किया जा सकता है ।
- नाफीऑन का उपयोग करके एक नूतन सुपर एसिड उपचार विकसित किया गया, जिसने लिग्नोसेलूलोज़िक बायोमास से सेलूलोज़ और हेमीसेलूलोज़ को चयनात्मक रूप से विलेयीकरण किया और इस उपचार के बाद प्राप्त जल-अपघटज एचएमएफ, फ़रफ्यूरल जैसे किण्वन अवरोधकों से रहित था।
- एक नूतन उस्टिलागिनोमाइसीटीज़ खमीर, *स्यूडोज़ामा* स्पीशीज़ एनII 08165 ने एक्सोपॉली सैकेराइड का उत्पादन किया जिसे ग्लूकोज के एकलकों, गैलेक्टोज और मन्नोस के साथ क्रमशः 2.4:5.0:2.6 के अनुपात में कार्बोहाइड्रेट की विशिष्ट बहुलक संरचना थी ।
- एक नूतन ग्राम नेगेटिव, एरोबिक,लवणरागी, गैर-गतिशील एवं छड़ के आकार के बैक्टीरियल स्ट्रेन P2E16T, को एक मैन्ग्रोव राइजोस्फियर से अलग किया गया और इसे *ज़ुनोंग्वानिया मन्ग्रोवी* स्पीशीज़ नाम दिया गया।

# BIOPROCESSES AND PRODUCTS DEVELOPMENT

## Industrial enzymes

**Cloning and over-expression of aminopeptidase P gene from *Streptomyces lavendulae*:** Studies were continued on the molecular cloning and overexpression of aminopeptidase P (APP) gene from *Streptomyces lavendulae* (ATCC 14162) in *E. coli,* followed by its purification and biochemical characterization. Based on the N-terminal amino acid sequences, the gene corresponding to APP (*app*) was amplified from *S. lavendulae,* was cloned in pET 28 (a) and over-expressed as a His-tagged protein in *E. coli* BL21DE3 using 1 mM IPTG. Nucleotide sequencing of this gene revealed a 1464 bp open reading frame encoding a 488 amino acid (NCBI Accession No: GenBank: KC292272.1). The substrate specificity of the expressed aminopeptidase P was analyzed by the hydrolysis of the Xaa-Pro bond in Gly-Pro dipeptide and bradykinin (Figure 1). Km and Vmax of the enzyme was 0.4793 mmol $l^{-1}$ and 0.6361, respectively. The APP activity was enhanced in the presence of divalent metal ions such as $Co^{2+}$, $Mn^{2+}$, $Mg^{2+}$ and $Cu^{2+}$ ions and got inhibited with 1, 10 phenanthroline, EDTA, PMSF and DTT. The *app* gene of *S. lavendulae* shared the identical features of the same gene from other *Streptomyces* species. The enzyme was a substrate specific metalloenzyme with an optimum pH of 8.0 at 37°C. The presence of proline residues in the second position of the N-terminus in peptides restricts the usage of many aminopeptidases; however, aminopeptidase P, one of the coupled enzymes for proline aminopeptidase activity, is capable of removing this blockage.

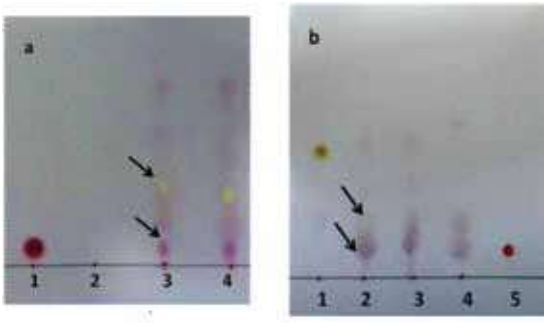
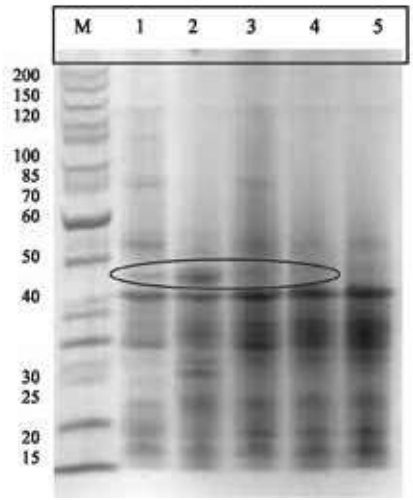



*Figure 1. TLC plate image showing substrate specificity of APP. Plate A- Bradykinin (Arg-Pro-Pro-Gly-Phe-Ser-Pro-Phe-Arg) degradation by APP 1- Arginine standard 2- Bradykinin 3 and 4- Bradykinin plus APP. Plate B- Hydrolysis of the substrate Gly-Pro-pNA by APP 1- Gly-Pro-pNA 2,3 and 4- Gly-Pro-pNA plus APP 5- Glycine standard*

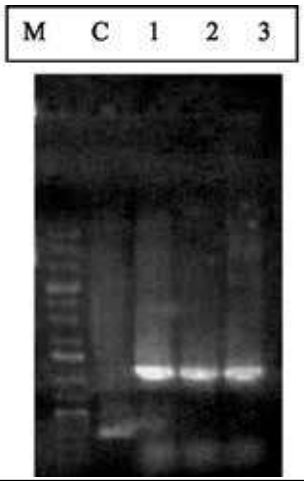
**Cloning and production of a genetically improved L-asparaginase from *Escherichia coli:*** L-asparaginase II is a widely used therapeutic enzyme for the treatment of selected types of haematopoietic diseases such as acute lymphoblastic leukemia and non-Hodgkin lymphomas. Asparaginase hydrolyzes L-asparagine to L-aspartic acid and ammonia in leukemic cells, resulting in the depletion of asparagine, inhibition of protein synthesis, cell cycle arrest in the G1 phase, and apoptosis in susceptible leukemic cell populations. The site-directed mutagenesis and chemical modifications can be used to produce an enzyme with better half-life and thermo stability. An enzyme with increased half life will be stable in blood than the normal enzyme, thus the frequent administration of the drug can be avoided. This work aimed to over-express the *E. coli* L-asparaginase in suitable expression systems such as prokaryotic and yeast system and to improve the characteristics by site-directed mutagenesis. The *ansB* gene of *E. coli* MTCC 739 was isolated by PCR amplification and cloned into pET20b expression vector and pPinkHCalpha (*Pichia* system). The cloned gene in pET20b was expressed in BL21DE3 host cells and the expressed protein was purified using Ni-NTA spin column by 6x His affinity tags (Figure 2). The cloned gene in pPinkHCalpha was

transformed to *Pichi*a pink cells by electroporation (Figure 3). The work is progressing towards confirmation of yeast clones and analysis of expressed glycosylated proteins in yeast.




M – Molecular weight marker (Fermentas)
1 – Uninduced control
2-5 – samples induced with 10, 50, 100 and 400 μ*M* IPTG

*Figure 2. SDS PAGE analysis of expressed soluble fractions Banding pattern of soluble cytosolic fractions of uninduced and induced samples*




M – Gene ruler 1kb plus ladder
Lane C – PCR amplification from the control plasmid
Lane 1 – PCR amplification from the clone plasmid S8
Lane 2, 3 - PCR amplification from the clone plasmids T2 and T3

*Figure.3. Yeast clone confirmation by PCR. The plasmids which showed an up shift in electrophoretic mobility was amplified with vector specific primers along with the control plasmid pPinkHCα*

**Recombinant expression of L-asparaginase II from *Escherichia* sp and property improvements through amino acid substitutions:** This work aimed to study the mutation of cloned L-asparaginase II gene by site-directed mutagenesis and expression and purification of the mutants. The mutated purified protein was studied for properties such as thermal tolerance and stability. 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 (Figure 4). The surface electrostatic potential maps of both wild and mutant proteins analysed using PyMO showed that alanine and asparatate substitution at position 139 resulted in localized negative charge density surrounding the residue than the positive potential in wild protein (Figure 5). The hydrogen bonds formed by all these mutants checked in PyMOL and swiss PDB viewer, which showed the absence of any additional hydrogen bonds formed in any of the improved mutants. Hence, it could be concluded that it was the surface charge interaction which contribute to the stability of the mutants.

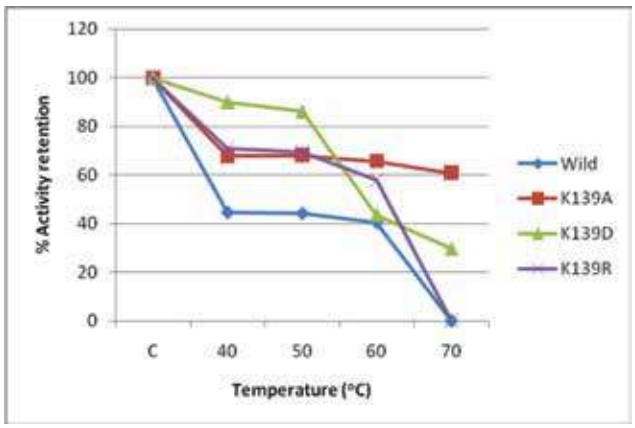
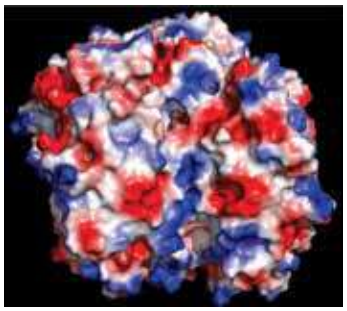
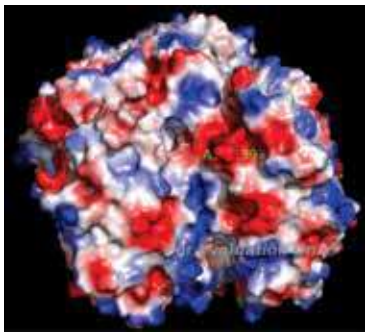


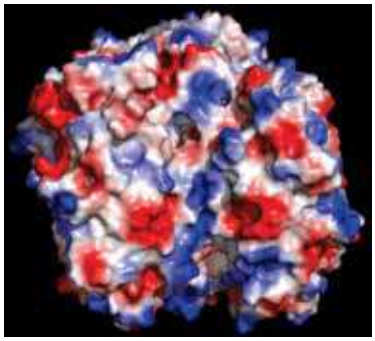

*Figure.4. Thermal tolerance of mutants at position 139 : themperature stability of wild and mutant proteins incubated at 40 - 70 °C for 10 minutes and residual activity retention compared to untreated control (C- 100%)*



**K139 A**



**K139D**



**Wild**

*Figure 5. Surface electrostatic potential map of mutant K139A, K139D and wild protein: compared to the wild protein map, in both of the mutants a positive potential is distributed around the site of mutation*

**Development of thermostable and low pH tolerant phytase from *Aspergillus niger* using site-directed mutagenesis**: Phytase A from *A. niger* NII 08121 was recombinantly expressed in *Kluyveromyces lactis*. Enzyme from culture supernatant was purified by hydrophobic interaction chromatography and ion exchange chromatography. Heterologously expressed enzyme showed an optimum activity at temperature 55°C and temperature tolerance up to 100°C. This enzyme possessed characteristic bi-peak pH optima at 2.5 and 5.5. In order to determine the thermostability, enzyme was incubated at 70, 80, 90 and 100°C for different time intervals and residual activity was analyzed after refolding the protein in ice for 30 minutes. Enzyme possessed considerable thermo stability which is desirable for its use in feed industry. Enzyme retained more than 40% activity after incubation at 90°C for 1h and retained more than 20% activity after incubation at 100°C for 1h.

The pH profile of this enzyme showed reduced activity at pH range 3 to 3.5, which was the pH prevalent in gut of monogastrics. Hence, site-directed mutagenesis was carried out by substituting amino acid with charge alteration at targeted sites. Constructed mutant plasmids were sequenced to confirm base changes, restriction digested with SacII and transformed into yeast. One of the mutants with histidine replacement in place of proline at position 212 showed increased activities at pH 3 to 3.5 compared to wild enzyme (Figure 6). When analyzed in Swiss PDB viewer, residue 212 was positioned at 10A° distance to D362 and 14A° distance from H82 which are the catalytic residues (Figure 7). Change in pKa of catalytic residues in homology modeled structures of wild and mutant proteins were determined by pKa calculation software package PROPKA. Proline substitution resulted in change in pKa of H82 from 0.61 to 0.64 while pKa of catalytic residue D362 was changed to -0.14 from -0.12. In addition this substituted histidine resulted in formation of three hydrogen bonds with surrounding residues (Figure 8). Since amino acid substitution near to active site resulted in shift in pKa of acid/base catalyst and change in pH profile of enzyme, five more mutants were constructed by charge alteration in ionizable residues positioned 12A° distance to catalytic residues. Effect of this replacement on pKa change was studied, and effect of this replacement on pH profile of enzyme is currently under study.

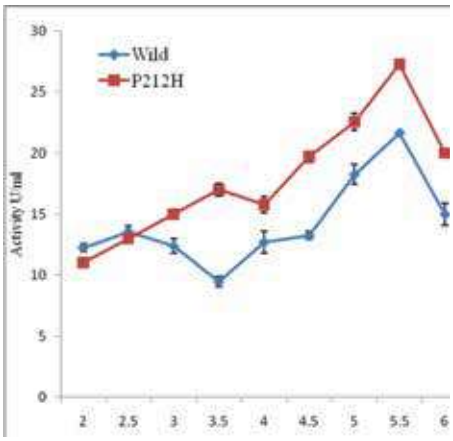
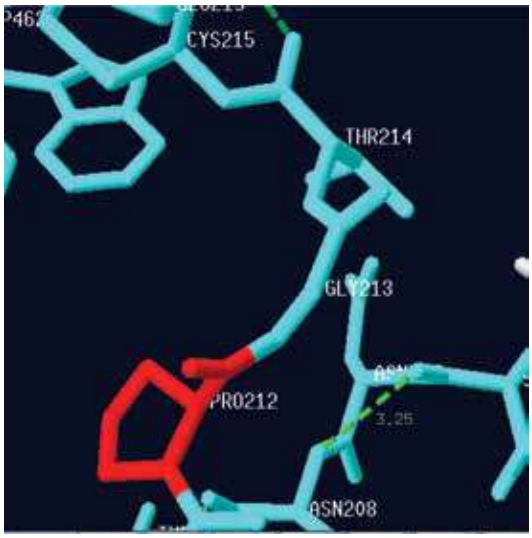
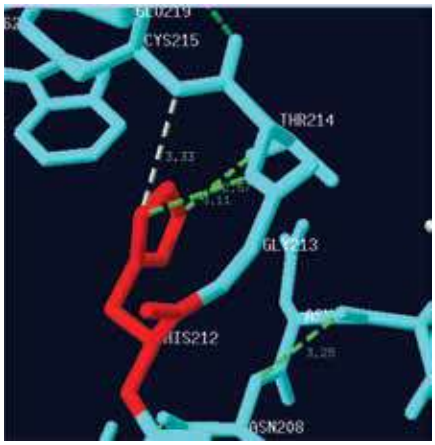



*Figure 6. pH profile of wild and mutant enzyme*

*Figure 7 Modeled structure of phyA showing residues 14A⁰ to catalytic residues*




A




B

*Figure 8. Hydrogen bonds in wild and mutant: A) wild and B) mutant P212H*

**Molecular cloning, expression, characterization and production of novel xylanases:** A novel *Streptomyces* strain producing cellulase-free xylanase was isolated from the soil samples collected from the mangrove forest of Kadalundi, Kerala, India. The culture produced cellulase-free xylanase, which was optimally active at pH 8.0 and temperature of 50°C. The enzyme was stable at high alkalinity (up to pH 12.0). The enzyme retained almost 85% activity up to 65°C. When the temperature was increased to 70°C, a decrease in activity was observed (65% of the activity retention). Partial gene amplification as well as partial purification of enzyme was carried out to characterize the enzyme (Figure 9). Zymogram and protein staining of native PAGE gel showed four different isoforms of xylanase detected by congo red staining (Figure 10).

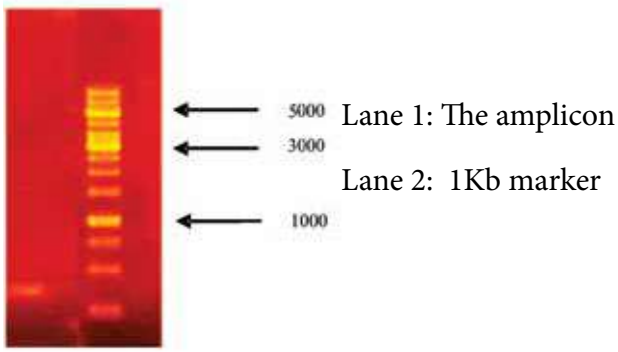



*Figure 9. Partial gene amplification and purification*

Lane 1 - 4: Partially purified protein

*Figure 10. Native gel zymogram showing isoforms of the xylanase*

**Microbial production of chitin degrading enzymes:** The current work involved the isolation of chitinase producing microbial cultures from the soil and water samples collected from the coastal regions of south Kerala. Of the 160 cultures screened for chitinase production, a *Streptomyces* sp. showed the highest chitinase production. Further optimization of the bioprocess parameters including pH, temperature, nitrogen source, media composition, etc. for maximum enzyme production showed the highest level of chitinase production (102 U) using 13g/l colloidal chitin, 8g/l yeast extract, with initial pH of 6.5, at 30°C and 200 rpm shaking for 72h of incubation.

**Development of a heterologous protein expression system in filamentous fungus:** A protein expression system was developed for the expression of heterologous proteins in a fungal host. An efficient inducible promoter and secretion signal of a highly expressed gene from filamentous fungus (cellobiohydrolase (CBH1) promoter & secretion signal from *Trichoderma reesei*) was cloned and an expression cassette was constructed with the gene for Green Fluorescent Protein (GFP) ligated down stream of the promoter and secretion signal; a termination signal was also attached. The expression cassette was tested in *Kluveromyces lactis* after incorporating the cassette in a pKlac expression vector by knocking down its promoter system. Successful expression of GFP proved the functionality of the expression system developed. Expression of cbh1 promoter was analysed by SDS PAGE and fluorescent intensity analysis. Efficiency of fungal secretion signal for driving heterologous protein in yeast system was also analysed and proved that the signal is a promising candidate for driving heterologous protein production. The fungal expression cassette was linked to a selection marker cassette for selection of transformants (Figure 11).

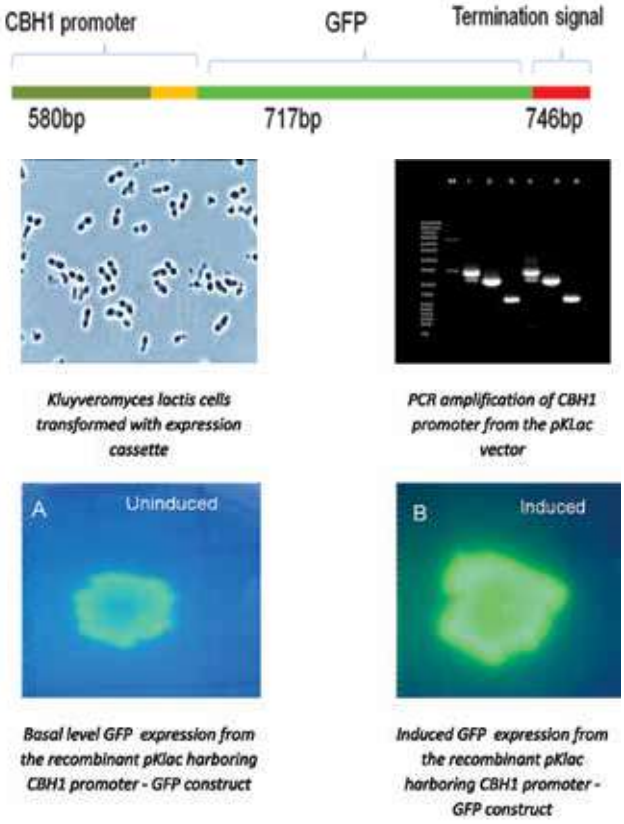



*Figure 11. Functional validation of CBH1 promoter in Kluyveromyces lactis by GFP expression*

## Amino acids

**Lysine production from biomass hydrolyzates using *Corynebacterium glutamicum*:** The prime objective of this study was to utilize the locally available agro- residual biomass for the production of the lysine by *Corynebacterium glutamicum*. Sev-

eral feedstocks, viz. cassava bagasse, jack fruit seed powder, wheat bran, coconut oil cake, potato peel and sorghum were hydrolyzed and fermented using *C. glutamicum* DM1729. The Plackett-Burman experimental design studies revealed that among the eleven variables studied, initial sugar concentration, pH, ammonium sulphate concentration were crucial variables for lysine fermentation.The shake flask experiments gave a lysine yield of 0.14g/g reducing sugar using jackfruit seed hydrolyzate. Experiments in parallel fermenter (300 ml working volume, $pO_2$: 90%) gave lysine yield of 0.13g/g reducing sugar. From the fermentation broth, lysine was successfully purified using ion exchange chromatography (with cation exchange resins such as Seralite SRC 120, Seralite WRC 50 and ammonia as the eluent).

## Sugar and chiral alcohols

**Biotransformation of agro-residual biomass to sugar alcohols using genetically modified *Corynebacterium glutamicum:*** A new study has been undertaken on the production of sugar alcohols using genetically engineered *C. glutamicum*. Heterologus expression of xylose reductase (*E. coli*), arabinose isomerase (*E. coli*), psicose 3 epimerase (*A. tumefaceans*) and xylulose reductase (*M. smegmatis*) genes together in *C. glutamicum* can help in the conversion of both arabinose and xylose to xylitol, thus achieving a total conversion of both pentose and hexose sugar to xylitol and mannitol, which has not been achieved so far. Based on the sequences available in NCBI, specific primers were designed and targeted genes were amplified. The amplicons sequenced using Sanger's dideoxy termination method and were confirmed by NCBI-BLAST.

**Stereo selective production of chiral alcohol using microbial oxidoreductase:** This study aims the production of ethyl (S)-4-chloro-3-hydroxy butyrate, (S)-(-)-1-(1-napthyl) ethanol and ethyl S-4-chloro-3-hydroxybutyrate through biotransformation using appropriate ketones. Screening of 169 soil isolates were done, which resulted four cultures showing positive growth in ethyl 4-chloroacetoacetate plates.

## Biopolymers

**Microbial degradation of the solid waste (polylactide plastics):** The concept of biodegradable plastics is of considerable interest with respect to solid waste accumulation and greater efforts have been made in developing degradable biological materials without any environmental pollution to replace oil-based traditional plastics. In the family of biodegradable synthetic polymers, poly lactic acid (PLA), an aliphatic polyester and biocompatible thermoplastic, is currently the most promising and it has become the 'green' environmental friendly material with the brightest development prospect because of its facile availability, good biodegradability and good mechanical properties. The aim of this study was to screen diverse soil samples and to isolate microorganisms capable of degrading PLA and to investigate the biodegradability of PLA after discarding in natural conditions and also in controlled laboratory conditions. Two actinomycetes (GA, DA), two bacteria (strain 8 and 14) and three fungal cultures were found to be potent degraders of PLA. A consortium was developed for degrading PLA. Composting studies were conducted with single cultures as well as with the biocompatible consortium (Figure 12). Initial studies were done in Laboratory environment in conical flasks with autoclaved soil samples and 100mg PLA film and with potent isolates alone and in combinations. The parameters used for the monitoring of degradation include variation in Lactic acid concentration, pH, dry cell weight and residual PLA film weight

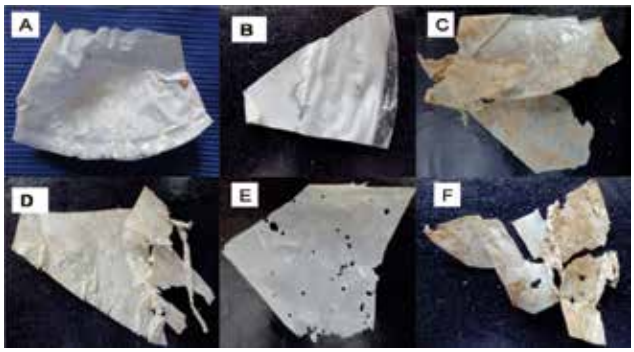
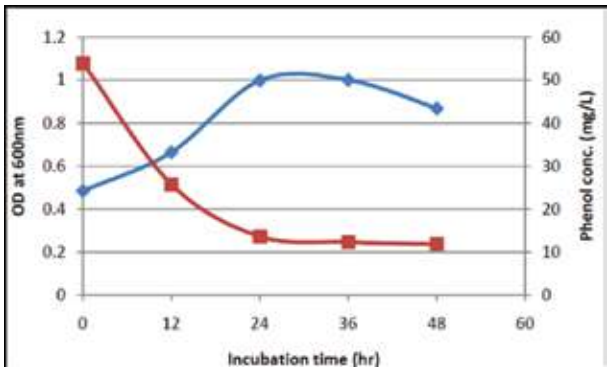



*Figure 12. Biodegradation of PLA film under composting after 20 days (A: PLA film before inoculation; B-E: degradation by individual isolates F: using consortium)*

### Encapsulated microorganisms for environmental protection

Phenol and its derivatives are common constitutes of industrial wastewater and toxic to human and the environment. Removal of phenolic waste from the industrial effluents is of great concern and biodegradation by microorganism can be envisaged as a green alternative. This work aimed in isolating microbial strains capable of degrading phenols and phenolic compounds, which resulted 26 unidentified isolates in two different growth media. Out of these, 10 isolates were able to degrade and grow in the presence of phenol (300 mg/L) in 48 h. Five potential phenol degrading microorganism were co-cultured (in equal amounts of cells). The resulting consortia retained the phenol degrading ability (Figures 13A & B). Experiments are in progress to make use of phenol degrading consortia for its ability to degrade other phenol derivates from specific industrial effluents.

A




B

*Figure 13. Phenol degrading consortia (A); phenol degrading potential versus growth (B)*

## BIOFUELS & BIOREFINERY

### Sorghum stover-based biorefinery for fuels and chemicals

Sorghum is a highly productive, short rotation agricultural crop with low water requirement, able to produce large quantity biomass with high nutritional content grains. Sorghum is also now proving as a commercially feasible and sustainable feedstock for renewable energy. A network project has been undertaken by NIIST (as coordinator) for developing an integrated process on sorghum biomass-based biorefinery involving IICT, Hyderabad; MNNIT, Allahabad and TERI, New Delhi.

**Pretreatment of soghum biomass:** The pretreatment studies on sorghum biomass using different acids showed dilute sulphuric acid as the best. Three different statistical models using acid concentration, solid loading, residence time and pretreatment temperature as the key parameters revealed following as the best pretreatment conditions: 0.37% (v/v) sulphuric acid, 16% (w/w) solid loading, pretreatment temperature at 150°C for 15 minutes, followed by enzymatic saccharification, which resulted about 66% conversion of sorghum biomass to free reducing sugars. The compositional analysis of pretreated sorghum showed efficient removal of hemicelluloses por-

tion when compared with that of native one.

## Alternative strategies for pretreatment of lignocellulosic biomass for bioethanol production

**Surfactant assisted ultrasound pretreatment of sugarcane tops for bioethanol production:** A novel surfactant-assisted ultrasound pretreatment was developed, which could effectively remove hemicelluloses and lignin and improve the reducing sugar yield from sugarcane tops. Operational parameters for pretreatment and hydrolysis were studied and optimized. Under optimal hydrolysis conditions, 0.661 g of reducing sugar was produced per gram of pretreated biomass. The structural changes of native and pretreated biomass were investigated by Scanning electron microscopy (SEM), X-ray diffraction (XRD) and Fourier transform infrared analysis (FTIR) (Figures 14 and 15). The results indicated that surfactant-assisted ultrasound pretreated sugarcane tops could be used as a potential feed stock for bioethanol production.

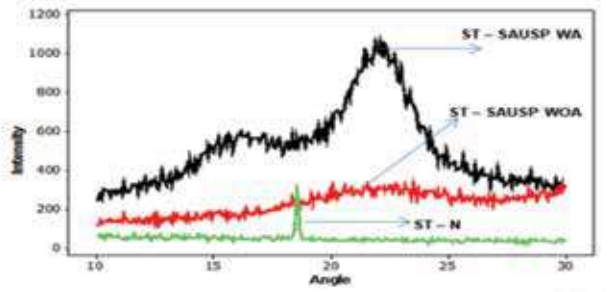
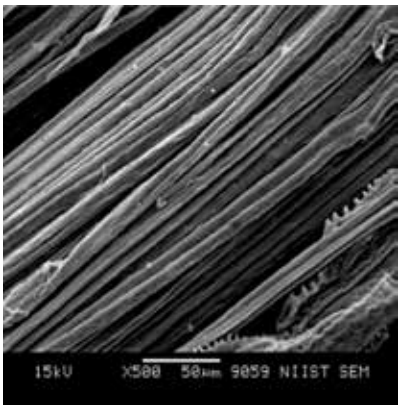



*Figure 14. FTIR analysis of pretreated biomass*



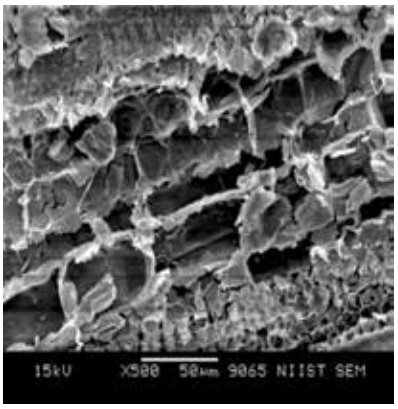




*Figure 15. SEM of native and pretreated biomass*

**Super acid treatment of rice straw for bioethanol production:** A novel super acid treatment using Nafion was developed, which selectively solubilised the cellulose and hemicelluloses of lignocellulosic biomass and the hydrolyzate obtained after this treatment was devoid of fermentation inhibitors such as HMF and furfural. Fermentation without any detoxification yielded 4% ethanol. The characterization by XRD and FTIR revealed that the residue formed after the treatment contained lignin as the major component. One of the main advantages of this method could be that the super acid were recovered after the pretreatment, which retained 60 and 35% activity after second and third cycles, respectively.

## Hydrolysis of biomass

The conversion to ethanol was pursued actively with emphasis on enzyme cocktail development and hydrolysis. NIIST's own enzyme blends with *Penicillium janthinellum* cellulase and *Aspergillus niger* (AN), or *A.unguis* (AU) beta glucosidase (BGL) were tried for hydrolysis of pretreated biomass and blends containing BGL supplementation was found to be more efficient than the cellulase used alone (Figure 16).

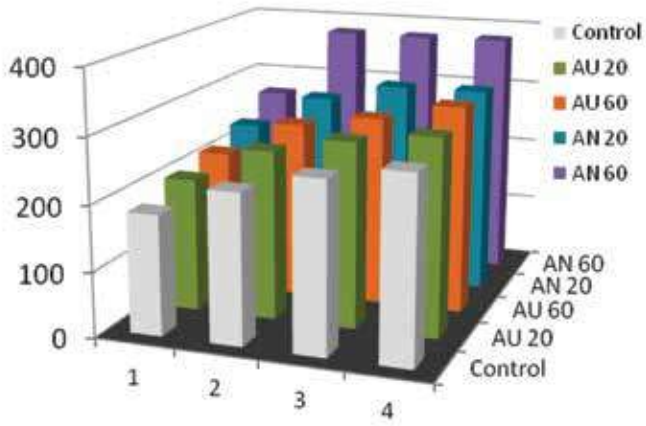



*Figure 16. Hydrolysis efficiency of enzymes from different sources*

Biomass hydrolysis using NIIST enzyme cocktail was efficient and at par with world's best enzymes for biomass hydrolysis. Bench marking of NIIST cocktail against world's leading commercial enzymes for biomass hydrolysis showed that while NIIST cocktail supplemented with in-house BGL at 0.2 U /FPU could yield ~60 % efficiency, the maximum attained by the best commercial enzyme containing 55.16 U BGL per FPU – (275 fold higher than NIIST cocktail) was only 73%. The cocktail is being developed further to enhance the efficiency and also for determining the optimal formulation.

**Table 1. Hydrolysis efficiency of enzyme blends**

| Time (h) | NIIST+BGL (0.2 U BGL /FPU) A | NIIST + Brand G BGL (1.2 U BGL / FPU) B | Brand N_CT2 (55.16 U/FPU) C | Brand N_ HT2 D |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 12 | 0.201 | 0.335 | 0.309 | 0.405 |
| 24 | 0.285 | 0.440 | 0.397 | 0.443 |
| 36 | 0.288 | 0.559 | 0.491 | 0.473 |
| 48 | 0.393 | 0.426 | 0.483 | 0.434 |
| *Efficiency (%) | **59.55** | **64.55** | **73.18** | **65.76** |

*A: NIIST enzyme cocktail containing P janthinellum cellulase and A.niger BGL, B : NIIST cellulase + Commercial BGL, C: Commercial biomass hydrolyzing cocktail from world's leading enzyme brand, D: Commercial biomass hydrolyzing cocktail from world's leading enzyme brand- different cocktail*

## Solid acid catalyst for biomass hydrolysis

While enzymatic hydrolysis is probably the most efficient method to do biomass hydrolysis, chemical catalysis may also be feasible if the catalyst can be repeatedly reused with fair amount of conversion efficiencies. Studies done with Amberlyst 15, as solid acid catalyst could yield 166 mg of sugar/g of pretreated rice straw. Though the efficiencies were low, it demonstrated the applicability of the method. New glycerol based carbon acid catalyst is being tried now for the hydrolysis as part of a collaborative project where NIIST is partner of a project on catalyst development by IICT.

## Production, characterization and applications of biosurfactant from *Pseudozyma* sp. NII 08165

Studies on exopolysaccharide (EPS) production from *Pseudozyma* sp. NII08165, novel ustilaginomycetes yeast revealed that EPS production was maximum on 4$^{th}$ day of inoculation with 3.5 g/l EPS yield. Structural elucidation by FTIR analyses showed the typical polymer structure of carbohydrate. Size exclusion chromatography showed that *Pseudozyma* EPS was a high molecular weight polymer of 1.7 MDa. Sugar analysis by HPLC showed that the monomers of this EPS were glucose, galactose and mannose in the ratio of 2.4:5.0:2.6, respectively. The EPS exhibited high viscosifying activity and pseudoplastic behavior, which could make it suitable as a bio-thickener and gelatinizer in different commercial products (Figure 17). The compound was thermally stable up to 220°C. The surface and microstructure of EPS were explored by SEM and AFM, which indicated that the surface of the EPS contained spike shaped lumps of varying size (Figures 18 & 19). SEM analysis suggested a rigid film-like structure, which showed its potential for preparing the plasticized films.

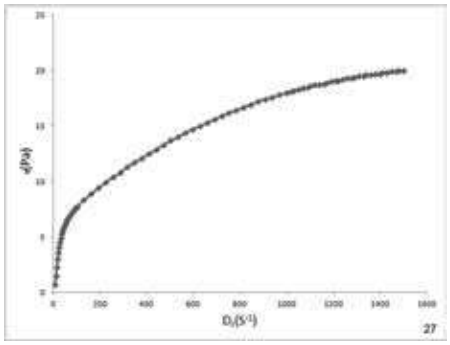


*Figure 17. Rheological behaviour of aqueous solution of Pseudozyma EPS*

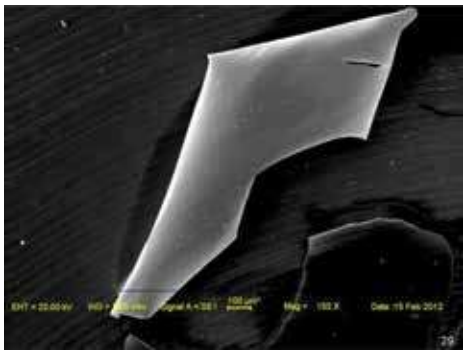


*Figure 18. Scanning electron micrograph revealing the compact, non-porous film like surface morphology of Pseudozyma EPS*

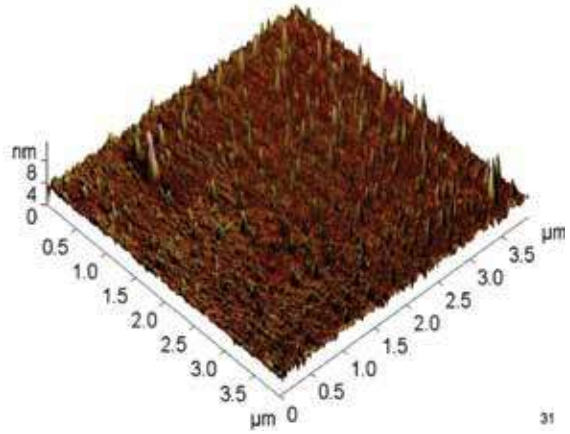



*Figure 19. Atomic force microscopy revealing the microstructure of Pseudozyma EPS containing spike shaped lumps*

## Fermentative production of succinic acid

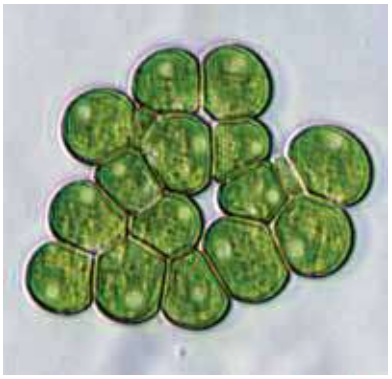
New activity was initiated at the Centre for Biofuels for the value-addition of biomass hydrolyzates and pentose rich acid pretreatment liquor. Fermentative production of succinic acid was undertaken using *Aspergillus terreus* and biomass hydrolyzates as medium for fungal cultivation and production. The culture could produce 1.25% of succinic acid in the fermentation broth, which was good considering that the best yields reported for microbial production have been ~ 4% in the defined media with glucose as carbon source and using recombinant *E. coli*.

## Production of oil from microalgae using biofuel industry waste material

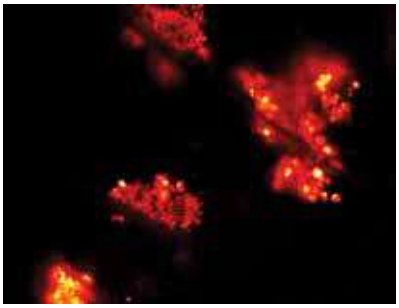
Microalgae capable of growth and oil production both phototrophically (using sunlight & $CO_2$) and heterotrophically (using carbon compounds as energy sources) were cultivated under phototrophic cultivation with supplementation of $CO_2$ and heterotrophically with biodiesel industry waste glycerol and using the pentose acid pretreatment liquor (APL) generated during dilute acid pretreatment of lignocellulosic biomass. The culture could grow and accumulate about 38% of its dry cell weight as oil when cultivated heterotrophically using waste glycerol as C source (Figure 20). The oil yield was 5-times higher than what was obtained when the algae was cultivated phototrophically with $CO_2$ and 10 times than when cultivated phototrophically without any $CO_2$ supplementation, showing high potential for biomass and oil production using this algae (Table 2).

*Table 2. Production of biomass and lipids by Chlorococcum sp*

| Cultivation conditions (*Chlorococcum* sp) | Biomass conc. (mg/l | Yield of lipids (mg/l) | % DCW of lipids |
|---|---|---|---|
| Phototrophic w/o Carbon | 152.5 ± 0.7 | 31 ± 0.65 | 20.8 ± 2.6 |
| Phototrophic w/$CO_2$ | 301 ± 0.3 | 72.5 ± 0.4 | 24.0 ± 0.84 |
| Heterotrophic w/ glucose | 1.008 ± 7.7 | 304 ± 2.0 | 30.5 ± 0.35 |
| Heterotrophic w/waste glycerol | 850 ± 7 | 330 ± 1.0 | 38.9 ± 1.9 |
| Heterotrophic w/Black liquor | 667.5 ± 4.9 | 158.5 ±1.6 | 23.4 ± 2.0 |



A



B

*Figure 20. Chlorococcum sp. isolated from silent valley national park (A); Nile red stain showing lipid accumulation when cultivated heterotrophically in waste glycerol (B)*

## Biobutanol Production

Organism isolated from the contaminated cooked meat medium was demonstrated to produce butanol without acetone formation. The culture was identified as *Clostridium sporogenes* by 16s rDNA sequencing (Figure 21). The culture produced butanol and ethanol using rice straw hydrolyzate in the ratio of 6.52 and 3.48, respectively. The culture utilized an average of 50% hexoses and pentoses present in the hydrolyzates. Specific growth rate decreased with 4% and 6% glucose when compared to 2% glucose as substrate. Organism showed specific growth of more than 50% in 1% butanol and growth ceased completely with 2% butanol. Acetic acid and formic acid were the major inhibitors found in the hydrolyzate and both were found toxic to the organism at low concentrations. Maximum 5.5g/l butanol was obtained by detoxification of hydrolyzate with anion exchange resin and media engineering.

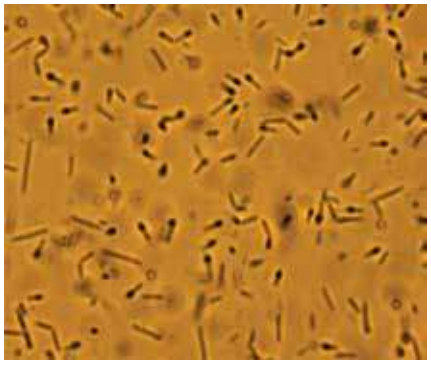


*Figure 21. Clostridium sporogenes BE01*

# HEALTH & GENOMICS

## Probiotics & Nutraceuticals

**Folic acid production by probiotic lactic acid bacteria:** Folate production by *Lactococcus lactis* sub sp. *lactis* (CM28) was studied. Fortification studies were carried out in 4% skim milk medium because folate binding proteins of milk improved its stability and also enhanced the bioavailability of both 5 methyltetrahydrofolate and folic acid. The influence of various components on folate production including folate precursors (PABA and glutamate), prebiotics (fructose oligosaccharides, sorbitol and mannitol), and reducing agents (sodium thioglycholate, sodium ascorbate and cysteine hydrochloride) were studied individually. The production titers achieved through the medium formulation studies are shown in Figure 22.

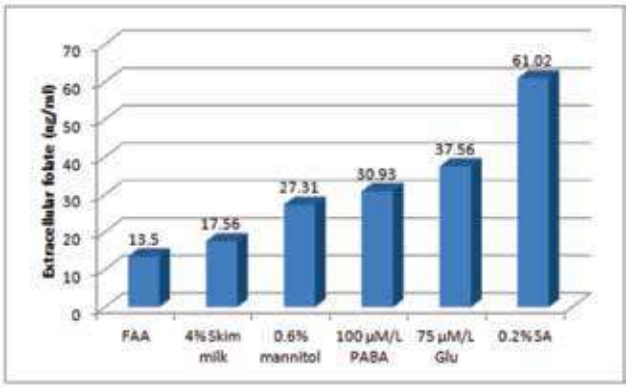



*Figure 22. Folate production (after 8h fermentation) through medium formulation using Lactococcus lactis sub sp. lactis (FAA – folic acid assay medium; Glu – glutamate; SA – sodium ascorbate)*

**Isolation and characterization of antifungal metabolites from lactic acid bacteria:** Antifungal lactic acid bacteria as bio-preservation organisms are of particular interest since they greatly influence the nutritional, sensory and shelf-life characteristics of fermented food products. In the present study *Pediococcus pentosaceus*, *Lactobacillus casei* and *Lactococcus garvieae* with antifungal activity (Figure 23) were used for the production of antagonistic metabolites. The active fractions were extracted in ethyl acetate and purified by silica column chromatography. Fractions from these bacteria showed inhibitory activity against varying fungal cultures such as *A. niger, P. chrysogenum, F. moniliformis and F. oxysporum.*


*Figure 23. Antifungal activity of the bioactive fractions from various Lactic acid bacteria*

# BIODIVERSITY

**Exploiting Western ghats biodiversity for antifungal metabolites for plant disease control:** The antagonistic cultures belonging to *Bacillus* sp, *Pseudomonas* and *Streptomyces* sp from the Western *ghats* regions of Kerala produced bioactive compounds, which exhibited strong anti-fungal activities against the plant pathogens such as *Phytophthora capsici* and *Rhizoctonia solani.* Field studies conducted with cow pea and pepper plants infected with these pathogens showed very effective protection from the pathogens (Figure 24). The bioactive compounds produced by two *Streptomyces* sp strains were identified and characterized (which had shown inhibition for both the pathogens). One of the cultures showed 89 % inhibition of *R. solani* and 63 % inhibition of *P. capsici* and the second strain showed 74 and 53% inhibition, respectively. One of the purified compounds was a highly conjugative fluorescent molecule with a mass of ~ 271 Da with absorbance maxima at 275 nm and emission at 437 nm.

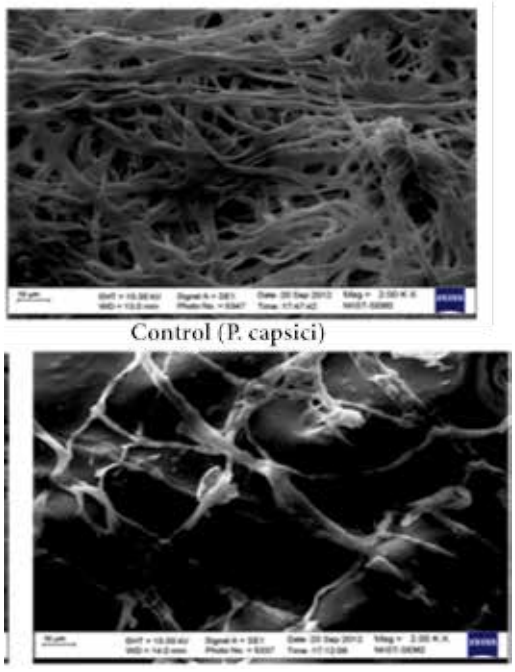



*Figure 24. SEM picture showing the growth inhibitory effect on Phytophthora capsici using the bioactive fraction of streptomyces species*

**Screening, isolation & characterization of anti-fungal metabolites from actinomycetes:** This study aimed to isolate actinomycetes cultures from the soil samples collected from the Western *ghats* and their evaluation of anti-fungal potential followed by purification and characterization of bioactive compounds. Based on the initial studies, one culture, designated as NII 1006 was studied in detail. The culture did not produce β-1,4-glucanase but showed the production of chitinase activity (0.05 U/ml on the fourth day of incubation). The *in vitro* bio-compatibility studies to find out the possibility of using the cultures in consortia for biocontrol formulations showed good compatibility with each other and exerted a synergistic biocontrol effect on fungal pathogen. The organic solvent extraction of the culture supernatant with hexane and ethyl acetate on partial purification (column chromatograph) showed the presence of a relatively polar bioactive compound in ethyl acetate extract. The HPTLC profiling and proton NMR of the purified active compound showed that it was highly fluorescent and UV active with Rf value 0.6.

**PGPR tools for improving crop productivity in stressed agricultural systems:** A group of diverse bacteria isolated from the rhizosphere of the members of family *Graminaceae*, grass and paddy (*Oryza sativa)* growing in the acid sulphate soils of Kuttanad region, Kerala, were screened for ACC deaminase activity. The pH of the soil was 4.5 and the type of soil was kari peat. The samples were collected from post harvested paddy fields under different conditions of dry field and field submerged in about two feet of sea water. A total of 158 isolates were obtained from both samples - grass (100) and paddy (58) isolates.

**Diversity of *Cobetia* sp. in mangrove ecosystem and its plant growth promoting attributes:** A group of 18 Gram-negative halotolerant bacteria isolated from the mangrove rhizosphere of Pichavaram and Devipattinam mangrove ecosystem was subjected to diversity studies and its biological functions. On the basis of 16S rRNA sequence analysis, the isolates belonged to the genus *Cobetia*. Phenotypically, the isolates showed three different morphotypes. The intraspecies genetic diversity as assessed using primers BOX and $(GTG)_5$, showed three genotypes among 18 strains and it collaborated the results of phenotypic data. The housekeeping genes (*gyrB*) were used to determine whether these isolates belonged to novel strains, which showed highest similarity with *Cobetia marina*, showing 88% sequence similarity. The representatives from each morphotypes were assayed for the biofilm formation, ACC deaminase activity, IAA production and growth in nitrogen-free medium. The isolates showed good biofilm formation, weak ACC deaminase and IAA production. Apart from this other PGPR activities like siderophore production, phosphate solubilisation, various enzyme hydrolysis (amylase, pectinase, xylanase, cellulase, protease, and chitinase) were negative. The biochemical characterization and antibiotic sensitivity of the isolates showed that all the isolates could tolerate up to salt concentration of 20 % and none grew in 0% NaCl. This is the first report showing the occurrence of genera *Cobetia* on different mangrove rhizosphere.

***Zunongwangia mangrovi* sp. nov., a novel bacterium isolated from a mangrove rhizosphere, *Avicennia marina*:** A Gram-negative, aerobic, halophilic, non-motile and rod-shaped bacterial strain, P2E16$^T$, was isolated from a mangrove rhizosphere, *Avicennia marina*, collected at devipattinam mangroves, Tamil Nadu, India. Strain P2E16$^T$ grew optimally at pH 7.0-8.0, at 25-28 °C and in the presence of 2-3% (w/v) NaCl. The 16S rRNA gene analysis showed that strain was phylogenetically related to the genus *Zunongwangia*, with *Zunongwangia profunda* SMA-87$^T$ as the closest related type strain (98.2% 16S rRNA gene sequence similarity) and less than

93% to all other representatives of the genus of the family *Flavobacteriaceae*. It contained phosphatidylethanolamine as the predominant polar lipid and iso-$C_{15:0}$ (17.8%), iso-$C_{17:0}$3-OH (15.1%), $C_{15:0}$ (12.8%), iso-$C_{15:1}$G (9.0%), iso-$C_{17:1}$ω9c (9.8%) and summed Feature 3 (comprising $C_{16:1}$ω7c and/or iso-$C_{15:0}$2-OH) (7.1%) as the major fatty acids. The DNA G+C content was 34.3 mol%. Differential phenotypic properties, together with the phylogenetic distinctiveness and low DNA-DNA relatedness demonstrated that strain P2E16$^T$ is distinct from *Zunongwangia profunda* SMA-87$^T$. On the basis of the data presented, strain P2E16$^T$ could be considered to represent a novel species of the genus *Zunongwangia*, for which the name *Zunongwangia mangrovi* sp. nov. has been proposed. The type strain is P2E16$^T$ (=DSM 24499$^T$ =KCTC 23496$^T$).

# CHEMICAL SCIENCES AND TECHNOLOGY DIVISION

The main research activities of the Chemical Sciences and Technology Division (CSTD) during the year 2012-2013 can be broadly classified under (i) self-assembly of organic molecules to form functional materials (ii) design of probes and sensitizers for photodynamic therapy, (iii) sensors and probes for metal ions and explosives, (iv) luminescent and composite materials, (v) organic catalysis and synthetic methodologies, (vi) isolation of natural bioactive molecules and (vii) rationalization of prediction of catalysts through theoretical calculations. The Division has also initiated new research activities for the 12th Five Year Plan in the interdisciplinary areas with a focus on functional advanced materials for affordable health, energy, imaging and diagnostic applications.

During this period, the Division has also been enriched by the joining of three new young scientists having expertise in the synthesis, supramolecular chemistry and device fabrication, respectively. Two new technical staff also joined to support the research activities of the Division. As in the earlier years, the members of the Division have been quite successful in publishing 66 papers in high impact journals with an average impact factor of 4.657. Given below are some of the research highlights of the Division during the year 2012-2013, along with brief abstracts of the results published in various international peer reviewed journals.

## RESEARCH HIGHLIGHTS

- Photoresponsive "smart" supramolecular assemblies of oligomers/polymers having controlled helicity and switchable morphologies developed.
- Prepared novel luminescent organogels and liquid crystals with tunable emission properties.
- Highly luminescent lanthanide complexes, simpler processing methodology for CNTs and electromagnetic interference shielding materials prepared.
- Novel water soluble porphyrins synthesized and their potential as sensitizers for live cell nucleus imaging and photodynamic therapeutical applications invstigated.
- Designed novel zinc–porphyrin pincer systems as well as the aza-BODIPY derivatives for their application in facile green photooxygenation reactions.
- A biocompatible SERS based nanotag for ultra sensitive detection and imaging of human cancer developed.
- Evidence for a new type of 1,3-metal-carbon bonding in organometallic chemistry discovered in metallocyclobutadiene systems using DFT calculations.
- Probes for selective detection of uric acid, nitrite and mercury ions developed.
- Facile and simple strategies developed for the synthesis of novel fused benzofuran and pyrazolidines as well as zerumbone derivatives.



# रसायन विज्ञान तथा प्रौद्योगिकी विभाग

वर्ष 2012-2013 के दौरान रसायन विज्ञान तथा प्रौद्योगिकी प्रभाग (सीएसटीडी) के मुख्य अनुसंधान कार्यों को मोटे तौर पर निम्न प्रकार से वर्गीकृत किया जा सकता है - (i) कार्यात्मक सामग्री के विकास के लिए कार्बनिक अणुओं का स्वत: समुच्चय (ii) प्रकाश गतिक चिकित्सा के लिए प्रोब्स एवं सुग्राहीकरों के डिजाइन (iii) धातु आयनों और विस्फोटकों के लिए सेंसरों और प्रोब्स (iv) संदीप्तिशील और मिश्रित सामग्री (v) जैविक कटैलिसीस और सिंथेटिक तरीके (vi) प्राकृतिक जैवसक्रिय अणुओं के अलगाव और (vii) सैद्धांतिक परिकलनों के माध्यम से उत्प्रेरकों के पूर्वानुमेय का औचित्य स्थापन । सस्ती स्वास्थ्य, ऊर्जा, इमेजिंग और नैदानिक अनुप्रयोगों के लिए कार्यात्मक उन्नत सामग्री पर ध्यान देने के साथ ही साथ प्रभाग ने 12वीं पंचवर्षीय योजना के लिए अंतर्विषयी क्षेत्रों में नयी शोध गतिविधियॉ शुरू कर दी है ।

इस अवधि के दौरान संश्लेषण, अति आण्विक रसायन विज्ञान और डिवाइज़ फैब्रिकेशन में विशेषज्ञता वाले तीन नए युवा वैज्ञानिकों के शामिल होने से प्रभाग समृद्ध किया गया है। दो नए तकनीकी स्टाफ भी प्रभाग की अनुसंधान गतिविधियों के समर्थन करने के लिए शामिल हो गए हैं । पिछले वर्षों जैसे, प्रभाग के सदस्य 4.657 के औसत प्रभाव कारक के साथ उच्च प्रभाव पत्रिकाओं में 66 शोध पत्रों के प्रकाशन में काफी सफल हुए हैं । वर्ष 2012-2013 के दौरान प्रभाग की शोध गतिविधियों की कुछ मुख्य विशेषताओं तथा विभिन्न अंतरराष्ट्रीय सहकर्मी समीक्षित पत्रिकाओं में प्रकाशित परिणामों के संक्षिप्त सार नीचे दिए जाते हैं ।

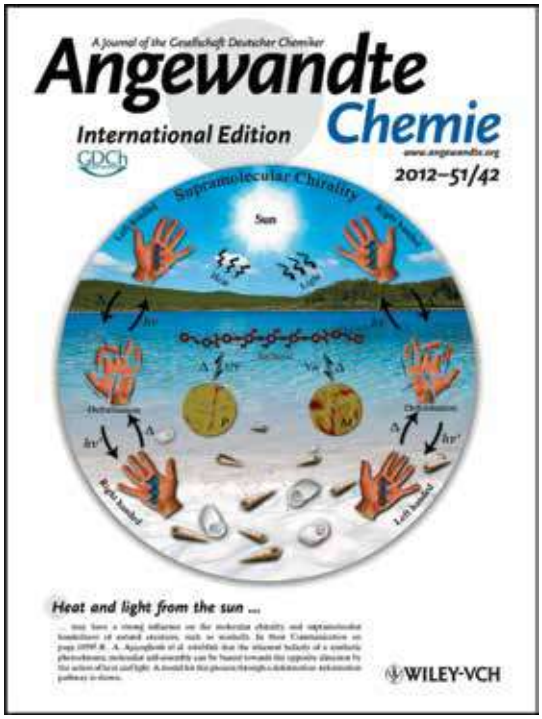
## अनुसंधान की मुख्य विशेषताएं

- नियंत्रित कुंडलता और स्विचनीय आकारिकी युक्त ऑलिगोमेर्स/पॉलिमरों के प्रकाशानुक्रियाशील 'स्मार्ट' अतिआण्विक समुच्चयों का विकास किया ।
- ट्यूनेबल उत्सर्जन गुणों के साथ नूतन संदीप्तिशील कार्बनिक जेल और लिक्विड क्रिस्टल तैयार किये गये ।
- अत्यधिक संदीप्तिशील लैन्थेनाइड कॉम्प्लेक्सस, सीएनटी के लिए सरल प्रसंस्करण कार्यप्रणाली और इलेक्ट्रोमैग्मीय हस्तक्षेप परिरक्षण सामग्री तैयार की गयी ।
- पानी में घुलनशील नूतन पॉर्फिरिन का संश्लेषण किया गया और लाइव सेल न्यूक्लियस इमेजिंग और प्रकाश गतिक चिकित्सा संबंधी अनुप्रयोगों के लिए सेंसिटरों के रूप में उनकी क्षमता पर अन्वेषण किया ।
- सहज हरी फोटोऑक्सिजनेशन अभिक्रियाओं में अपने आवेदन के लिए नूतन जिंक- पॉर्फिरिन संदंशिका सिस्टम तथा ऐजड़ए -बोडिपी डेरिवेटिव का डिजाइन किया ।
- मानवीय कैंसर के अति संवेदनशील पहचान और इमेजिंग के लिए एक जैव सुसंगत एसईआरएस आधारित नैनोटैग विकसित किया ।
- धातुसाइक्लोब्यूटाडाईन सिस्टम में डीएफटी परिकलनों का उपयोग करके कार्ब-धात्विक रसायन विज्ञान में एक नए प्रकार का 1,3 धातु कार्बन बॉडिंग का प्रमाणन के लिए खोज की ।
- यूरिक एसिड, नाइट्राइट और पारा आयनों के चुनिंदा संसूचन के लिए प्रोब्स विकसित किया गया ।
- नूतन संगलित बेन्जोफ्यूरेन तथा पाइरैजोलिडिन्स साथ ही साथ ज़रुम्बोन डेरिवेटिव के संश्लेषण के लिए सहज एवं सरल योजना विकसित की ।

## SELF-ASSEMBLY OF OLIGOMERS / POLYMERS

Molecular self-assembly plays an important role on the construction of biological macromolecular assemblies in living organisms, and so is crucial to the function of cells. It is equally important in synthetic organic molecules also, particularly in the case of π-conjugated systems, which could be precisely organized through self-assembly, to make them suitable for applications in the area of opto-electronics, sensors and biology. In this context, the division is actively involved in the development of new functional organic materials through self-assembly and light induced switching of supramolecular handedness, tuning of optoelectronic properties, controlled dye release in oligomer/ polymer materials etc.

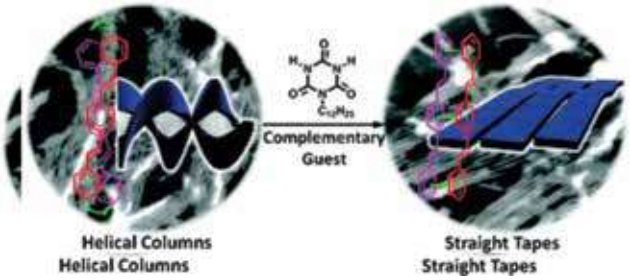
**Thermally assisted photonic inversion of supramolecular handedness.** Symmetry breaking, leading to a specific handedness (either right or left) of biological structures is one of the most fascinating phenomenon in nature. While several factors such as vortex motion, stirring, magnetic field and redox forces may be involved, natural light may have a key role in controlling the chirality and helical sense of biological helices. Light is undoubtedly a versatile external stimulus to control the chemical and physical properties of molecules, both natural and synthetic. The role of light and heat on helicity at a supramolecular level, has been demonstrated with azobenzene linked phenyleneethynylene (OPE) derivatives. It was found that the helicity of supramolecular assemblies associated with a specific chirality can be reversibly switched to the opposite helical sense through a chiral-center-controlled photoisomerization of the attached azobenzene moieties. The study strengthens the general perception that in combination with other forces, light may help to determine the parity violation in the symmetry of natural objects. Temperature-controlled photonic switching of macroscopic handedness of π-systems could be further used for the design of smart materials with switchable electronic properties, such as conductivity and charge carrier mobility (Ajayaghosh *et al.*, *Angew. Chem. Int. Ed.,* **2012**, *51*, 10505 –09).



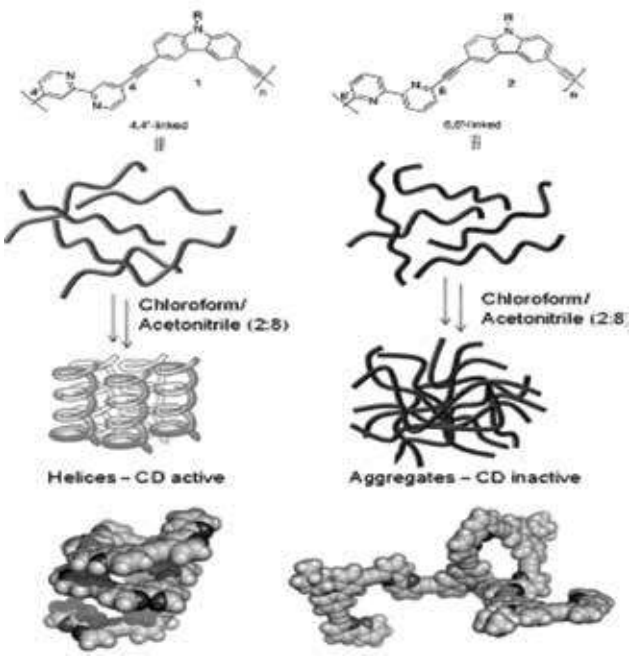

**Oligo(p-phenylene-ethynylene)-derived super-π-gelators with tunable emission and self-assembled polymorphic structures.** Linear π-conjugated oligomers are known to form organogels through noncovalent interactions. The effect of repeat units on the gelation and morphological properties of three different oligo(p-phenylene-ethynylene)s: OPE3, OPE5, and OPE7 were reported. All of these molecules form fluorescent gels in nonpolar solvents at low critical gel concentrations, thereby resulting in a blue gel for OPE3, a green gel for OPE5 and a greenish yellow gel for OPE7. The molecule–molecule and molecule–substrate interactions in these OPEs are strongly influenced by the conjugation length of the molecules. Silicon wafer suppresses substrate–molecule interactions whereas a mica surface facilitates such interac-


tions. At lower concentrations, OPE3 formed vesicular assemblies and OPE5 gave entangled fibers, whereas OPE7 resulted in spiral assemblies on a mica surface. At higher concentrations, OPE3 and OPE5 resulted in super-bundles of fibers and flowerlike short-fiber agglomerates when different conditions were applied. The number of polymorphic structures increases on increasing the conjugation length, as seen in the case of OPE7, which resulted in a variety of exotic structures, the formation of which could be controlled by varying the substrate, concentration, and humidity (Ajayaghosh *et al.*, *Chem. Asian J.*, **2012**, *7*, 2061–67).

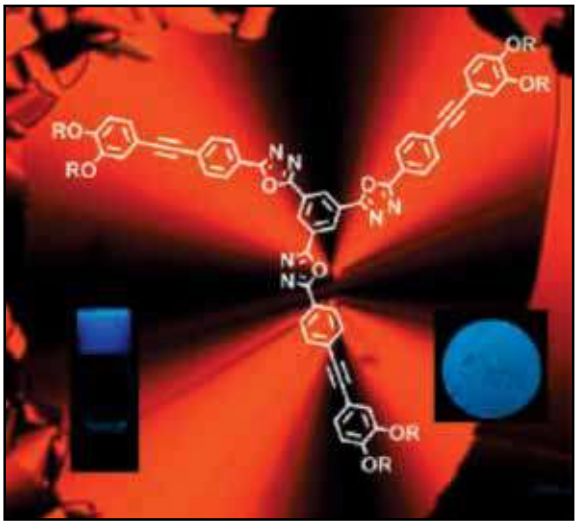
**Guided supramolecular polymerization of oligo(p-phenylenevinylene) functionalized bismelamines.** Controlling self-assembled nanostructures of functional π-conjugated molecules using concerted action of various noncovalent interactions, such as π-π stacking and hydrogen-bonding, is an important research topic for the development of nanostructures based on organic materials. In particular, the use of complementary multiple hydrogen-bonding interactions is attractive because it would dramatically change self-assembled structures of π-conjugated building blocks in the absence and presence of complementary guests. Bismelamines-functionalized with oligo(pphenylenevinylene) is found to self-aggregate in nonpolar solvent to form short nanorods by helical π-π stacking. This inherent self-aggregation can be guided to a supramolecular polymerization pathway by complexing with a cyanurate, leading to gel-forming elongated nanotapes lacking helical sense of the π-conjugated moieties (Ajayaghosh *et al.*, *Chem. Commun.*, **2013,** *49*, 4941-43).



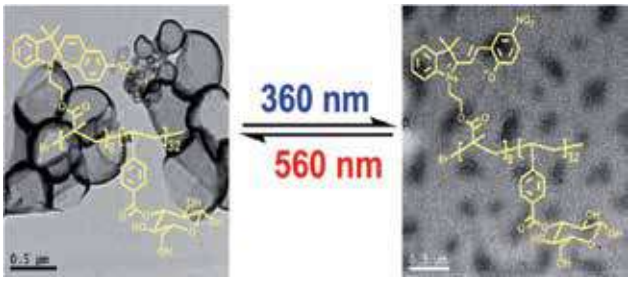

**Chain folding controlled by an isomeric repeat unit: helix formation versus random aggregation in acetylene-bridged carbazole–bipyridine co-oligomers.** An unprecedented, positional effect of the isomeric repeat unit on chain folding in donor–acceptor-linked oligomers, which contain alternating bipyridine and carbazole moieties that are connected through an acetylinic linkage, was observed. 4,4'-Linked oligomer **1** adopts an intrachain helical conformation (CD-active) in $CHCl_3$/MeCN (20:80 v/v), whereas 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, are in support of the proposed mechanism (Ajayaghosh *et al.*, *Chem. Asian J.*, **2013**, DOI: 10.1002/asia.201300132).




**Trigonal 1,3,4-oxadiazole-based blue emitting liquid crystals and gels.** Star-shaped molecules consisting of a 1,3,4-oxadiazole core derivatized with alkoxy-substituted phenyl ethynylenes, FD12 (dodecyl) and FD16 (hexadecyl) were synthesized. These molecules exhibited enantiotropic columnar mesophases over a wide temperature range, with the liquid crystalline phases exhibiting strong blue fluorescence. On cooling, FD12 transformed into a transparent glass at room temperature and the liquid crystalline texture was retained. The glassy film remained stable over a period of one year and exhibited blue luminescence with an absolute quantum yield of 26%. The oxadiazole derivatives formed stable luminescent gels in decane and study of their morphology by scanning electron microscopy (SEM) and transmission electron microscopy (TEM) indicated formation of interlocked network of self-assembled fibers. X-ray diffraction (XRD) analysis of the xerogel of these derivatives indicated oblique columnar ordering of the molecules within the fibers. The length of the alkyl substituent was observed to have a significant effect on the absorption and fluorescence properties of the gels, which was attributable to the role of the alkyl substituents in controlling the nature of the molecular packing within the self -assembled fibers of the gels (Suresh Das *et al.*, *J. Phys. Chem. B,* **2012**, *116*, 13071–80).

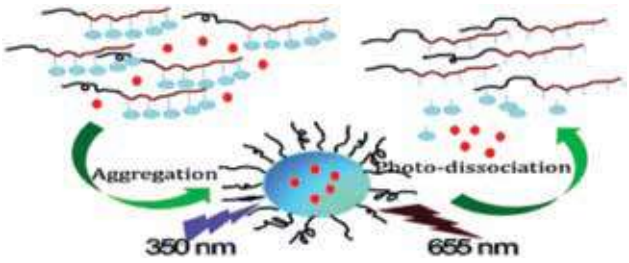



**Photocleavable glycopolymer aggregates.** A novel water soluble diblock glycopolymer, poly (spiropyran methacrylate) - block - poly (3-O-4-vinylbenzoyl-D-glucopyranose) (PSP-b-PBG), was synthesized by the conventional atom transfer radical polymerization (ATRP) technique. Irradiation with UV light results in switching of the hydrophobic colourless spiropyran (SP) form to zwitterionic purple coloured merocyanine (MC) increasing the overall polarity of the glycopolymer, resulting in its enhanced affinity towards water. The MC form reverts back to the SP form in the dark or under visible light irradiation, restoring the amphiphilic nature of the polymer. Vesicular aggregates formed by this diblock copolymer in water could be dissociated and reconstructed by alternate UV and visible light irradiation. The ability of these polymersomes to efficiently encapsulate, release and re-encapsu-



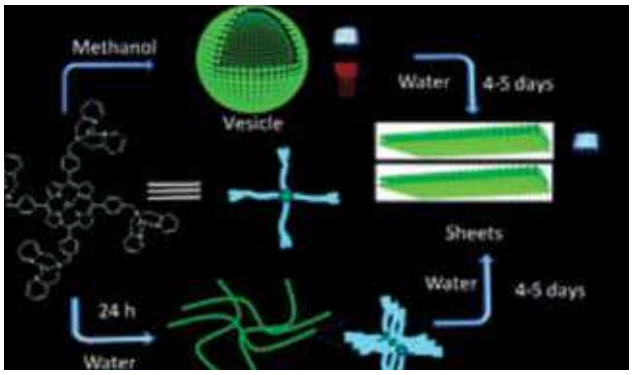
late a hydrophobic dye was also explored (Suresh Das *et al.*, *Polym. Chem.* **2013**, *4*, 623-28).

**A photoresponsive fluorescent glycopolymer.** A new photoresponsive amphiphilic glycopolymer, poly (pyrenylmethyl methacrylate) - b - poly (3-O-4-vinylbenzoyl-D-glucopyranose) (PPy-b-PBG), synthesized *via* atom transfer radical polymerization (ATRP). The aggregation behaviour of PPy-b-PBG was investigated in dilute aqueous solutions by dynamic light scattering and fluorescence spectroscopy. Formation of spherical aggregates was observed in solutions under controlled conditions due to the amphiphilic nature of the polymer. The presence of strong pyrene excimer emission in aqueous solution indicated the aggregation of pyrene units.




Irradiation of these glycosomes with UV light resulted in the photo-solvolysis of 1-pyrenylmethyl esters accompanied by the disruption of the polymer aggregates due to the hydrophilic nature of the residual polymer. The morphology of the polymer aggregates before and after UV irradiation was examined by AFM, SEM and TEM. Encapsulation of hydrophobic Nile Red molecules by the glycosomes resulted in successful fluorescence modulation and UV irradiation resulted in the controlled release of the entrapped dye into water (Suresh Das *et al.*, *Polym. Chem.*, **2012**, *3*, 2619-24).

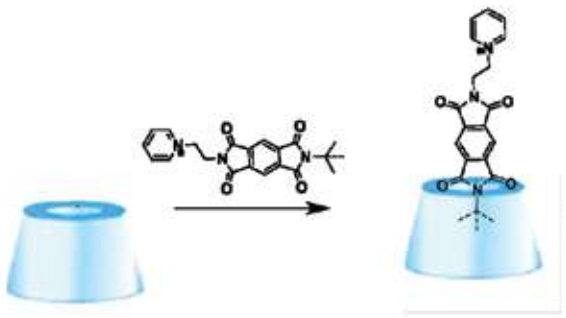
**Dye encapsulation and release by a zinc–porphyrin pincer system through morphological transformations.** With a view to develop organic and supramolecular assemblies for biological applications, novel amphiphilic porphyrin systems containing the pyridine pincer systems were designed



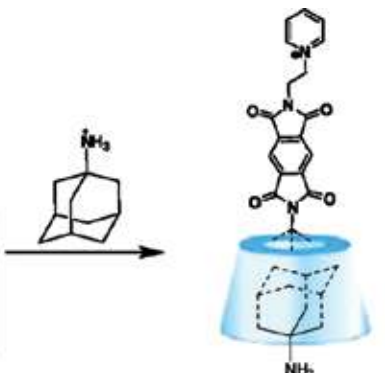

and investigated their photophysical and morphological transformations under different conditions. Of these systems, the complex possessing five $Zn^{2+}$ ions in the core as well as pendant groups exhibited vesicular structures in methanol, whereas in the aqueous medium, it underwent a time-dependent morphological transformation from nanofibers to sheet-like structures as evidenced through various photophysical and microscopic techniques such as SEM, AFM, TEM and DLS. Uniquely, the vesicles of the complex can encapsulate fluorescent, HPTS dye molecule in methanol, which can be released on demand into the aqueous medium through morphological transformations induced by time and solvent polarity. The effect of metal ions on the stability and nature of the supramolecular assemblies and interactions of these assemblies with biologically relevant molecules are currently being explored for their potential applications (Ramaiah *et al., RSC Adv.,* **2013**, *3*, 3815-18).

**Study of β-cyclodextrin–pyromellitic diimide complexation. Conformational analysis of binary and ternary complex structures by induced circular dichroism and 2D NMR spectroscopies.** Complexation of *N*-alkyl derivatives of PMDI with β-CD was probed using a variety of techniques. Although MALDI-TOF and CV experiments suggested complex formation it was very evident from UV-Vis and NMR experiments that these complexes are different from regular inclusion complexes. A clear understanding of the struc-

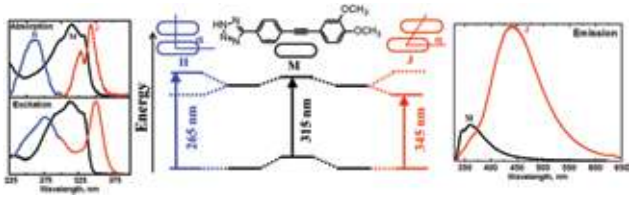
ture of the binary complex PMDI@β-CD could be obtained using ICD and NMR ROESY experiments. ICD signals were negative which suggest that the PMDI moiety is placed outside of the cavity. ROESY experiments provide support for this contention. When the alkyl group is *t*-butyl or 2-propyl, the $CH_3$ protons exist very close to the inner protons of β-CD, but the aromatic proton of PMDI is clearly outside the β-CD cavity. Based on these results, a structure for PMDI@β-CD with the PMDI moiety placed at the narrow rim of β-CD and the *N*-alkyl group projecting into the cavity was proposed and designated these as 'rim-binding' complexes. Additional experiments showed that β-CD can accommodate a PMDI moiety at the narrow rim and an adamantane moiety in its cavity simultaneously, resulting



in the formation of ternary complexes PMDI⊃β-CD⊂ADA. Structure of the ternary complex was also probed by ROESY. The ternary complex formation can be utilized for the design of higher order functional materials such as CD-based hydrogels (Gopidas *et al.*, *J. Phys. Chem. C,* **2012**, *116*, 25004-14).



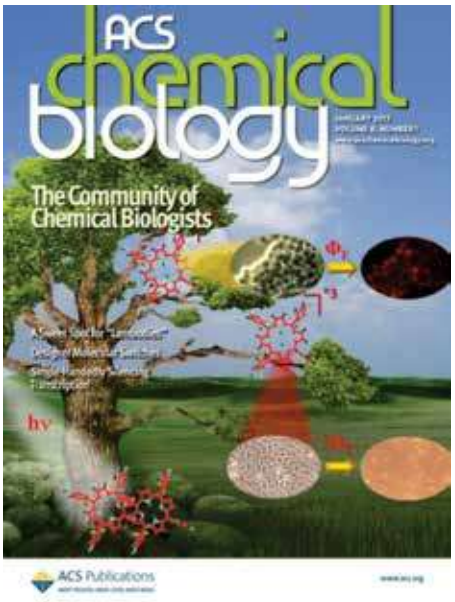
**Optical investigation of self-aggregation of a tetrazole substituted diphenylacetylene derivative: Steady and excited state dynamics in solid and solution state.** Slow crystallization and fast precipitation of a tetrazole substituted diphenylacetylene derivative (**MPT**), led to formation of solids with significantly different photoluminescence efficiencies of 0.06 and 0.33 respectively. Detailed study of the photophysical properties of solutions of **MPT** as a function of concentration and temperature indicated that extent of formation of J- and H-aggregates played a significant role in determining the luminescence properties of these materials. Time resolved emission spectroscopy showed that the lifetime of emission arising from the aggregated species was significantly higher than that of the monomer species. The long lived emission might be due to the formation of excimer arising from the excitation of ground state J- and H-aggregates. The higher quantum yield of fluorescence in the solids obtained by fast precipitation could be attributed to the presence of increased amounts of J- aggregates similar to that observed in highly concentrated solutions ($\geq 4.2\times10^{-4}$ M). The photophysical studies of **MPT** in various concentrations indicated that J-aggregates are significantly more fluorescent than that of the H-aggregates. Transient absorption spectra measured by nanosecond laser flash photolysis indicated the formation of a triplet excited state with an absorption maximum~490 nm and a quantum yield of 0.61 (Karunakaran *et al.*, J. *Phys. Chem.* C, **2013**, *117*, 9404 – 15).



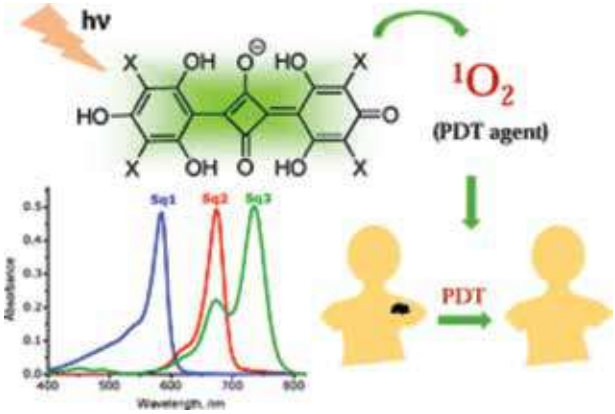
## PROBES AND SENSITIZERS FOR PHOTOMEDICINE

Photobiology deals with the scientific study of interaction of light with living organisms, and imparts a crucial role in human life. It helps us to understand the sensory and regulatory reactions of organisms upon exposure to light such as photosynthesis, vision, phototropism, photoperiodism, growth and development of the organism. The much attracted on-going researches in photobiology are the effect of various kinds of radiation on the evolutionary process, origin of life, maintenance of the ecological balance and use of light as diagnostic and treatment tool by photooxidation of proteins and photoinactivation of diseased cells and tissues such as photodynamic therapy for cancer and PUVA therapy for psoriasis. The results related to the design of probes and sensitizers for PDT are described below.

***In vitro* demonstration of apoptosis mediated photodynamic activity and NIR nucleus imaging through a novel porphyrin.** Porphyrins have attracted much attention as sensitizers due to their higher cellular affinity and very low dark toxicity. In this context, novel water soluble neutral porphyrin derivatives were synthesized and investigated their photophysical and *in vitro* photobiological properties. These systems exhibited high triplet excited state ($\Phi_T$ = 0.66-0.94) and singlet oxygen generation efficiency ($\Phi_\Delta$= 0.59-0.92). Investigation of the *in vitro* photodynamic activity indicated that these porphyrins exhibit high photocytotoxicity in cancer cell lines with negligible dark toxicity even at higher concentrations. Interestingly, the porphyrin derivative THPP showed about 2-3-fold higher *in vitro* photodynamic activity than the clinically used sensitizer Photofrin@ under identical conditions. The mechanism of the biological activity of these systems was evaluated through DNA fragmentation, comet assay, PARP cleavage, CM-$H_2$DCFDA assay, flow cytometric analysis, fluorescence and confocal microscopy, which confirmed the apoptotic cell death. Importantly, **THPP** showed rapid cellular uptake (< 10 min) and localized specifically in the nucleus of the cells. These derivatives can act as efficient sensitizers in photodynamic therapy and for nucleus imaging applications (Ramaiah *et al.*, *ACS Chem. Biol.*, **2013**, *8*, 127–32).

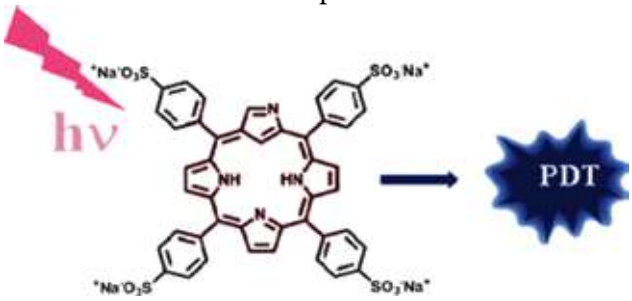



**Squaraine dyes in PDT: From basic design to *in vivo* demonstration.** The high selectivity in the destruction of tumour cells over normal cells has made photodynamic therapy (PDT) an attractive alternative to the traditional cancer therapies. The basic principle of PDT involves the generation of highly toxic and reactive oxygen species upon excitation of a sensitizer. Several compounds from simple aromatics to complex macrocycles have been proposed as sensitizers in PDT including porphyrins, phthalocyanins, chlorins, bacteriochlorins, methylene blue etc. The development of novel squaraine dyes as sensitizers for photodynamic therapy (PDT) has grown tremendously in the last decade. The squaraine dyes which show i) improved absorption properties, ii) improved




quantum yields of triplet excited state and singlet oxygen generation iii) squaraines that exhibit two photon-absorption iv) as carrier-based drug delivery systems and v) squaraines for *in vitro* and *in vivo* investigations also got much attention during the recent years (Ramaiah *et al.*, *Org. Biomol. Chem.* **2012**, *10*, 911-20).

**Meso-tetrakis(*p*-sulfonatophenyl)N-confused porphyrin tetrasodium salt: A potential sensitizer for photodynamic therapy.** *N*-Confused porphyrins (NCPs) are isomers of porphyrins with an 18 π electron conjugated pathway as a normal porphyrin. A water-soluble derivative of N-confused porphyrin, meso-tetrakis(*p*-sulfonatophenyl)-N-confused porphyrin tetrasodium salt (NCPS) was developed and its photodynamic activity was investigated. NCPS showed a triplet quantum yield of $\Phi_T$ = 0.70 with triplet life time of 1.2 μs. The singlet oxygen generation efficiency of NCPS was found to be $\Phi_\Delta$ = 0.70 in methanol. Cytotoxic studies over a series of cell lines revealed that NCPS is essentially non-toxic in the absence of light but interestingly showed high photocytotoxicity toward adenocarcinomas over the other epithelial cancer cell lines

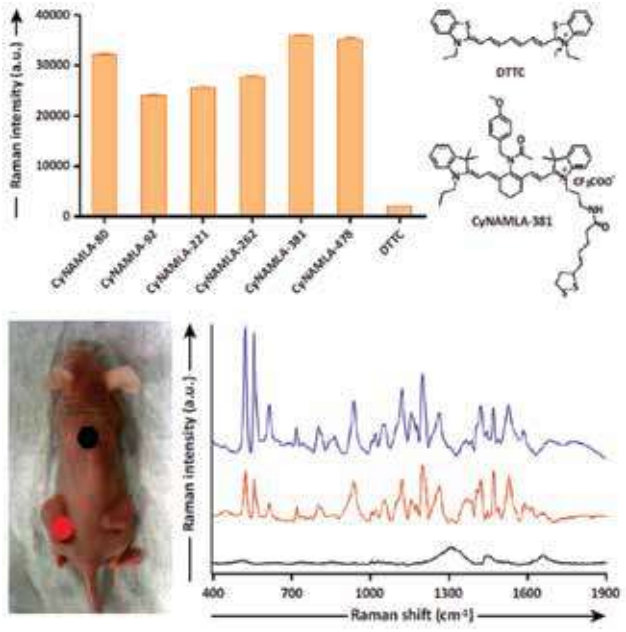



studied. The mechanism of the biological activity of NCPS was evaluated through PARP cleavage, CM-$H_2$DCFDA assay and flow cytometric analysis, which confirmed the apoptotic cell death mediated in a mitochondrial-dependent manner. The photophysical and *in vitro* studies ensure the potential candidacy of NCPS as a photodynamic therapeutic drug (Ramaiah *et al.*, J. *Med. Chem.* **2012**, *55*, 5110-20).

**Aza-BODIPY derivatives: enhanced quantum yields of triplet excited state and singlet oxygen generation and their role as facile green photooxygenation catalyst.** Singlet oxygen can mediate a wide range of reactions such as photooxygenation of organic substrates, in addition to PDT applications,. In this context, a new series of aza-BODIPY dyes was developed and tuned their triplet excited state as well as the yield of singlet oxygen generation, by substituting with heavy atoms such as bromine and iodine. The effect of substitution was studied by varying the position of halogenation. The core-substituted dyes showed high yields of the triplet excited state and high efficiencies of singlet-oxygen generation when compared to the peripheral-substituted systems. The aza-BODIPY

dye having six iodine atoms on the core and peripheral phenyl ring, showed the highest quantum yields of triplet excited state ($\Phi_T$ = 0.86) and singlet-oxygen generation ($\Phi_\Delta$ = 0.80). Interestingly, these dyes were found to be highly efficient as photooxygenation catalysts under normal sunlight conditions. These aza-BODIPY systems exhibit high yields of singlet-oxygen generation, and can act as efficient and sustainable catalysts for photooxygenation reactions (D. Ramaiah *et al.*, *Chem. Eur. J.* **2012,** *18*, 12655-62).

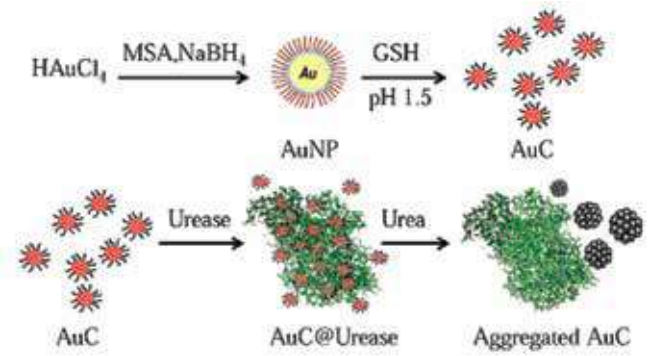
**Surface-enhanced Raman scattering (SERS) in cancer detection and imaging.** Raman scattering is a relatively weak optical process that provides information about the unique vibrational modes of molecules. SERS offers an excellent platform for the development of diagnostic assays and optical imaging tools. In addition to high sensitivity, SERS fingerprints of individual molecules permit excellent multiplexing capabilities because of the very narrow spectral width of Raman peaks (typically 10–100 times narrower than fluorescence peaks). The possibility of using a single excitation source for multiple probes, minimal photo bleaching, and low background from water are additional advantages. In recent years technologies that use surface-enhanced Raman scattering (SERS) have experienced significant growth in bio-medical research. SERS is also used as a non-invasive tool for cancer imaging with immuno-SERS microscopy, histological analysis of biopsies, and *in vivo* detection of tumors. A review article was published summarizing the progress in SERS for cancer diagnostics, including multiplexed detection and identification of new biomarkers, single-nucleotide polymorphisms, and circulating tumor cells. This also covers the Institute's work on the development of ultrasensitive SERS-nanotags for cancers detection *viz.*, breast and head and neck both *in vitro* through cell surface marker and *in vivo* xenograft model of small animal. The future of SERS probes compatible with multiple imaging modalities and their potential for clinical translation (e.g., endoscope-based and intraoperative imaging as tools for surgical guidance) are also discussed. In addition, this review highlights the potential of SERS agents for targeted drug delivery and photo-thermal therapy (Maiti et al., *Trends in Biotechnology*, **2013**, *31*, 249-57).




## PROBES / SENSORS FOR EXPLOSIVES AND METAL IONS

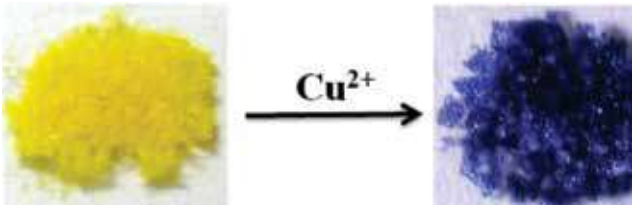
A number of proteins, other molecules and ions have been identified in the living system in the last era. Most of them play an essential role in regulating cellular functions and therefore in the maintenance of health and other activities. Understanding the chemistry of these intracellular molecules and ions, directly inside the cells is one of the biggest challenges of the post genome era. Direct visualisation of cellular molecules, provides us direct information clarifying their biological significance without homogenizing the cells or dissecting the living organism. Design and synthesis of a chemosensor, which can convert a biological signal to a readable chemical output is therefore of great significance.

**A near-infrared fluorescent nanosensor (AuC@Urease) for selective detection of blood urea.** Urea is a by-product of protein metabolism that is formed in the liver, carried by the blood and excreted through the kidney in urine. Therefore, urea is an important marker for evaluating uremic toxin levels and kidney and hepatocellular functions. Urea detection is also important in the estimation of non-protein nitrogen in food products such as milk since it is known that urea adulteration is utilized as an indicator of protein feeding efficiency. A gold cluster based nanosensor (AuC@ Urease) for the selective and direct detection of urea in blood samples is reported. This method has relevance in clinical diagnosis and health care. The main advantage of the proposed sensing mechanism is that, it works directly on the blood, whereas




currently adopted clinical methods require serum separation for the detection of urea and many of them work on colorimetric assay which is often hindered by the color of blood. Moreover, this highly sensitive and direct sensing method has the advantage of providing quick results as there is no need of serum separation (Ajayaghosh *et al.*, *Small*, DOI: 10.1002/smll.201300213).

**Colorimetric detection of copper ions in sub-micromolar concentrations using a triarylamine-linked resin bead.** The triarylamine derivative, methyl-4-(bis(4-methoxyphenyl)amino) benzoate (ETPA) reacts with $Cu^{2+}$ to give deeply colored, stable radical cations in acetonitrile solu-



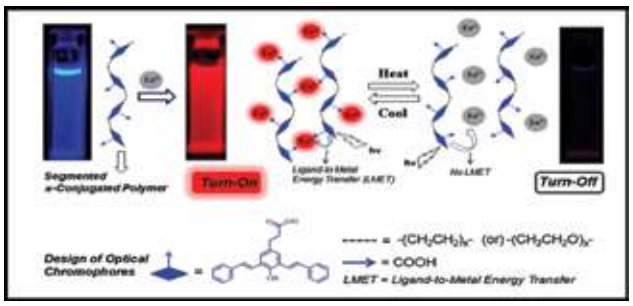

tion. ETPA was immobilized on to a tentagel resin bead which was then used for the fabrication of a simple device capable of colorimetric detection of submicromolar concentration of $Cu^{2+}$ ions in water. The naked eye detection limit reported by this method for $Cu^{2+}$ is one of the lowest ever reported for small molecule sensors (Gopidas *et al.*, *Analyst*, 2012, *137*, 5358-62).

**Highly selective and sensitive colourimetric detection of $Hg^{2+}$ ions by unsymmetrical squaraine dyes.** A novel class of sulphonate group containing unsymmetrical squaraine dyes has been synthesized. These dyes showed a selective and sensitive affinity towards $Hg^{2+}$ in methanol and were practically insensitive to most other environmentally and biologically relevant metal ions. Isothermal titration calorimetric (ITC) studies and High Resolution Mass Spectral (HRMS) analysis indicated a 1:1 binding mode. $^{1}H$ and $^{13}C$ NMR of the isolated dye $Hg^{2+}$ adduct showed an unusual addition reaction of $Hg^{2+}$ along the phenyl-squarate carbon–


carbon bond which was also supported by TD-DFT calculations using PM6 level geometries (Suresh *et al.*, *Dyes and Pigments*, **2013**, *96*, 714-21).

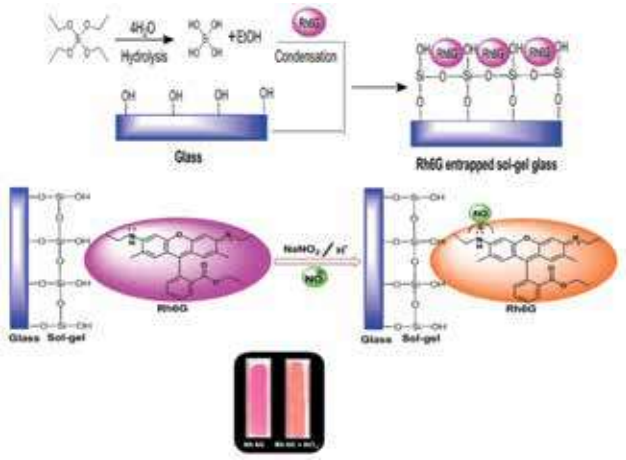
**π-Conjugated polymer–$Eu^{3+}$ complexes: Versatile luminescent molecular probes for temperature sensing.** Carboxylic acid functionalized segmented π-conjugated polymers having oligophenylenevinylene chromophores in the

poly(ethyleneoxide) or polymethylene backbones were custom designed, synthesized and utilized as efficient photosensitizers for $Eu^{3+}$ ions. These π-conjugated polymer–$Eu^{3+}$ ion complexes were found to be thermo-sensitive and behaved as reversible 'turn-on' or 'turn-off' luminescent switches in solution and in solid state. Luminescent decay studies revealed that the red-emission from the $Eu^{3+}$ ion excited state was highly sensitive to temperature which drove the functioning of optical switches. The decay rate constants followed a typical Arrhenius trend over a wide temperature range



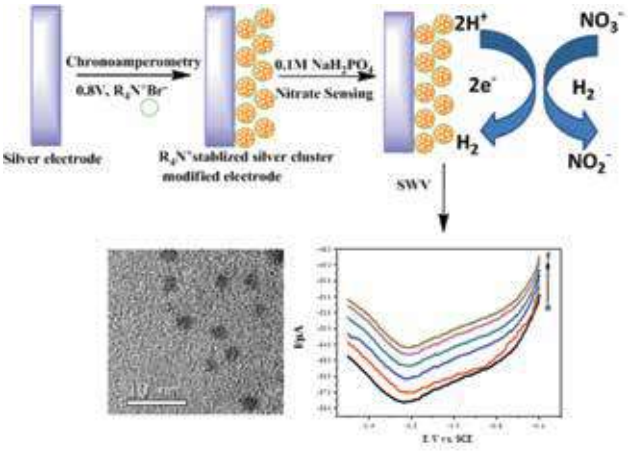

having similar activation energies. Both the nature as well as length of the segmented polymer chain that tied the OPV optical chromophores in the backbone determines the temperature range of the luminescent on–off process. The present strategy opens up new concept and molecular design principles for π-conjugated polymer–lanthanide ion complexes as potential candidates for temperature sensitive luminescent molecular probes (Reddy *et al.*, *J. Mater. Chem. A*, **2013**, *1*, 2256–66).

**Construction of rhodamine 6G entrapped sol-gel film test strip for virtually specific and sensitive sensing of nitrite.** A test strip sensor was developed for nitrite by the entrapment of rhodamine 6G in sol-gel film conformed by different characterization techniques. The pink coloured sol-gel films turns orange on treatment with nitrite containing samples, acidified with sulphuric acid. Linear calibration graph ($R^2$ =0.9980) for nitrite was obtained in the range 40-120 ppb with a limit detection of 7 ppb and this method is by far the




most selective amongst the existing ones. The test strip also showed a reproducible result with RSD of 6% for 40 ppb of nitrite with response time of 10 minutes. The method was applied for the determination of nitrite in different types of environmental samples and the results obtained were in good correlation with those obtained by a standard method (Prasada Rao *et al., Sensors & Actuators B Chemical*, **2012**, 173510-16).

**Synthesis of silver nanocluster film modified silver electrode for trace level sensing of nitrate in aqueous media.** A simple potentiostatic method was used in the synthesis of surfactant stabilized silver nanoclusters onto a silver disc electrode. Characterization of silver nanoclusters was carried out by spectral, morphological and electrochemical techniques. The silver nanocluster film modified electrode was used for square wave voltammetric sensing 1x10$^{-14}$ to1x10$^{-7}$ M of nitrate



with a detection limit of $1.5x10^{-15}$ M. The sensor showed a good precision of 1.2 %( n=3) at $10^{-12}$ M of nitrate. Electrocatalytic studies were undertaken with AgNC modified electrode in 0.1M $NaH_2PO_4$ buffer solution (pH 4.5) containing $10^{-8}$M $NO_3^-$ by scan rate variation and single step chronoamperometric studies (Prasada Rao *et. al.*, *Indian J. Chem.* **2012,** *51B,* 1607-12).

**Virtually specific UV-molecular probe for nitrite sensing.** A highly sensitive and selective UV-molecular probe has been developed for detection of low concentrations of nitrite in aqueous solution based on monotonous increase in absorbance of rhodamine 6G at 385 nm. Addition of nitrite (0 to 0.5 $mgL^{-1}$ ) resulted in a bathochromic shift in UV absorption maximum of rhodamine 6G from 355 to 385 nm. The addition of other anions like $I^-$, $SCN^-$, $ClO_4^-$, $[HgI_4]^{2-}$ and $[Zn(SCN)_4]^{2-}$ showed a bathochromic shift from 525 (the visible range absorption maximum) to 575 nm with no perceptible absorption at 385 nm. This enabled a virtually specific UV-molecular probe for rapid, precise and reliable monitoring of traces of nitrite in environmental samples and food materials. (Prasada Rao *et al.*, *Electrochim Acta, 102*, **2013**, 299-305).

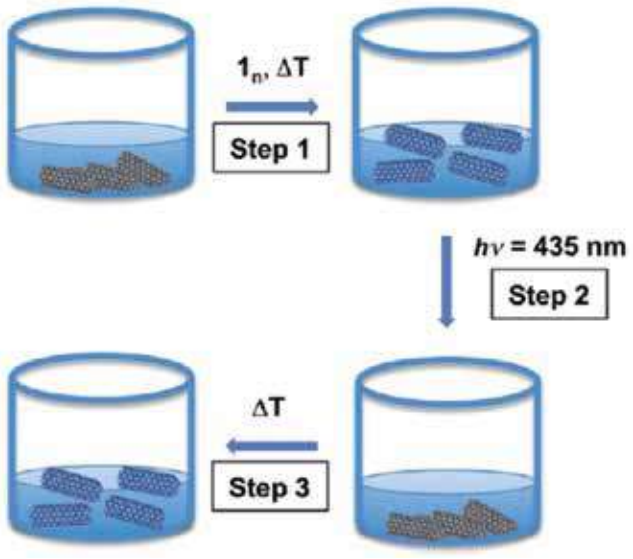
**Anthracene-oxyquinoline dyad as a chemosensor for Hg(II): Unfolding with Hg(II) (sensors).** The design and development of synthetically simple fluorescent reporters with inherent properties of selective binding and sensing of environmentally hazardous cations is considered as an active area of research. Among the different transition metal ions, the detection of $Hg^{2+}$ is attracting attention due to its neurotoxic, genotoxic, and immunotoxic effects. As part of ongoing research in the development of synthetically simple 8-hydroxyquinoline (8-HQ) derived chemosensors, the synthesis and characterization of a new oxyquinoline-anthracene dyad (HQ-AN) which behaves as a selective chemosensor with excellent selectivity and sufficient sensitivity for the detection of $Hg^{2+}$ ions in ACN–H2O system was successfully done. The dyad which originally exists in a folded conformation with the two anthracene moieties in close proximity opens up and the sensing event is characterized by a color change from greenish-blue (excimer) to blue fluorescence (monomer) ( Luxmi Varma *et al., Tetrahedron Lett.*, **2012**, *53,* 3951-54).

## LUMINESCENT AND COMPOSITE MATERIALS

Invention of novel materials and developing low cost processing methodologies forms the back bone of any technological progresses. Chemists with their special ability to manipulate atoms, bonds and composition have achieved the capacity to develop materials with fine-tuned properties suitable for a wide variety of applications. Carbon nanotubes, with their peculiar mechano-electronic properties, is shown to be a replacement candidate for silicon based devices and their hybrid combination phosphorescent materials pave way to novel light emitting devices. Results related to material applications research from the division are described below.

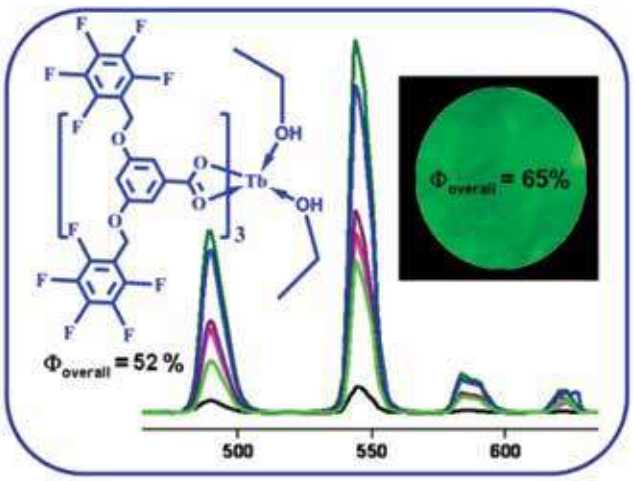
**Azobenzene-based supramolecular polymers for processing MWCNTs.** Carbon nanotube (CNT) based materials have found potential applications in a number of different areas such as opto – and electronics devices, gas storage, sensing, solar cells, biomedicine and therapeutics. However, processing and purification of CNTs remains as one of the major challenges. Among the various proposed methodologies, processes utilizing non covalent interactions are promising as this would lead to minimum structural modifications of the carbon framework, preserving its key electronic and struc-

tural properties. The Institute team has synthesized a molecule having photo and thermo responsive azobenzene unit and H-bonding terminal groups. This molecule forms supramolecular polymer through H-bonding interaction and, in the *trans* configuration, bind to the exosurface of the CNTs resulting in efficient solubilisation. By controlling



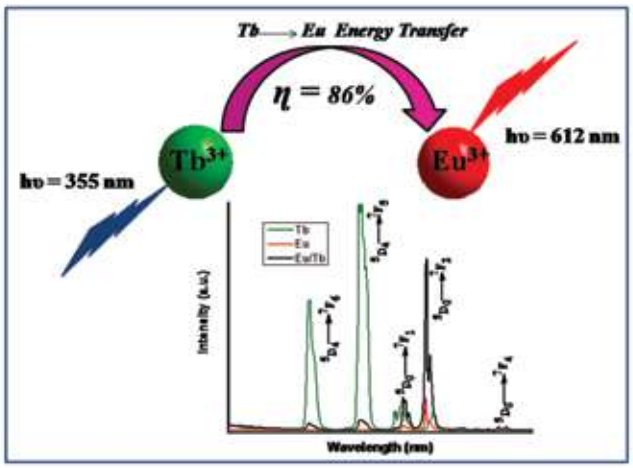

the trans–cis isomerisation of the supramolecular polymer, the investigators could modulate the intermolecular interactions between MWCNTs thus reversibly affecting the suspensions of the MWCNTs, either favouring it (by heating, i.e. cis → trans isomerisation) or inducing the CNTs' precipitation (upon irradiation, trans → cis isomerisation). With this methodology the processability of CNTs can be made simpler by the application of one of the common external stimuli such as light and heat. Schematic representation of the envisaged methodology for controlling the dispersibility of CNTs by means of stimuli-responsive molecule is shown in the figure (Yoosaf *et al.*, *Nanoscale*, **2013**, *5*, 634-45).

**Bright green luminescent molecular terbium plastic materials derived from 3,5-bis(perfluorobenzyloxy)benzoate.** This work focuses on the development of bright green luminescent molecular terbium plastic materials, which exhibits impressive quantum yields (65%) and excited state life time values (1.49 ms).The results demonstrated that the replacement of high-energy C–H vibrations with fluorinated phenyl groups in the 3,5-bis(benzyloxy)benzoate effectively improves the luminescence intensity and lifetimes of lanthanide complexes. It is interesting to note that the designed fluorinated carboxylate is well suited for the sensitization of $Tb^{3+}$ emission ($\Phi_{sen}$ = 52%), thanks to favourable position of the triplet state of the ligand as investigated in the $Gd^{3+}$ complex. On the other hand, the corresponding $Eu^{3+}$ complex shows weak luminescence efficiency ($\Phi_{sen}$ = 24%) due to poor match of the triplet state of the ligand with the emissive excited states of the metal ion. In the present work, efforts have also been made to isolate luminescent molecular terbium plastic materials by combining the unique optical properties of lanthanides with the mechanical characteristics, thermal stability, flexibility and film-forming tendency of polymers (PMMA). The photoluminescence quantum yields of polymer–lanthanide hybrid materials were

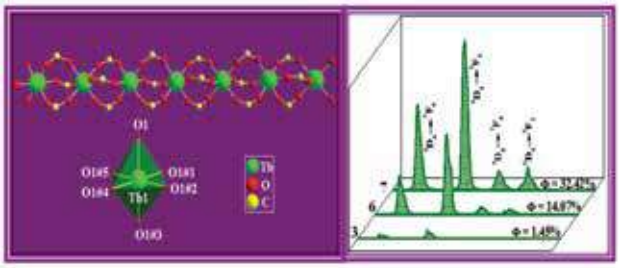



significantly enhanced (53–65%) as compared to that of the $Tb^{3+}$–3,5-bis(perfluorobenzyloxy) benzoate complex (Reddy *et al.*, *J. Mater. Chem.*, **2012**, *22*, 10852–59).

**Highly luminescent and thermally stable lanthanide coordination polymers designed from 4-(dipyridin-2-yl)aminobenzoate.** A new aromatic carboxylate ligand, namely, 4-(dipyridin-2-yl)aminobenzoic acid (HL), was designed and employed for the construction of a series of lanthanide complexes ($Eu^{3+}$,$Tb^{3+}$ and $Gd^{3+}$). Complexes of $Eu^{3+}$and $Tb^{3+}$ were structurally authenticated by single-crystal and were found to exist as infinite 1D coordination polymers with the general formulas $\{[Eu(L)_3(H_2O)_2]\}_n$ and $\{[Tb(L)_3(H_2O)].(H_2O)\}_n$. The photophysical properties demonstrated that the developed 4-(dipyridin-2-yl)aminobenzoate ligand is well suited for the sensitization of $Tb^{3+}$ emission ($\Phi_{overall}$ = 64%) due to the favourable position of the triplet state ($^3\pi\pi^*$) of the ligand [the energy difference between the triplet state of the ligand and the excited state of $Tb^{3+}$ ($\Delta E$) = $^3\pi\pi^* - {}^5D_4$ = 3197 $cm^{-1}$], as investigated in the $Gd^{3+}$ complex. The corresponding $Eu^{3+}$ complex showed weak luminescence efficiency ($\Phi_{overall}$ = 7%) due to poor matching of the triplet state of the ligand with that of the emissive excited states of the metal ion ($\Delta E = {}^3\pi\pi^* - {}^5D_0$ = 6447 cm−1). Another noteworthy feature from the current study is an efficient $Tb^{3+}$-to-$Eu^{3+}$ energy transferability in a heteronuclear lanthanide complex, and hence it is a potential candidate for applications in the field of colour displays, luminescence sensors, and structural probes (Reddy *et al.*, *Inorg. Chem.* **2012**, *51*, 8818–26).

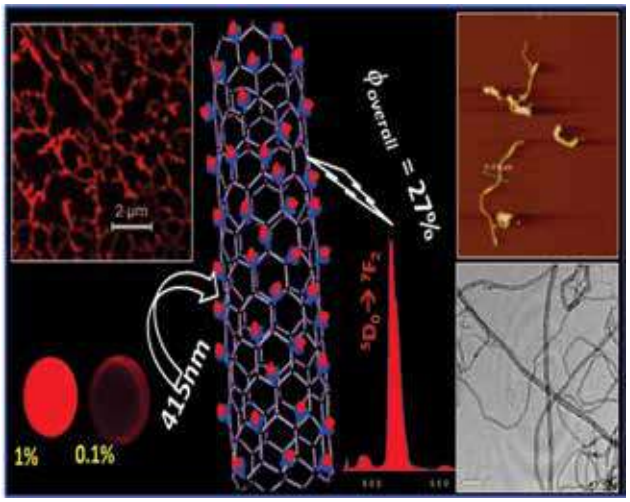



**Unique green luminescent solvent-free terbium coordination polymer.** A unique, green luminescent solvent-free terbium coordination polymer based on the new 4-[4-(9H-carbazol-9-yl)-butoxy] benzoate ligand synthesized and structurally authenticated by single-crystal X-ray diffraction. The polymer exhibited an unusually low coordination number for a terbium cation (CN = 6). It is interesting to note that each carboxylate group exhibits only a bridging-bidentate mode, with a complete lack of more complex connectivities that are commonly observed for extended lanthanide-containing solid-state structures. While the reason for this rare coordination environment is unclear, it is possibly related to the steric influence that results from the bulky nature of the ligand species. The presence of bidentate nitrogen donor ligands significantly enhanced the quantum yields of both the $Eu^{3+}$ and $Tb^{3+}$ benzoate complexes. This observation can be explained on the basis of additional energy transfer from the ancillary ligand to the carboxylate ligand in the ternary complexes, which in turn enhances the overall sensitization efficiency of the complex molecule. This result may be further explained on the basis of the minimization of non- radiative decay rates in monomeric complexes in comparison with those of polymeric species (Reddy *et al.*, *Dalton Trans.*, **2012**, *41*, 14671–82).




**Visible-light excited red emitting luminescent nanocomposites derived from Europium (III)-phenathrene-based fluorinated β-diketonate complexes and multi-walled carbon nanotubes.** A novel β-diketone ligand, 4,4,5,5,5-pentafluoro-3-hydroxy-1-(phenanthren-

3-yl)pent-2-en-1-one (Hpfppd), which contains a polyfluorinated alkyl group, as well as a conjugated phenanthrene unit, was synthesized and utilized for the construction of two new europium coordination compounds $[Eu(pfppd)_3(H_2O)_2]$ and $[Eu(pfppd)_3(tpy)]_2$ (where tpy = terpyridine). The designed europium compounds were well characterized and their solid-state photoluminescence (PL) properties were examined. The introduction of a highly conjugated phenanthrene moiety into the 3-position of the β-diketonate ligand remarkably extended the excitation window of the corresponding $Eu^{3+}$ complexes towards the visible region (up to 500 nm). The PL study demonstrated that the replacement of high-energy oscillators O–H (water molecules) with an ancillary ligand terpyridine leads to an impressive enhancement in both overall quantum yield (from 31 to 75%) and $^5D_0$ lifetime (from 0.51 to 1.04 ms) values. The solid-state quantum yield of $[Eu(pfppd)_3(tpy)]_2$ is found to be the highest so far reported in the literature under

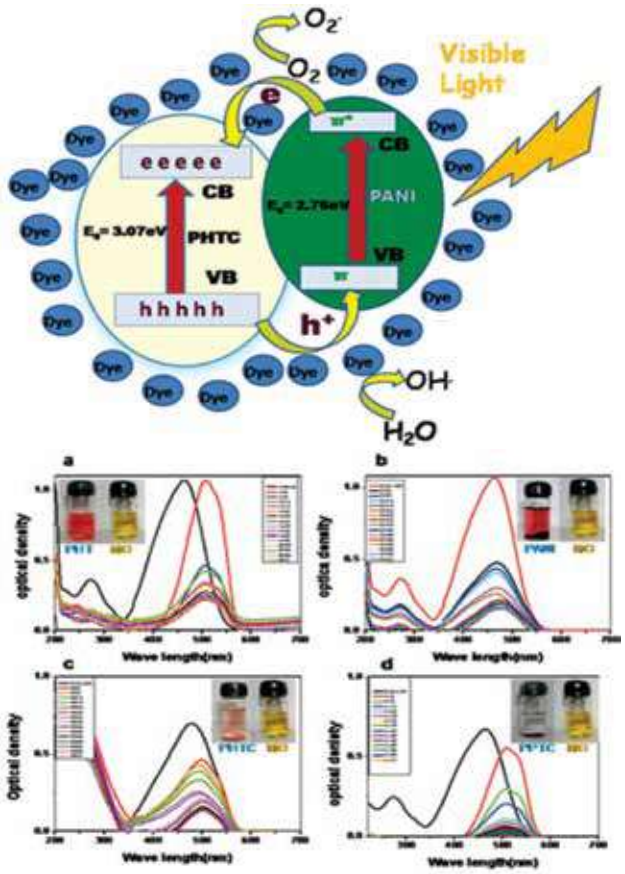



blue-light excitation (415 nm). To gain a wider applicability and also to overcome the poor thermal, photochemical and mechanical stabilities of $Eu^{3+}$-β-diketonate luminophores a nanocomposite material (1@oxMWCNTs) also has been developed, which exhibited high thermal stability and luminescence efficiency (Reddy *et al., J. Mater. Chem*. C, **2013**, *1*, 160–70).

**Development of electromagnetic interference shielding materials from the composite of nanostructured polyaniline-polyhydroxy iron-clay and polycarbonate.** Nanostructured multifunctional electromagnetic composites have attracted a great deal of attention for their potential applications in various fields. EMI shielding essentially depends on the conductivity, dielectric constant and magnetic property of the materials for various applications. Materials having dual property of conductivity and magnetic properties are suitable for EMI shielding applications. In the present work, the development of novel electromagnetic interference shielding material from the composite of nanostructured polyaniline- polyhydroxy iron-clay (PPIC) and polycarbonate through solution blending process is 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 were 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. Poly. Sci.*, **2013**, *128*, 1756–63).

**Nanostructured polyaniline-polytitanate-clay composite for photocatalytic applications: Preparation and properties.** Nanostructured multifunctional polyaniline-polytitanate-clay composite (PPTC) was prepared by the polymerization of anilinium hydrochloride in a dispersion of polytitanate functionalized clay at room temperature. During

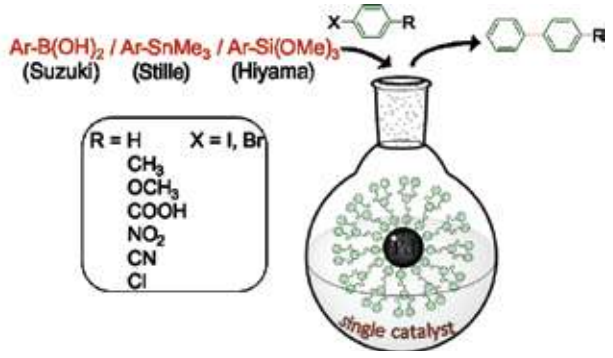
polymerisation, polyaniline form linkages between these disorganized titanate modified clay layers and may co-structure with the self-assembled polyaniline layers. Later, they rolled up to form three dimensionally ordered nanotubes by the self-assembly process which was confirmed by morphological analysis, EDS and XRD. Photocatalytic efficiency of this PPTC was demonstrated by performing the photodegradation studies of methylene blue and methyl orange at room temperature under natural light irradiation. Studies revealed that this novel PPTC nanocomposite can be used as a prospectable candidate for the disposal of pollutants present in the environment (*Sudha et al., RSC Adv.*, **2012**, *2*, 6228–36.




## ORGANIC CATALYSIS AND SYNTHETIC METHODOLOGIES

The quest for sustainable development in chemistry has tempted both organic chemists and environmental chemists to search for green and environmentally friendly methodologies. For sustainable development, the methodologies should address three main factors: 1) reduced consumption of raw materials and energy, 2) maximum use of renewable resources and 3) minimal use of harmful chemicals. In the above context, catalysis is the key technology to achieve these goals. New catalytic methods need to be developed and known methods must be improved for sustainable organic synthesis. These new methods must be environment friendly with minimum of waste, with high efficiency and by utilizing processes with 100% atom economy. The development of efficient methods to access complex molecules with multiple stereogenic centers has become a substantial challenge in both academic research and industrial applications. The catalytic methods developed towards various molecules are discussed below.

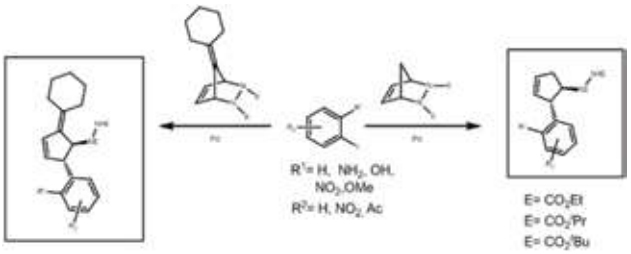
**Synthesis, characterization and catalytic applications of palladium nanoparticle-cored dendrimers stabilized by metal-carbon bonds.** Synthesis and characterization of four generations of palladium nanoparticle-cored Fréchet type dendrimers (Pd-$G_n$), possessing direct palladium-carbon bonds were carried out. Synthesis of these core-shell materials were achieved by the simultaneous reduction of different generation diazodendrons and Pd(II) in an organic medium. The resulted organic-inorganic




hybrid materials were characterized by IR, NMR as well as UV-visible spectroscopic techniques. Formation of nearly spherical particles of 2 – 4 nm diameters was confirmed by TEM studies. The ef-

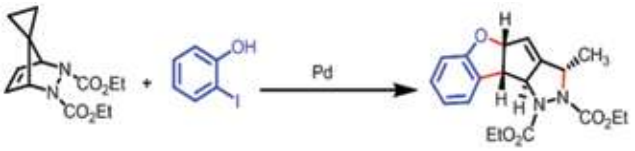
ficiency of a member of this series, Pd-$G_1$ in catalyzing important C-C bond forming reactions such as Suzuki, Stille and Hiyama couplings was investigated. The results clearly showed that Pd-$G_1$ can efficiently catalyze the cross coupling of aryl boronic acids, aryl stannanes and organosilicon compounds with differently substituted aryl halides in addition to efficiently catalyzing hydrogenation reactions. The catalyst exhibited good recovery and recyclability in Suzuki coupling reactions. The study suggested that a single catalyst capable of catalyzing several reactions can be designed (Gopidas *et al., Eur. J. Org. Chem*., **2012**, 30447-58).

**An exclusive approach to 3,4-disubstituted cyclopentenes and alkylidene cyclopentenes *via* palladium catalyzed ring opening of azabicyclic olefins with aryl halides.** A mild, simple and efficient strategy for the exclusive synthesis of disubstituted cyclopentenes and alkylidene cyclopentenes



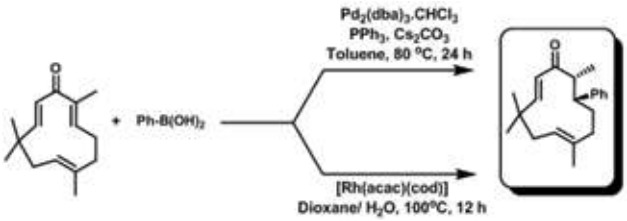

has been developed. The generality of the method was established by the reactions of various bicyclic hydrazines with aryl and heteroaryl iodides. The products of the developed methodology can be used as potential intermediates towards a number of biologically relevant molecules by utilizing the multifunctionality. This was established by the synthesis of antidepressant Cypenamine. Thus the developed reaction can also be viewed as a practical and rapid approach towards *trans*-disubstituted cyclopentyl amines (Radhakrishnan *et al.*, *RSC Adv.*, **2013**, *3*, 7751-57).

**Palladium catalyzed skeletal rearrangement of spirotricyclic olefins: A facile one pot strategy for the synthesis of a novel motif with cyclopentene fused to benzofuran and pyrazolidine.** A facile one pot catalytic tandem reaction for the synthesis of tetracyclic skeleton consisting of densely functionalized cyclopentene fused to a benzofuran and pyrazolidine skeleton has been developed. This is the first report on utilizing a cyclopropane bearing spirotricyclic olefin in palladium catalyzed organic transformations wherein complexity is generated from two simple achiral molecules. The benzofuran-cyclopentane core can be found in more than 200 biologically active molecules. The developed strategy opens a route towards the development of catalytic tandem reactions towards the synthesis of



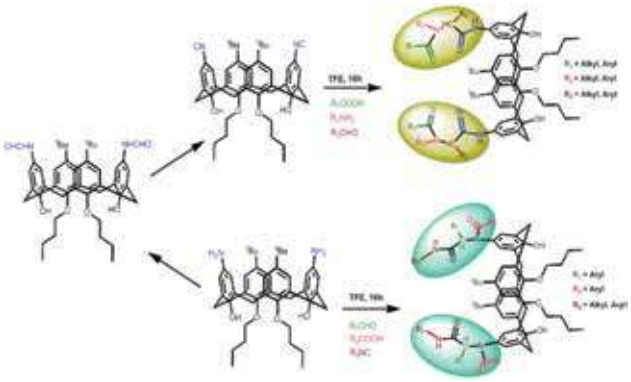

polycyclic molecules with multiple stereocentres. Proper functionalization of azabiyclic olefins can carry forward the palladium relay from the initial *syn* addition of organopalladium species leading to highly functionalized molecules. The methodology assumes significance because complexity is generated from simple and distinct achiral molecules (Radhakrishnan *et al., Chem. Eur. J.*, **2013**, DOI: 10.1002/*chem*.201301475).

**Transition metal catalyzed regio and stereoselective 1,4-conjugate addition of boronic acids to zerumbone: A facile route towards novel zerumbone derivatives.** An efficient, catalytic and general method has been developed for the synthesis of novel zerumbone derivatives, *via* rhodium(I) catalyzed 1,4-conjugate addition of various boronic acids. The addition across the enone of zerumbone took place in a regio- and stereoselective manner. A comparative study of the reactivity of organopalladium and organorhodium reagents towards the 1,4-conjugate addition reaction was done and it led




to the conclusion that, in most cases organopalladium reagents showed inferior reactivity compared to that of organorhodium reagents. The synthesized molecules have high synthetic utility and can be efficiently utilized in the synthesis of a number of biologically relevant molecules (Radhakrishnan *et al.*, *Synthesis*, In Press, ID - SS-2013-04-0291-OP.R1).

**Synthesis of upper rim N-formamido and isocyanocalix[4]arenes: Adaptation of Ugi-4-CR on calix[4]arenes towards peptide-like architectures.** A multicomponent synthetic methodology to access large diversities of multifunctionalized

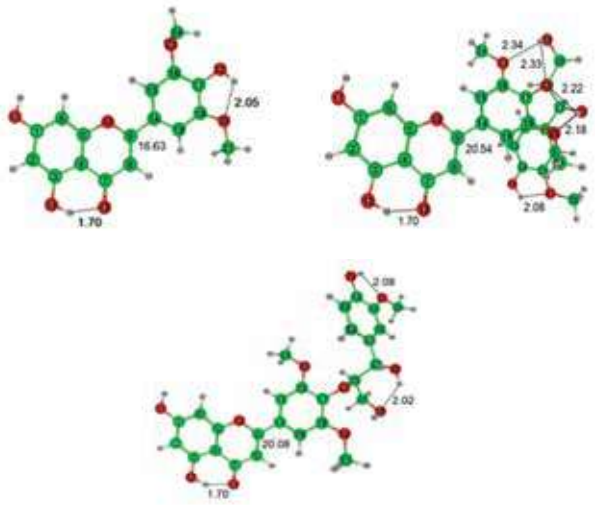


calix[4]arenes *via* Ugi reaction of aminocalix[4] arenes and novel isocyanocalix[4] arenes was developed. The reaction allows to make a variety of α-acylaminocarboxamide derivatives of calix[4] arene with considerable generality and simplicity. This methodology enabled the synthesis of multifunctionalized calixarenes bearing heteroaromatic rings and also chromophoric groups like naphthyl moeity in the peptoid chain. In contrast to many other peptidocalixarenes reported, the compounds obtained using this methodology has excellent solubility in non-polar solvents. During the course of the present study, the conditions for attaining N-formamido and diisocyanocalix[4]arenes were also optimized successfully, which are of great synthetic use (Luxmi Varma *et al.*, *Tetrahedron,* **2012**, *68,* 6323-28).

## BIOACTIVE NATURAL PRODUCTS

Natural products represent a rich source of new molecules with pharmacological or biological properties, which are lead compounds for the development of new drugs. The inspiration for drug discovery since the inception of penicillin till date can be mainly attributed to natural products. 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 the activities undertaken are listed below.

**Studies on bioactive compounds of 'Njavara', the unique medicinal rice of Kerala.** The three important antioxidant compounds namely, tricin and two rare flavonolignans -tricin 4'-O-(*erythro*-β-guaiacylglyceryl) ether and tricin 4'-O-(*threo*-β-guaiacylglyceryl) ether, found to occur in higher proportions in Njavara(black-glumed) rice bran



were further investigated for molecular mechanisms of their anti-inflammatory and anti cancer effects, in collaboration with Department of Biochemistry, University of Kerala, Thiruvananthapuram and Rajiv Gandhi Centre for Biotechnoloy (RGCB), Thiruvananthapuram, respectively. The compounds substantially attenuated the levels of various inflammatory enzymes like COX, 5-LOX, NOS and oxidative stress, induced by LPS in cell culture studies with human peripheral blood mono nuclear cells (Jayalekshmi *et al.*, *International Immunopharmacology,* **2012,** *14*, 32–38). The study revealed that the inhibitory effects of these compounds on cell signalling pathways are responsible for its anti-inflammatory activity. Tricin is a known anti-carcinogenic compound. In the studies conducted, it was found that the rare flavonolignans also induced apoptosis in multiple cancer cells through mitochondrial membrane potential loss and subsequent chromatin condensation and significantly increased the Annexin V binding (Jayalekshmi *et al.*, *Journal of Natural Medicines*, **2013**, DOI:10.1007/s11418-012-0710-7). The antioxidant, anti-inflammatory and anticancer effects of the above bioactive compounds identified in Njavara, confirm the medicinal properties of 'Njavara' used in Ayurveda and the findings corroborate with its preferential use in indigenous medicine, over staple varieties (Jayalekshmi *et al.*, *J. Food Biochem.* **2012**, doi:10.1111/j.1745-4514.2011.00646).

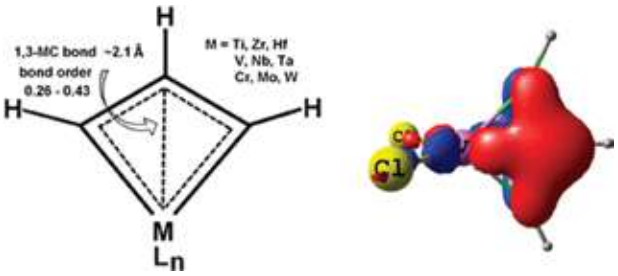
**Nimbolide retards tumor cell migration, invasion, and angiogenesis by down regulating MMP-2/9 expression *via* inhibiting ERK1/2 and reducing DNA-binding activity of NF-kB in colon cancer cells.** Neem (*Azadirachta indica*) is a traditional medicinal plant, which is commonly used for treating various human ailments. Nimbolide, a major constituent of the neem leaf has been shown to exert its antiproliferative effects in various cell lines. In continuation of work on the anticancer activity of nimbolide, it is further demonstrated that nimbolide effectively inhibits proliferation of WiDr colon cancer cells through inhibition of cyclin A leading to S phase arrest. It also caused activation of caspase-mediated apoptosis through the inhibition of ERK1/2 and activation of p38 and JNK1/2. Further nimbolide effectively retarded tumor cell migration and invasion through inhibition of metalloproteinase-2/9 (MMP-2/9) expression, both at the mRNA and protein level. It was also a strong inhibitor of VEGF expression, promoter activity, and *in vitro* angiogenesis. Nimbolide suppressed the nuclear translocation of p65/p50 and DNA binding of NF-kB, which is an important transcription factor for controlling MMP- 2/9 and VEGF gene expression (Mangalam S Nair et al., *Molecular Carcinogenesis* **2012,** *51*, 475–90).

**Sesquiterpene lactones isolated from *Elephantopus scaber L.* inhibits human lymphocyte proliferation and the growth of tumour cell lines and induces apoptosis *in vitro.*** Bioassay-guided isolation of the whole plant of chloroform extract of South Indian *Elephantopus scaber* afforded the known sesquiterpene lactone, deoxyelephantopin, and isodeoxyelephantopin whose structures were determined by spectroscopic methods. These compounds caused a dose dependent reduction in the viability of L-929 tumour cells in 72 h culture ($IC_{50}$ value of 2.7 µg/mL and 3.3 µg/mL) by the cell viability assay. Both the compounds act selectively on quiescent and PHA-stimulated proliferating human lymphocytes and inhibited tritiated thymidine incorporation into cellular DNA of DLA tumour cells. The compound deoxyelephantopin at a concentration of 3 µg/mL caused maximum apoptotic cells. It also exhibited significant *in vivo* antitumour efficacy against DLA tumour cells. The results, therefore, indicate that the antiproliferative property of deoxyelephantopin and isodeoxyelephantopin could be used in regimens for treating tumors with extensive proliferative potencies. (Mangalam S. Nair *et al., J Biomed. Biotechnol.*, **2012**, 721285. doi: 10.1155/2012/721285).

## THEORETICAL CHEMISTRY

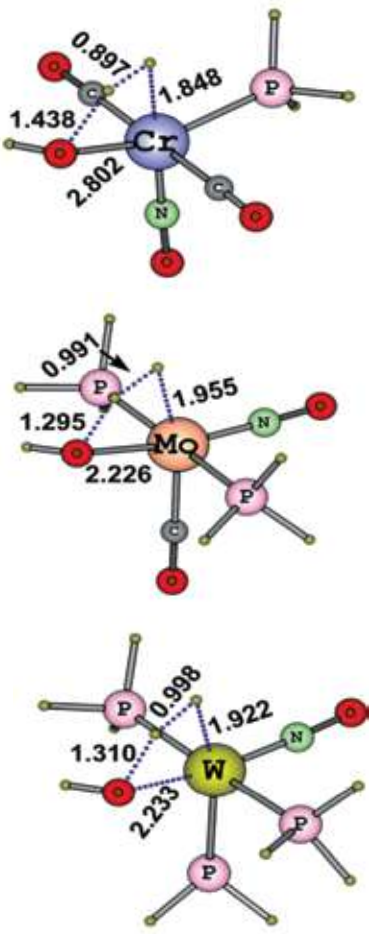
In applied theoretical chemistry area, the state-of-the-art high accuracy computational quantum chemistry methods have been used to study structure and reactivity of molecular systems to provide understanding of the theoretical and experimental results. The structural, energetic and bonding data obtained from theoretical calculations are used to predict new functional molecules and also to predict the outcome of a reaction. The main focus lies in the transition metal-mediated homogeneous catalytic reactions. Recent work has been carried out on N-heterocyclic carbene mediated reactions, CC-bond alkene and alkyne metathesis reactions, ruthenium-mediated water splitting reactions and $CO_2$ sequestration reactions.

**1,3-Metal-carbon bonded metallacyclobutadienes.** Alkyne metathesis provides an important homogeneous catalytic procedure for the creation of CC triple bonds. The metathesis reaction often passes through stable metallacyclobutadiene (MCB) intermediates. DFT studies on the formation of MCBs from chloro-ligated alkylidyne complexes of group 4, 5, and 6 transition metals revealed that a new type of 1,3-metal-carbon bonding exists




between the metal and the β-carbon which render planar tetra-coordinate character to the β-carbon. On the basis of this bonding, a new mechanism for metathesis is proposed which is different from the well-established Katz's mechanism. This mechanism suggested that stable MCB complexes can act as metathesis catalyst by reacting with alkyne to form a bicyclic intermediate which subsequently disproportionate to yield alkyne and the catalyst (Suresh et al., *Organometallics*, **2012**, *31*, 7171-80).

**Mechanism of water-assisted dihydrogen elimination in group 6 octahedral metal hydride complexes.** Metal hydride complexes of transition metals have been widely investigated for their potential use in producing hydrogen from hydrogen-rich molecules. In many water-splitting reactions, hydrogen evolution is thought to be preceded by dihydrogen bonding, a noncovalent interaction of the type H...H between the hydride ligand and the hydrogen of the incoming molecule. DFT studies have been conducted to unravel possible mechanisms (associative, dissociative and migratory insertion mechanisms) of dihydrogen elimination from phosphine based octahedral bis-, tris- and tetrakis-phosphine hydride complexes of group 6 transition metals (Cr, Mo and W) in the presence of water. In many cases, the migratory insertion mechanism simultaneously operated with the dissociative mechanism as a minor pathway, whereas associative mechanism was found to be inactive in the reaction.




However, irrespective of the mechanisms, dihydrogen elimination invariably occurs with the formation of a dihydrogen bonded transition state. The mechanistic studies clearly suggested that group 6 octahedral metal hydride complexes are attractive targets for the design of water splitting reactions (Suresh et al., *Dalton Trans.*, **2012**, *41*, 11018–25).

# MATERIAL SCIENCES AND TECHNOLOGY DIVISION

The Material Sciences and Technology Division has been actively engaged in R & D of advanced functional materials. The major research areas of the division during 2012-13 were (i) nanoceramics (ii) electronic materials (iii) polymer based materials (iv) superconducting and magnetic materials (v) light alloys and composites (vi) mineral based value added products. The division has initiated several major projects under the 12 th five year plan in the area of advanced functional materials for energy, strategic, automobile, etc. The Division has published 61 papers in SCI journals, two book chapters and was granted two foreign patents. Given below are the highlights of the Division for the period 2012-13.

## Highlights:

1. As part of the self cleaning TiO2 coatings for solar cell covers project, a demonstration set-up consisting commercial solar cell panel assembly with glass covers coated with high photoactive nano TiO2 on the top was fabricated and installed. The online, computer control monitoring unit was also integrated.
2. Low-k silica dielectric ink was successfully synthesized at lab scale.
3. Crystallographically oriented iron pnictide superconducting material with high critical field developed.
4. Developed Al-12Si-Mg-Cu-Ni piston alloy.
5. Fabricated low pressure cast Al alloy (LM25) compressor cover and triple clamp components for automotive applications.
6. Developed electroless Ni-B-Al2O3/SiC composite coating on aluminium substrates.

# पदार्थ विज्ञान तथा प्रौद्योगिकी विभाग

पदार्थ विज्ञान तथा प्रौद्योगिकी प्रभाग उन्नत कार्यात्मक सामग्री के अनुसंधान एवं विकास पर सक्रिय रूप से लगे हुए है । वर्ष 2012-13 के दौरान प्रभाग के प्रमुख अनुसंधान क्षेत्र ये थे (i) नैनोसिरेमिक्स (ii) इलेक्ट्रॉनिक सामग्री (iii) पॉलीमर आधारित सामग्री (iv) अतिचालक और मैग्नेटिक सामग्री (v) हल्के मिश्र और कंपोजिट और (vi) खनिज आधारित मूल्य वर्धित उत्पादों । प्रभाग ने 12 वीं पंचवर्षीय योजना के तहत ऊर्जा, स्ट्रेटेजिक, ऑटोमोबाइल, आदि के लिए उन्नत कार्यात्मक सामग्री के क्षेत्र में कई प्रमुख परियोजनाओं को शुरू कर दिया है । प्रभाग ने एससीआई पत्रिकाओं में 61 शोध पत्र और दो पुस्तक अध्यायों का प्रकाशन किया है और प्रभाग को दो विदेशी पेटेंट प्रदान किये गये हैं । वर्ष 2012-13 की अवधि के दौरान प्रभाग की मुख्य विशेषताएं नीचे दी गयी हैं।

## मुख्य विशेषताएं:

1. सौर सेल कवर्स परियोजना के लिए स्वयं सफाई टाइटेनियम डाइऑक्साइड कोटिंग्स के भाग के रूप में शीर्ष पर उच्च प्रकाश सक्रिय नैनो टाइटेनियम डाइऑक्साइड लेपित गिलास कोटिंग्स के साथ वाणिज्यिक सौर सेल पैनल असेंबली शामिल एक प्रदर्शन सेटअप का फैब्रिकेशन और संस्थापना की गयी । ऑनलाइन कंप्यूटर नियंत्रण निगरानी इकाई भी एकीकृत की गयी ।
2. प्रयोगशाला पैमाने पर कम- के सिलिका डाइइलेक्ट्रिक स्याही सफलतापूर्वक संश्लेषित की गयी ।
3. उच्च क्रांतिक क्षेत्र के साथ क्रिस्टल संरचनात्मकता उन्मुख लोहा प्निक्टिड अतिचालक सामग्री विकसित की गयी ।
4. Al-12 Si-Mg-Cu-Ni पिस्टन मिश्रधातु विकसित किया गया ।
5. ऑटोमोटिव अनुप्रयोगों के लिए कम दबाव संचकन एल्यूमीनियम मिश्र धातु (LM25) संचकन कंप्रेसर कवर और ट्रिपल क्लांप घटकों का निर्मण किया गया।
6. एल्यूमीनियम क्रियाधारों पर इलेक्ट्रो विहीन Ni-B-Al2O3/SiC कंपोजिट कोटिंग विकसित किया गया ।

## FUNCTIONAL MATERIALS

### Silica Dielectric Ink for Printed Electronic Applications

Printed electronics is all set to revolutionize the electronics world by fabricating electronic devices on polymeric substrate materials such as plastic, textiles etc. using electrically functional inks employing standard printing processes such as screen printing, and ink-jet printing. The use of functional materials and nanoparticles in inks has broaden the scope of applications to low cost electronics. Presently, one of the biggest challenges facing printed electronics is the lack of qualified material solutions usable for printing with low curing temperature. Over the last several years focus of industry has been on the development of metallic inks like silver and copper and less care has been given to high K functional dielectric inks.

A


B

*Fig. 1(a) CSIR-emblem printed using of silica ink, on Mylar substrate (b) Comparison of silica ink (white) with commercial yellow pigment ink on Mylar substrate*

As a first step towards realizing a printed electronic circuit, the Institute took up the challenge to develop a low loss, low $\varepsilon_r$ dielectric ink and suitably optimized their rheological characteristics for screen printing, by varying the sedimentation, surface tension and viscosity. The novel and cost effective self healing ink is silica based which is screen printable on flexible substrates like Mylar sheet for high frequency printed electronic applications (Fig. 1). The colloidal ink comprises of silica as the major filler with suitable organic vehicles. Thixotropic behaviour of the colloidal silica ink is optimized based on screen printing technique. Solvent mixture, natural dispersant, polymer binder etc. played a key role in controlling the colloidal stability of the ink. The radio and microwave dielectric properties were investigated for the optimized silica ink.

### Demonstration set-up for self-cleaning titania coated glass for solar cells. Self cleaning titania coatings on solar panels for increased efficiency

Photo active titanium oxide nano coatings were developed on solar cell glass covers to remove the contaminants getting deposited from the environment, thus decreasing the efficiencies of panels considerably. This problem is reported as severe, for urban areas, remote and difficult to reach locations. Periodic cleaning calls for additional energy and expenditure. A specific composition of sun light active, partly hydrophobic, nano titanium oxide developed was applied to glass surface on solar panel and was integrated with an automated data acquisition system to measure voltage and current uninterruptedly at specific intervals from coated and uncoated panels. The titanium oxide is characterized by particle size <50 nm, crystallite size < 10 nm, specific surface area 140 $m^2/g$, and contact angle >80°. The NIIST titania composition exhibited very high photocatalytic activity (~94%) when compared with that of pure titania. The coated glass has transmittance >98% compared to the uncoated

glass. Initial results indicated considerable improvement in efficiency on coated panels. The experimental station installed in NIIST is provided in Fig. 2.


*Fig. 2. Demonstration set up installed in NIIST*

## Facile synthesis of "Quench-Free Glass" and ceramic - glass composite for LTCC applications

The main difficulty in using glasses for lowering the sintering temperature of ceramic is that it requires additional process step like preparation of glass through quenching and grinding into fine powder. Usually glass quenching requires ultra fast cooling rate to preclude crystal nucleation and growth. The qualification of a suitable quench-free glass could avoid the cumbersome cooling and tempering steps in melt quench synthesis. Moreover, in LTCC technology, casting of ceramic into thin tapes is one of the crucial procedures. The presence of glassy phase in the LTCC composition makes the tape casting process more complex and tedious.

Only very few glasses could avoid the long procedures of quenching in their synthesis. The novel glass developed in CSIR-NIIST with composition 10 mol% ZnO – 2 mol% $B_2O_3$ – 8 mol% $P_2O_5$ – 80 mol% $TeO_2$ (ZBPT) was found to be a typical 'quench free' glass which can be prepared by quenching as well as slow cooling the melt.The ZBPT glass prepared by both methods showed similar microwave dielectric properties. ZBPT glass has an $\varepsilon_r$ of 22.5 (at 7 GHz), $Q_u \times f$ of 1500 GHz and $\tau_f$ of -100 ppm/ °C. These glass compositions are ideal for reducing the sintering temperature of a double perovskite tellurate $Sr_2ZnTeO_6$ (SZT), which can be a potential candidate for LTCC applications. The ceramic – glass composites of SZT and ZBPT are prepared through two convenient methods : (*a*) conventional way of co-firing the ceramic with ZBPT glass powder and (*b*) a non conventional facile route by co-firing the ceramic with precursor oxide mixture of ZBPT glass at 950 °C. In the former route, SZT + 5 wt% ZBPT composite sintered at 950 °C showed moderately good microwave dielectric properties ($\varepsilon_r$ = 13.4, $Q_u \times f$ = 4500 GHz and

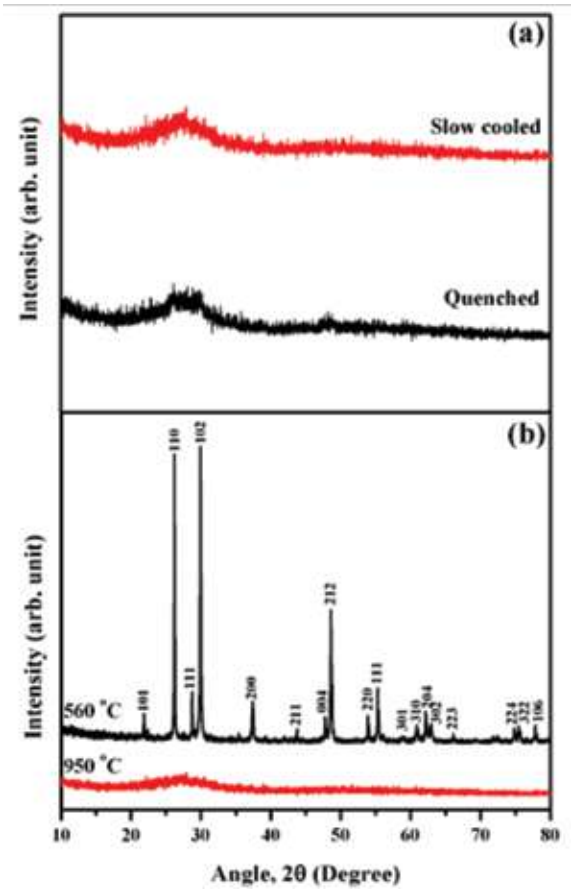



*Fig. 3. XRD patterns of (a) ZBPT glass prepared by quenching and slow cooling*
*(b) ZBPT glass annealed at 560 °C and 950 °C.*

$\tau_f$ = -52 ppm/ °C). Though the SZT + 5 wt% ZBPT composite prepared through the non conventional method also showed similar microwave dielectric properties ($\varepsilon_r$ = 13.8, $Q_u \times f$ = 5300 GHz and $\tau_f$ = -50 ppm/ °C), the synthesis procedure is much simplified in the latter case. The composites are found to be chemically compatible with Ag. The composite containing 5 wt% ZBPT prepared through conventional and non conventional ways showed linear coefficients of thermal expansion of 7.0 ppm/ °C and 7.1 ppm/ °C respectively. Both the composites have a room temperature thermal conductivity of 2.1 W $m^{-1}$ $K^{-1}$.

## SmFeAsO Superconductor with preferred crystallographic orientation and enhanced critical current density

Samarium based iron pnictide (SmFeAsO) is a promising superconductor because of its high critical temperature and large critical field. However, the transport critical current of the material is not adequate for practical application due to its random crystallographic orientation. In a recent investigation, it was found that simultaneous doping of $F^-$ at $O^{2-}$ site (electron doping) and $Ca^{2+}$ at $Sm^{3+}$ site (hole doping) causes considerable structural as well as microstructural modification in the system wherein the crystallographic (*00l*) planes are oriented preferentially. In addition, the critical temperature is also found to increase remarkably from 40.5 K to 53.8 K. Consequent to the dramatic change in the crystallographic orientation and the significant enhancement in critical temperature, the transport critical current of the binary doped superconductor has increased remarkably (by two fold). The results strongly indicate the scope for development of SmFeAsO based practical conductors with higher current carrying capacity by properly aligning the preferentially oriented planes along a single axis by methods such as powder-in-tube technique as done in the case of bismuth based superconducting based tapes.

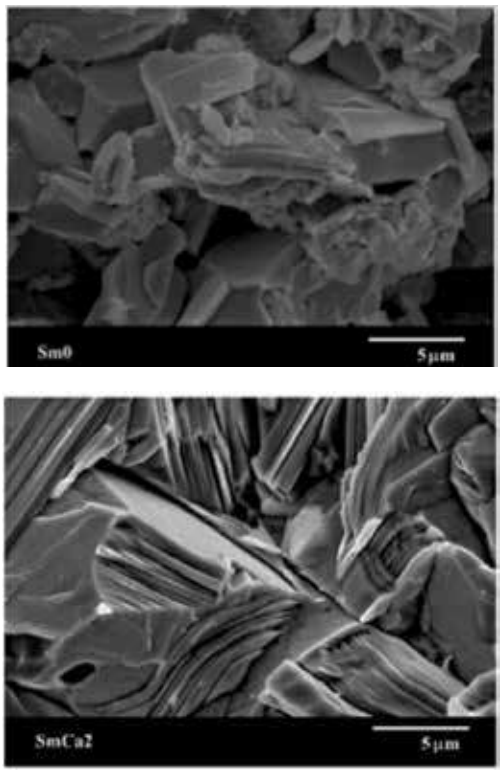



*Fig. 4. Microstructural change due to binary doping (Sm0 – undoped, SmCa2 – binary doped)*

## Magneto-dielectric effect and re-entrant spin glass behavior in insulating $Sm_2NiMnO_6$ double perovskite

The structure and magneto-dielectric properties of $Sm_2NiMnO_6$ double perovskite have been studied. The pure monoclinic bulk phase of $Sm_2NiMnO_6$ is an intrinsic B-site disordered ferromagnet showing a second order magnetic phase transition ~ 157 K, along with a low temperature re-entrant spin glass-like transition (~ 20 K) due to the inherent coupling of Ni-Mn network with $Sm^{3+}$ ion. Moreover, it is an insulator with room temperature dc resistivity ~$10^8$ Ω cm. Further, the high dielectric permittivity (~$10^3$) coupled with a shift in dielectric maxima towards higher temperature with frequency, analysis of the phenomenological parameters ($T_m$, $T_B$, γ, $\Delta T_{relax}$), and the validity of non-linear Vogel–Fulcher relation, this ferromagnetic insulator is defined as a relaxor-type dielectric material. Importantly, it exhibits a positive in-

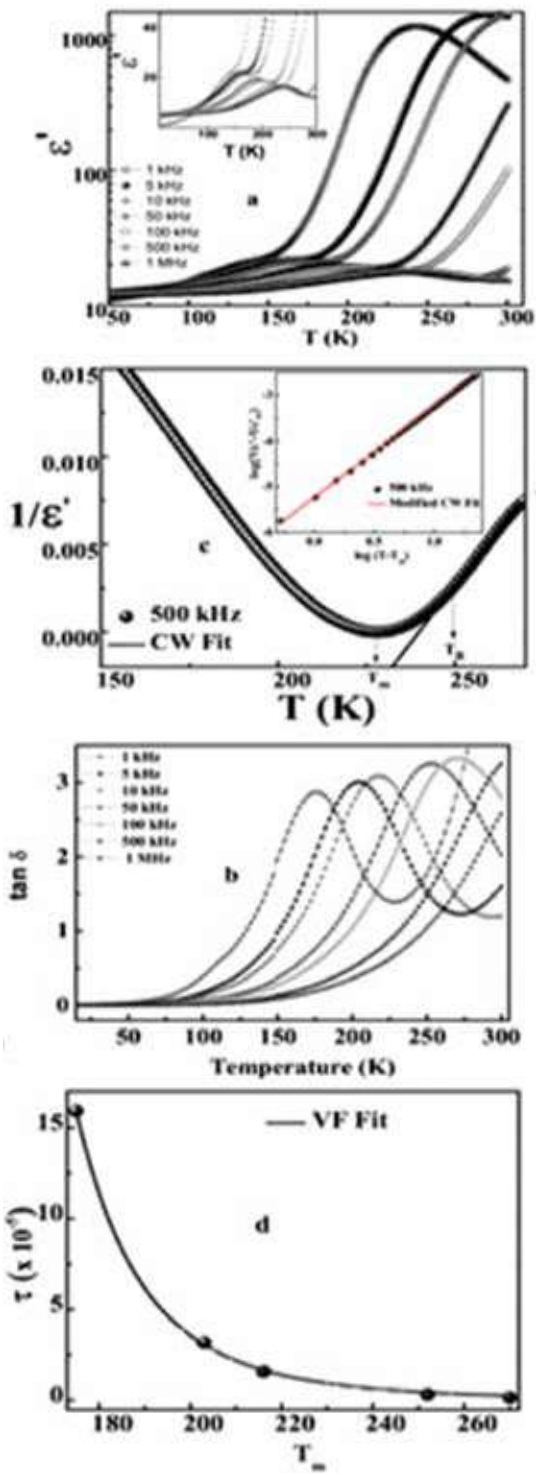
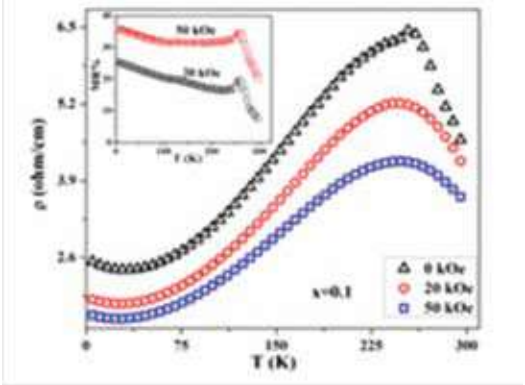



*Fig. 5. (a) Real part of the dielectric permittivity (ε′) of $Sm_2NiMnO_6$ as a function of temperature at several frequencies. Inset expanded view of low temperature relaxation, (b) Dielectric loss as a function of temperature at several frequencies, (c) Temperature variation of the reciprocal dielectric constant (1/ε′) fitted with Curie–Weiss law at 500 kHz. Inset log $(1/\varepsilon'-1/\varepsilon'_m)$ as function of log $(T-T_m)$ at 500 kHz, (d) Non linear Vogel Fulcher fitting.*

trinsic magnetodielectric (MD) response ~2 % at 100 kHz under a low magnetic field of 0.5 T close to 150 K. The intrinsic MD effect indicates a connection between spin orientations on the two magnetic sublattices (Ni and Mn) and the magneto-dielectric coupling in the ferromagnetic regime. This insulating ferromagnetic behavior coupled with MD effect make $Sm_2NiMnO_6$ an attractive spintronics material.

## Co-existence of magnetocaloric effect and magnetoresistance in Co-substituted LSMO

Magnetization, Magnetocaloric effect (MCE) and Magnetoresistance (MR) in Co-substituted $La_{0.67}Sr_{0.33}Mn_{1-x}Co_xO_3$ (x=0.03, 0.05 and 0.1) samples have been studied. All the studied samples were crystallized into a single phase rhombohedral structure with $R\bar{3}c$ space group. The Curie temperature was found to decrease with the increase of Co-content and for the composition x=0.1, a cluster glass-like nature was observed. Temperature variation of magnetic entropy change ($\Delta S_M$) showed a positive peak at $T_C$ for the composition x=0.1 with $\Delta S_M$=3.1 J/kgK and relative cooling power, RCP=155 J/kg at a magnetic field of 50 kOe. Again, the critical analysis of the paramagnetic to ferromagnetic transition and the scaling behaviour of field dependence of MCE for x=0.1 composition was also studied. The temperature dependence of electrical resistivity under the magnetic fields up to 50 kOe was investigated along with the values of 20% enhancement in MR at the room temperature for the Co-substituted samples.



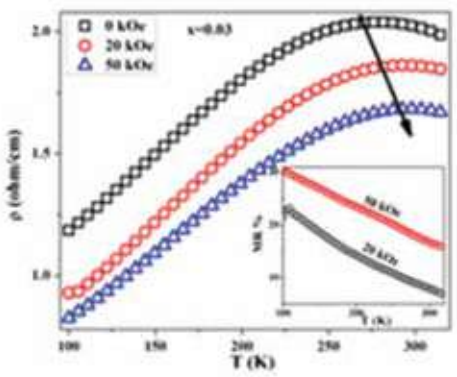



*Fig. 6. Temperature dependence of electrical resistivity of $La_{0.67}Sr_{0.33}Mn_{1-x}Co_xO_3$ under different magnetic fields (a) x=0.03 and (b) x=0.1. Inset of each figure shows the MR% vs. T at different fields.*

## Development of novel functional ceramic oxides for electrical and electro-optical applications:

### *(a) Improvement of morphology and luminescence properties of powellite type red phosphors $CaGd_{1-x}NbMoO_8$: $xEu^{3+}$ synthesized via citrate gel route*

Powellite type molybdate-based red phosphors $CaGd_{1-x}NbMoO_8$: $xEu^{3+}$ ($x$ = 0.05, 0.1, 0.15, 0.20, 0.25, and 0.30) were synthesized by a solid-state reaction (SSR) route, and a citrate gel (CG) route. The solid solution formation of the phosphor took place at a lower temperature by the CG route than the SSR route. Particle morphology of the phosphors prepared by the CG route revealed that they were less agglomerated, more spherical, and homogenous in nature with uniform particle size. Investigations on photoluminescence properties showed that these phosphors emit strong red light (614 nm) under both near UV (395 nm), and blue (465 nm) excitations. The morphological variation of the developed phosphors with respect to synthesis method and heat treatment played an important role in their luminescence enhancement. The red phosphors prepared *via* CG route were characterized by enhanced and sharper red emission with longer life time compared to that of phosphors synthesized *via* SSR route. The CIE color coordinates of the developed red phosphors were (0.65, 0.34) that are closer to NTSC standard red phosphor. Thus, these phosphors could be a promising red candidate for the phosphor converted white light emitting diode applications.

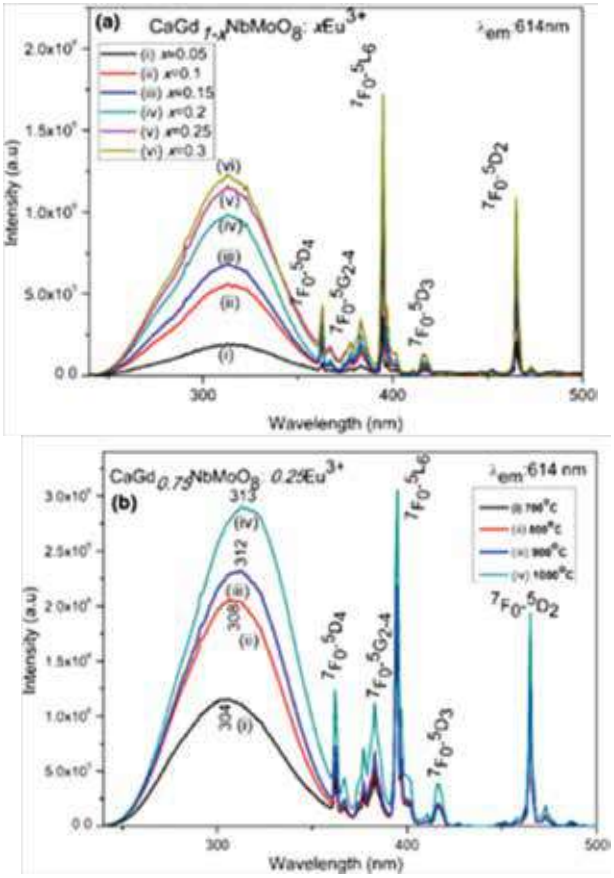



*Fig.7. The excitation spectra of (a) $CaGd_{1-x}NbMoO_8$: $xEu^{3+}$ ($x$ = 0.05, 0.1, 0.15, 0.2, 0.25, 0.30) (SSR) and (b) $CaGd_{0.75}NbMoO_8$:0.25$Eu^{3+}$ (CG) samples for an emission at 614 nm.*

### *(b) Enhanced $Eu^{3+}$ red luminescence in scheelite based oxides, $CaLaSbWO_8$*

Scheelite type tungstate based red phosphors, $CaLa_{1-x}SbWO_8$:$xEu^{3+}$ ($x$ = 0.05, 0.10, 0.15, 0.20 0.25, 0.50 and 1) were synthesized by the conventional solid state method. These phosphors exhibited intense $Eu^{3+}$ red luminescence (613 nm) under both near UV (394 nm), and blue (465 nm) excitations which corresponds to the $^5D_0$-$^7F_2$ forced

electric dipole transition of $Eu^{3+}$. The analysis of XRD patterns and luminescence data points out that the distribution of $Eu^{3+}$ is in highly ordered state with some aperiodicity which attributes for intense luminescence. The emission intensity of $CaLa_{0.5}SbWO_8$:*0.5*$Eu^{3+}$ was one and half times stronger than that of commercial red phosphor, $Y_2O_3$:$Eu^{3+}$. These phosphors are characterized by sharp red emission with shorter lifetimes and strong absorption strength at near UV (394 nm). The CIE color coordinates of the developed phosphors are (0.65, 0.34) comparable to the NTSC standard red phosphors.

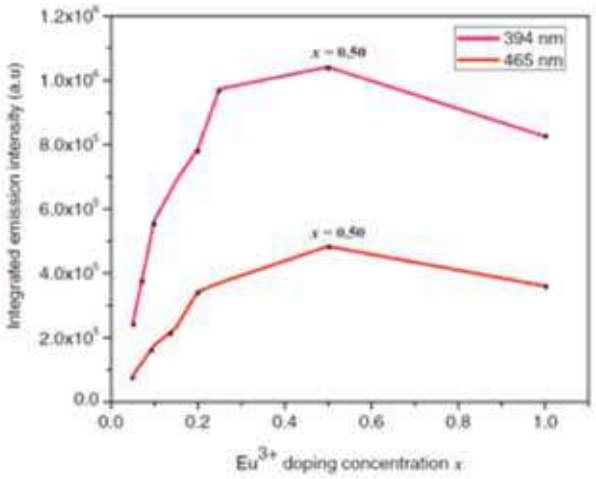



*Fig.8. Variation of Emission Intensity of $CaLa_{1-x}SbWO_8$ :x$Eu^{3+}$(x = 0.05, 0.10, 0.15, 0.20, 0.25, 0.50, 1) under 394 nm and 465 nm with Eu3+ doping concentration*

## *c) Influence of Ce doping on the order-to-disorder structural transition and electrical properties in $Sm_2Zr_{2-x}Ce_xO_7$ system*

Cerium doped rare earth zirconates of the form $Sm_2Zr_{2-x}Ce_xO_7$(x= 0, 0.1, 0.2, 0.3, 0.4, 0.5) were synthesized *via* solid state reaction route. Addition of Ce ions into the crystal induced structural disorder to both cationic and anionic sublattices, gradually transforming the unit cell from an ordered pyrochlore to a defect fluorite structure. Substitution of bigger Ce ions to the Zr sites also expanded the lattice parameter. The ionic disorder led to decreased energy barrier for the thermally activated conduction process thereby increasing the overall conductivity of the materials. Beyond x=0.4, the ion-ion interaction in the disordered lattice began to dominate, leading to increased activation energy and decreased total conductivity.

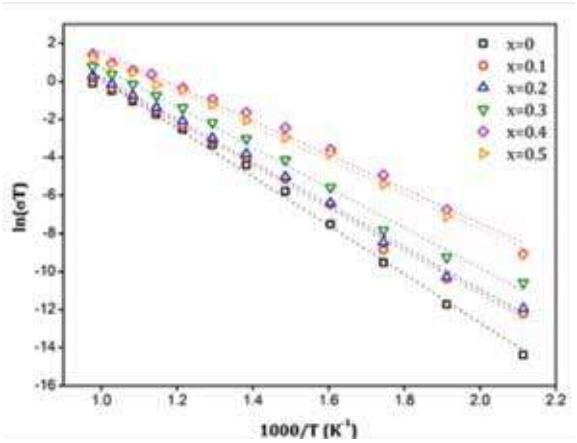



*Fig. 9. Arrhenius plots of $Sm_2Zr_{2-x}Ce_xO_7$ compositions and their linear fit*

## *(d) Impedance spectroscopic investigation on the electrical transport properties of manganese double substituted pyrochlore type semiconducting oxides: $(CaCe_{1-2x}Mn_{2x})(Sn_{1-x}Mn_xNb)O_{7-\delta}$ for high temperature NTC thermistor applications*

The effect of simultaneous substitution of Mn in both A and B site of the pyrochlore structured semiconducting oxides: $(CaCe_{1-2x}Mn_{2x})(Sn_{1-x}Mn_xNb)O_{7-\delta}$ ($x$ = 0, 0.1, 0.2, 0.3 and 0.4) was studied by employing X-ray diffraction, Raman spectroscopy, scanning electron microscopy and impedance analysis. In addition to the structural confirmation, Raman spectroscopy studies revealed the increased local disordering in the structure with progressive Mn substitution which was not observable in X- ray diffraction studies. The conductivity measurements confirmed the Negative Temperature Coefficient of Resistance (NTCR) behaviour of the samples. Grain boundary dominant electrical characteristics have been shown by the compounds with higher Mn concentration. Thermistor constant was calculated in the temperature range from 300°C to

600˚C. β value of the system was in the range 5700K – 8500K and the sensitivity values were in the range -1 to - 2%. Thermistor properties can be tuned with Mn concentration. All the compositions showed better thermistor properties compared with many of the spinel and pyrochlore based systems and may find application in devices like high-temperature thermistors. Correlated barrier hopping model was successfully applied for explaining the conduction mechanism within the compounds. The presence of grain boundary and localization of electrons associated with $Mn^{2+}$ ions play an important role in the variation of barrier height and hopping distance in the materials.

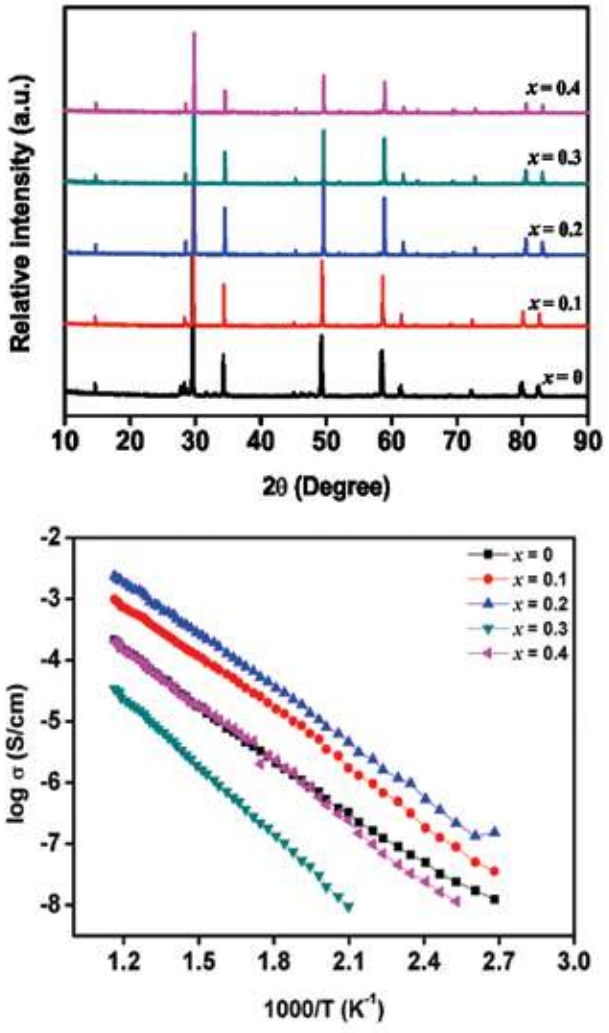



*Fig.10. powder XRD patterns of $CaCe_{1-2x}Mn_{2x}$)($Sn_{1-x}Mn_xNb$) $O_{7-\delta}$ (left), Arrhe minus plots of conductivity (right)*

## *(e) Brilliant yellow color and enhanced NIR reflectance of monoclinic $BiVO_4$ through distortion in $VO_4^{3-}$ tetrahedra*

Bright yellow coloration and enhanced NIR reflectance of monoclinic bismuth vanadate were obtained by the substitution of Ta/P into the vanadium sites of $BiVO_4$. Pentavalent metal ion substitution in bismuth vanadate blue shifted the absorption edge leading to bright yellow coloration and the color properties were comparable to that of commercially used praseodymium yellow. Lattice distortion and reduced crystallite size imposed by pentavalent metal ion substitution were responsible for the special optical properties. The synthesized pigments with improved yellow coloration exhibited good NIR reflectance making them potential candidates for cool colorants to reduce the heat build-up.

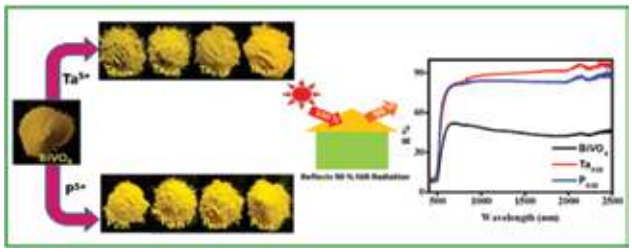



*Fig. 11. NIR reflectance of (a) $BiV_{1-x}Ta_xO_4$ and (b) $BiV_{1-x}P_xO_4$. NIR reflectance is enhanced significantly from 46 % to 90 % for $Ta^{5+}/P^{5+}$substituted $BiVO_4$.*

## *(f) Yttrium and Lanthanum Doped multiferroic bismuth ferrite as reddish brown pigments: Synthesis and optical properties for coating applications*

Reddish brown pigments were synthesized by doping Yttrium and Lanthanum at Bismuth site of $BiFeO_3$ system using solid state route. Though its multiferroic properties are well established, its optical properties and color performance are not explored. UV-Vis-NIR analysis of the samples showed that the incorporation of $Y_{3+}$ and $La_{3+}$ exhibit a significant enhancement of color characteristics. The typical pigment $Bi_{0.9}Y_{0.1}FeO_3$ was comparable with

the commercially available brown pigment (BR 300) of Kawamura Chemicals Co. Ltd., Japan. A systematic enhancement of redness (a*) and yellowness (b*) was seen with La doping, exhibiting a bright reddish brown hue. The influence of dopants on the optical properties and color performance of $BiFeO_3$ positions them in the class of lead free inorganic pigments for coating applications.

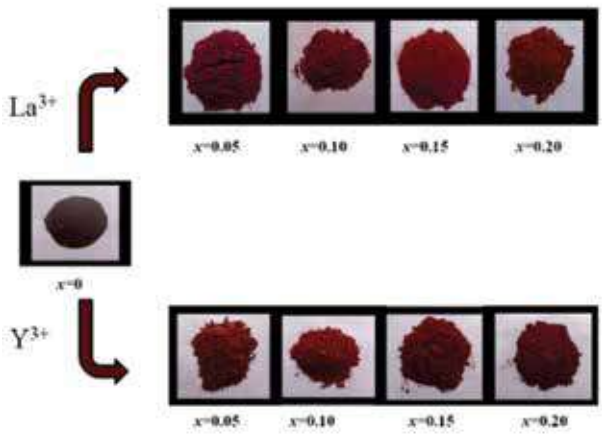



*Fig.12. Typical photography of pigment powders $Bi_{1-n}M_{x-}Fe_xO_3$ (M=La,Y)*

## MAX phase ceramic nano laminates for functional nano composites

Titanium silicium carbide ($Ti_3SiC_2$) is a nano laminate, 'metallic-ceramic' material belongs to 312 MAX phase, extensively used as soft-interface for fabricating high-tough, damage tolerant ceramics and composites.$Ti_3SiC_2$ nano laminate structure was successfully processed by displacement reactions under pressure less sintering conditions using TiC, Si and CNT raw materials. The nano laminate $Ti_3SiC_2$ was reinforced in $Al_2O_3$ matrix to fabricate ultra low friction $Al_2O_3$ ceramic solid lubricants and thermally stable PEAK-$Ti_3SiC_2$ ceramic nano composites. When the $Ti_3SiC_2$ nano laminates were introduced in epoxy polymers, the flow property increased due to increase in viscosity. Phase pure $Ti_3SiC_2$ has thermal conductivity close 57 W.m/k. Addition of $Ti_3SiC_2$ in epoxy polymer increased the bulk thermal conductivity and thermal dissipation properties. A high thermal conductivity value of 1.7 W.m/k was achieved by reinforcing 5 wt% $Ti_3SiC_2$ as co-fillers with conventional $SiO_2$ and $Al_2O_3$ fillers. The SEM images of $Ti_3SiC_2$ ceramic nano laminates and multifunctional $Ti_3SiC_2$ ceramic/PEAK polymer nano composites are shown in Fig.13.

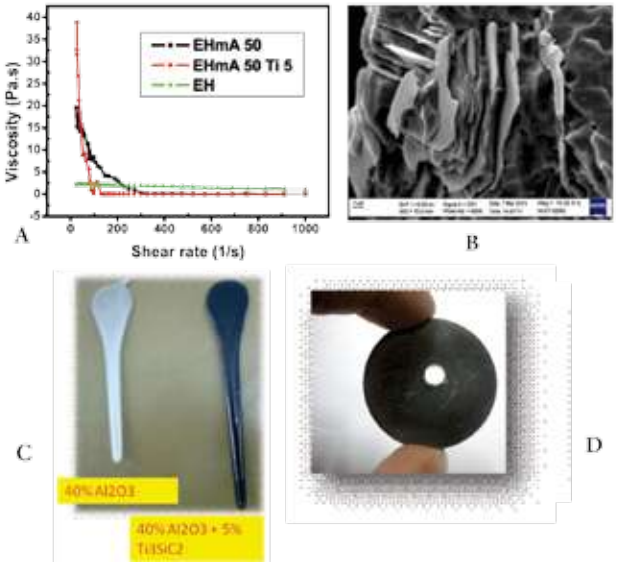



*Fig.13. MAX phase nanolaminates and its functional properties (a) Co-filler for rheology control (b) SEM image of $Ti_3SiC_2$ nanosheets (c) Machined $Ti_3SiC_2$-$Al_2O_3$ composite (d) $Ti_3SiC_2$ reinforced high thermal conducting epoxy plate $Ti_3SiC_2$*

# METALS AND MINERALS

## Aluminium-Silicon Piston Alloy

Automotive engines operate at higher temperatures and pressures. Components like pistons must be able to withstand these increasingly challenging conditions. Due to environmental requirements, a stronger aluminium piston alloy is required in order to reduce the HC emission in the automotives. Al-Si casting alloys having low thermal expansion coefficient, high wear resistance, high strength at room and elevated temperature are being developed at NIIST for piston applications in advanced internal combustion engines for strategic sector. The required properties are achieved by alloy additions using copper, magnesium and nickel

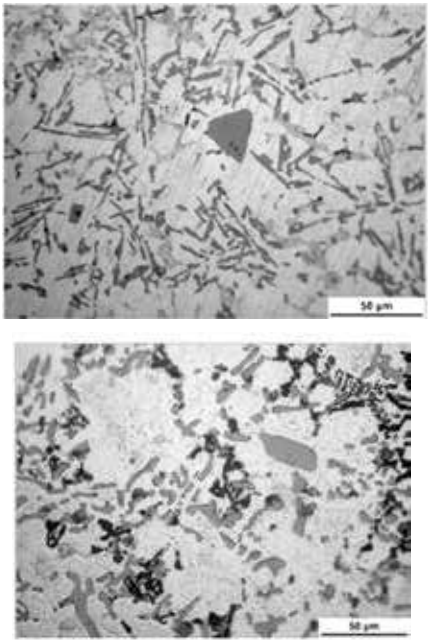


*Fig. 14. Microstructures Al-12Si-Mg-Cu-Ni alloy made by die casting and squeeze casting*

and processing by squeeze casting (SQ) techniques. Nickel is the most effective element in improving the elevated-temperature properties of Al-Si piston alloys. It also reduces the coefficient of thermal expansion. Magnesium can strengthen the material through precipitation of fine $Mg_2Si$ in the matrix. Copper can additionally strengthen the alloy by precipitation of $Al_2Cu$ phase. Copper also improves the corrosion resistance of the Al-Si alloy. The $Al_3Ni$, $Al_3CuNi$ and $Al_7Cu_4Ni$ phases which form in the alloy have much bigger contributions to the elevated-temperature properties owing to their better thermal stability.

Al-Si alloy melt was prepared and the alloying elements (Cu, Mg, Ni) were added using master alloys. The melt was degassed and casting billets were made in gravity die (with an inner cavity 100mm x 100mm x 100mm) and squeeze casting by applying 110MPa pressure onto the casting for 2 minutes. The cut samples were heat treated for T6 conditions. The tensile properties were evaluated at room and elevated temperature. The mechanical properties of the castings made by squeeze casting technique were found to be significantly higher due to the faster solidification, fine structure and lesser casting defects.

*Table.1. The effect of casting processes and heat treatment on the mechanical properties of Al-12Si-Mg-Cu-Ni alloy piston alloy*

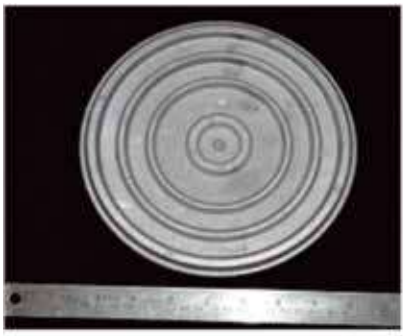
| | Die-Cast | | Squeeze Cast | |
|---|---|---|---|---|
| | As-cast | Heat treated | As-cast | Heat treated |
| YS (MPa) | 190 | 245 | 285 | 315 |
| UTS (MPa) | 170 | 280 | 240 | 350 |
| Elongation, % | 0.5-1 | 1-1.5 | 1-1.5 | Upto 2 |
| Hardness(BHN) | 90 | 125 | 110 | 140 |

The results showed that the squeeze casting followed by heat-treatment causes spheroidization of eutectic silicon and precipitation of the fine precipitates which resulted in the improvement of strength, hardness and ductility.

## Low pressure casting of non ferrous alloys

An indigenously designed and developed low pressure casting (LPC) setup at the Institute has been used to carry out preliminary works on the development of high quality castings of aluminum and magnesium alloys. Using the prototype setup it has been demonstrated, in collaboration with HAL, Bangalore, that LPC is capable of producing high quality castings of various aerospace components of weighing around 400 to 1000 grams. In order to demonstrate to the auto industries about the process capability of LPC machine to produce many of the auto components, which is now being produced using gravity castings, a sophisticated LPC setup, which includes computer controlled mould filling, air tight crucible, high capacity melting furnace and crucible, automatic mould clamping system, mould lifting and positioning system, casting ejection system, etc., was procured. During the installation and

commissioning of the machine a few trails of LM25 Al alloy automobile components were made.



(a)

(b)

*Fig.15. Al alloy (LM25) LP cast components (a) Compressor cover (b) Triple clam*

## Microstructural modification of Mg-Si based alloys

Mg-Si alloys are potential candidate for high temperature applications in automobile industries. Various $Mg_{2-x}Si$ (x=0.5, 0.7, 1.15, 2,4,6,8 and 10 wt.% Si) alloys prepared and its microstructure, tensile and wear behavior were investigated. 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.%) appears 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.%) solidifies as a coarse dendrites. These features reduce the tensile properties. In order to modify the morphology of the $Mg_2Si$, Nd and misch metal (MM) of various percentages (0.3, 0.6, 0.9 and 1.2 wt %) were added and the results indicated that addition of these elements modify the morphology of the $Mg_2Si$ significantly. The typical microstructures of Mg-Si alloys with and without modification of primary $Mg_2Si$ phase are shown in Fig.16.

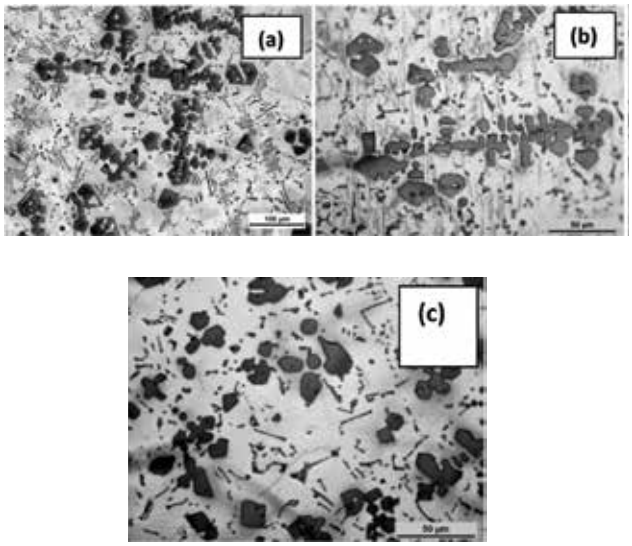
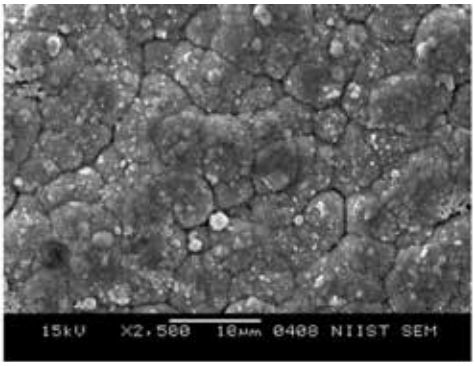


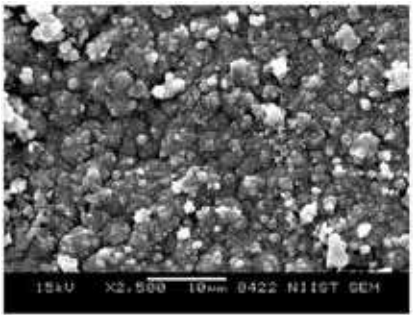

*Fig.16. Microstructures of (a) Mg-6Si (b) Mg-6Si-0.3MM (c) Mg-6Si-0.6MM alloys*

## Electroless Ni-B-$Al_2O_3$/SiC composite coating on aluminium substrates

Electroless Ni-B alloy and Ni-B-$Al_2O_3$/SiC composite coating over aluminium substrate were successfully formed. Zinc and palladium activation prior to coating improves the adherence and uniformity of the Ni-B coating over the aluminium substrate. The introduction of 350nm alumina particles leads to the formation of bimodal coating morphology of micron size clusters and nano size metal rods (50nm) / platelets. Electroless composite coating improves the applicability of aluminium for making wear resistance engineering components working under various extreme environmental conditions.




(a)

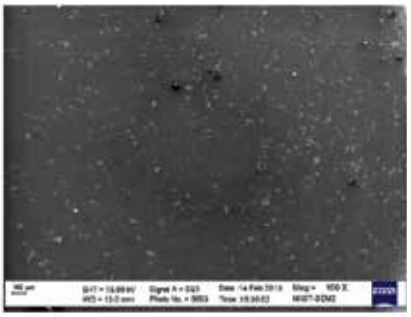


(b)

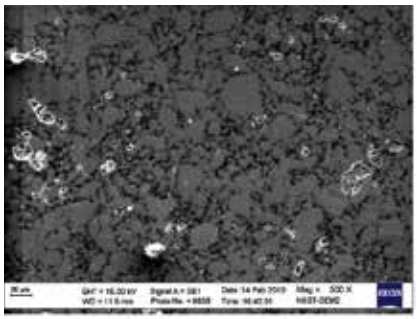
*Fig.17. SEM micrographs of Electroless (a) Ni-B alloy and (b) Ni-B-Zn-$Al_2O_3$ composite coating*

## Powder metallurgical processing of aluminium-alumina nano composites

Al-$Al_2O_3$ nano composites with 5 and10 wt% of $Al_2O_3$ of 100 nm particle size were successfully prepared by powder metallurgy technique. Distribution of reinforcement was uniform in 5 wt% composite and the particles were mostly distributed in the grain boundaries. The 10 wt% $Al_2O_3$ dispersed aluminum nano composites showed segregated distribution of particles in the grain boundary. The well dispersed nano composites provided better strength, hardness and wear resistance.



(a)



(b)

*Fig.18. SEM micrograph of Al-Alumina nano composites (a) 5 and (b) 10 wt% of $Al_2O_3$*

## Micro patterned polystyrene composite membranes induced by silane modified nano alumina particles

Micro patterned polymer composite membranes have received considerable attention due to their applicability in various fields such as separation, filtration, sensors cell patterning etc. A facile fabrication technique was used for the synthesis of micro patterned polystyrene membranes with the aid of silane [3-(amino propyl) triethoxysilane and vinyl trimethoxysilane] modified nano alumina particles. The micro patterns obtained on the polystyrene surface is shown in following SEM micrographs. Two dimensional array of concavities were formed in the range of 2 to 10 µm size at 5 wt % of alumina solid loading.

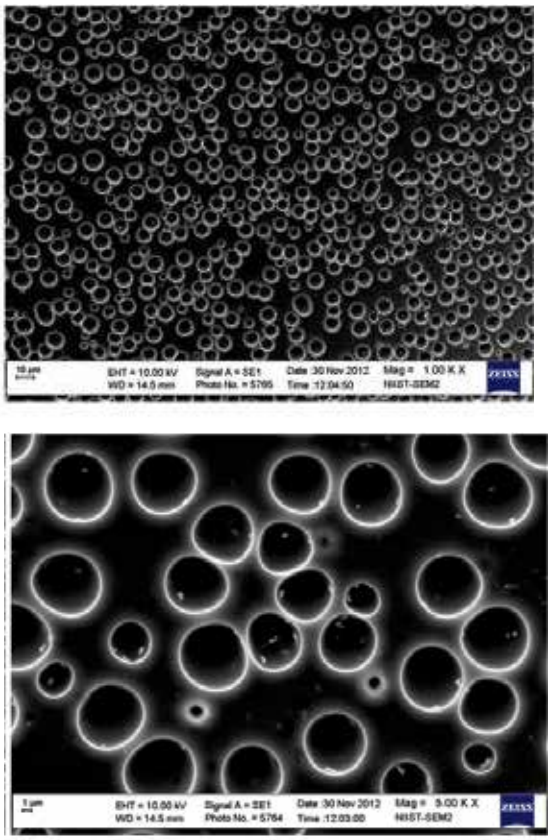


*Fig.19. SEM images of top surface on micro patterned polystyrene membrane at different magnification*

# MAJOR INSTRUMENT FACILITIES

## Electron Microscopy and Micro Chemical Analysis

The section maintains two Scanning Electron Microscopes (SEM) that find important applications in material characterization and morphological study for different divisions and other institutions. More than 2,300 Samples were investigated. Different types of materials such as aluminum alloys, various types of ceramics, superconductive materials, polyaniline nanomaterials, clays and biological samples were handled.

## Liquid Nitrogen Plant

A 10 l/h capacity liquid nitrogen plant has been well maintained. LN2 requirements for the up keep of the sophisticated instruments like NMR, TEM, SEM, EDS were met in addition to superconductivity research as well as other R&D requirements of NIIST. This facility produced about 20,000 liters of LN2 during the year of which 9,600 litres were supplied within the institute and the remaining to outside customers.

## Powder X-Ray Diffractometer

PANalyticalX'pert Pro X-Ray diffractometer has been maintained in the department. Necessary expertise in the analysis and interpretation of the powder diffraction pattern was built up in the department and the facility is also extended to all the R&D activities of the institute. A large number of samples (1200) have been studied for their structural characterization.

# PROCESS ENGINEERING AND ENVIRONMENTAL TECHNOLOGY DIVISION

The Process Engineering and Environmental Technology Division develops innovative processes and technologies for value addition to the region's resources and for the management of the region's environment. The Division has a computational modelling section that provides computational tools and services for investigating natural phenomena and for designing engineering processes. PEET comprises engineers, chemists, physicists, mathematicians, biologists and computer scientists. These multi-disciplinary skills help to address real problems. Some of the issues that are being addressed are:

- Municipal and household waste treatment
- Industrial effluent treatment
- Odour Control
- Dioxins and persistent organic pollutants in the environment
- Environmental impact analysis
- Water quality analysis
- Analysis and remediation of perchlorate in water,
- Anaerobic technology application in retting for extraction of plant fibres
- Anaerobic technology application in production of white pepper from black
- 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 and actively participating in four networked XII Five Year Plan projects sanctioned.

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

## Highlights :

- Commercial release of AutoCast XI with Virtual Casting module
- The feasibility of continuous cultivation of autoflocculant, high-lipid content marine microalgae in outdoor seawater raceway reactor established.
- Transferred technology for family size biogas digester for kitchen wastes
- Licensing of the technology for white pepper production
- Licensing of banana and pineapple fibre extraction
- Carried out analysis of large number of sample from Periyar to test the pesticide and other contamination, as ordered by the Kerala High Court

The activities of the Division are under four sections namely Chemical Process Engineering, Environmental Technology, Computational Modeling and Simulation, and Dioxin Research.

# प्रोसेस इंजीनियरिंग तथा पर्यावरण प्रौद्योगिकी प्रभाग

प्रोसेस इंजीनियरिग तथा पर्यावरण प्रौद्योगिकी प्रभाग इस क्षेत्र के संसाधनों के मूल्य वर्धन और वातावरण के प्रबंधन के लिए नवीन प्रक्रियाओं और प्रौद्योगिकियों का विकास करता है । प्रभाग को एक कम्प्यूटेशनल मॉडलिंग अनुभाग है जो प्राकृतिक घटनाओं की जांच के लिए तथा इंजीनियरिग प्रक्रियाओं के डिजाइन के लिए कम्प्यूटेशनल उपकरण और सेवाएं प्रदान करता है । पीईईटी में इंजीनियरों, कैमिस्टों, भौतिकविदों, गणितज्ञों, जीवविज्ञानियों और कंप्यूटर वैज्ञानिकों शामिल हैं। ये बहु विषयी कौशल वास्तविक समस्याओं को निपटने के लिए मदद करते हैं । संबोधित किये जा रहे मुद्दों में से कुछ हैं:

- नगरपालिका और घरेलू अपशिष्ट उपचार
- औद्योगिक बहि: स्रावी उपचार
- गंध नियंत्रण
- वातावरण में डाइऑक्सीन और सतत् कार्बनिक प्रदूषक
- पर्यावरणीय प्रभाव का विश्लेषण
- पानी की गुणवत्ता का विश्लेषण
- पानी में परक्लोरेट का विश्लेषण और प्रत्युपाय
- पादप फाइबर की निकासी के लिए रेट्टिंग में अवायवीय प्रौद्योगिकी का इस्तेमाल
- काली मिर्च से सफेद मिर्च के उत्पादन में अवायवीय प्रौद्योगिकी का इस्तेमाल
- मृत्तिका खनिजों के सज्जीकरण और मूल्य वर्धन
- सस्ती स्वदेशी सॉफ्टवेयर के माध्यम से औद्योगिक लाभप्रदता में वृद्धि
- प्रक्रिया उद्योग में कम्प्यूटेशनल द्रव गतिशीलता अनुप्रयोगों

जबकि स्थानीय समस्याओं के लिए प्रौद्योगिकी लक्ष्य को प्राथमिकता हैं, प्रभाग द्वारा लंबी अवधि के लक्ष्यों के साथ निम्नलिखित क्षेत्रों के वैश्विक मुद्दों पर अनुसंधान एवं विकास कार्य जारी रखते हैं और मंजूर चार बारहवीं पंचवर्षीय योजना नेटवर्क परियोजनाओं में सक्रिय रूप से भाग ले रहे हैं ।

- जैव ईंधना के लिए सूक्ष्म शैवाल के उत्पादना के लिए प्रौद्योगिकी का विकास
- जैविक प्रणालियों के व्यवहार को समझने के लिए एजेंट आधारित सिमुलेशन का विकास

मुख्य विशेषताएं:

- वर्चुअल कास्टिंग मॉड्यूल के साथ ऑटोकास्ट XI का वाणिज्यिक रिलीज ।
- आउटडोर समुद्री जल नाला रिएक्टर में ऑटोफ्लोक्कुलंट, उच्च लिपिड सामग्री युक्त समुद्री सूक्ष्म शैवाल की निरंतर खेती की व्यवहार्यता स्थापित की गयी ।
- रसोई के कचरे के लिए फैमिली साइज़ बायोगैस डाइजेस्टर के लिए प्रौद्योगिकी हस्तांतरित की गयी ।
- सफेद मिर्च के उत्पादन के लिए प्रौद्योगिकी का लाइसेंसिंग ।
- केले और अनानास फाइबर की निकासी की तकxोलॉजी का लाइसेंसिंग ।
- केरल के उच्च xयायालय के आदेश के अनुसार, कीटxाशक और अन्य संक्रमण का परीक्षण के लिए पेरियार से बड़ी संख्या में नमूने का विश्लेषण किया गया ।

प्रभाग की गतिविधियॉ चार अनुभागों के अंतर्गत हो रही हैं - रासायनिक प्रक्रिया इंजीनियरिंग, पर्यावरण प्रौद्योगिकी, कम्प्यूटेशनल मॉडलिंग और सिमुलेशन और डाइऑक्सीन अनुसंधान ।

# ENVIRONMENTAL TECHNOLOGY

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

The work done during the year are summarized below:

## Biofuel from marine microalgae

Biodiesel, produced from vegetable oil, is a substitute for fossil diesel. However diverting agricultural resources for production of vegetable oils for fuel, puts unacceptable pressure on agricultural production. Microalgae, a potential oil source, can be cultivated in large scale without impacting food agriculture. The technological challenge is to produce microalgae at oil yields at costs comparable to vegetable oil. NIIST is a partner in CSIR's New Millenium Indian Technology Initiative (NMITLI) project on 'Biofuel from marine microalgae'. The Phase I of the project was completed this year. In this project, NIIST has developed a new approach – 'natural selection engineering' for producing microalgae in outdoor scaleable seawater reactors. The natural selection approach allows selection of algae that are easily harvested and have good growth rate and lipid yield.

In previous reports, working with fresh water, using the natural selection engineering approach, it was shown that auto-flocculating algal cultures (perpetual) can be selected by recycling of biomass, essentially controlling hydraulic retention time and mean cell retention time. It was demonstrated that energy accumulation can be selected by control of nutrient loading. Algae that accumulate energy as lipid was shown to be selected by control of carbon dioxide partial pressure.

Seawater experiments were conducted during 2012-2013. A seawater raceway pond reactor was set up and seawater was supplied by tankers to NIIST. In freshwater experiments it was seen that diatoms are selected under process conditions favourable for auto-flocculation and lipid accumulation. Analysis of diatoms showed more than 20% silica. Seawater has less than 2mg-$SiO_2$/l, and therefore, it is not possible to produce large quantities of diatoms. In the seawater raceway pond, a consortium containing a species of lightly silicified diatom, *Cylindrotheca*, and another shelled brown algae got selected under the conditions applied for lipid.

In order to select for auto-flocculation, the hydraulic retention time for the raceway pond was maintained at 1 d and mean cell retention time of suspended cells was maintained as 2 d. Under these conditions, it was found that attached growth algae start to dominate the culture. The main attached growth species was *Enteromorpha*. Wall attached growth cannot be harvested efficiently and needs to be controlled. Besides *Enteromorpha* has poor lipid content. It was observed that *Enteromorpha* periodically (once in 8 days, if nutrient loads are adequate) produces spores – each cell producing 8, 16 or 32 zoospores that move rapidly and attach to surfaces. This allows the species to outcompete suspended growth algae, even when having overall lower vegetative growth rates. Since the mechanical cleaning of walls is not economically feasible at large scale, the concept of natural selection engineering was applied to control the rate of growth of wall attached species. A biosorption tank was installed so that nutrient was supplied only to suspended biomass. This method allowed reduction in attached growth.

Seawater has excess of calcium and magnesium, and is supersaturated with calcite, aragonite and dolomite. The best production was obtained when brown algae with shell structure became

dominant. Overall, the raceway pond performance with algal consortium can be summarized as: for irradiance > 20 MJ/m$^2$/d: biomass production rate: 15 to 20 g/m: lipid content 15 to 20%.

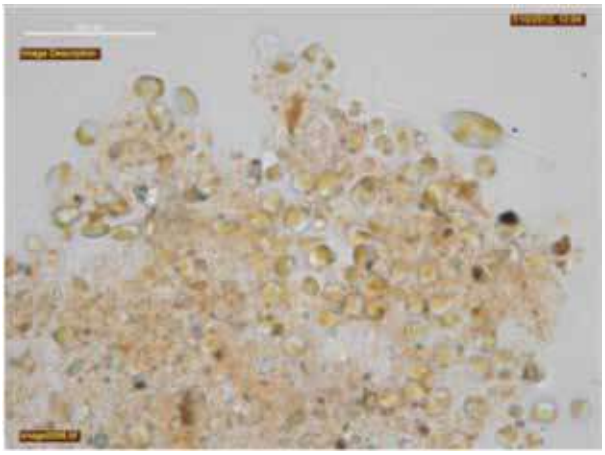


*Figure 1. Formation of algal biomass flocs in seawater*

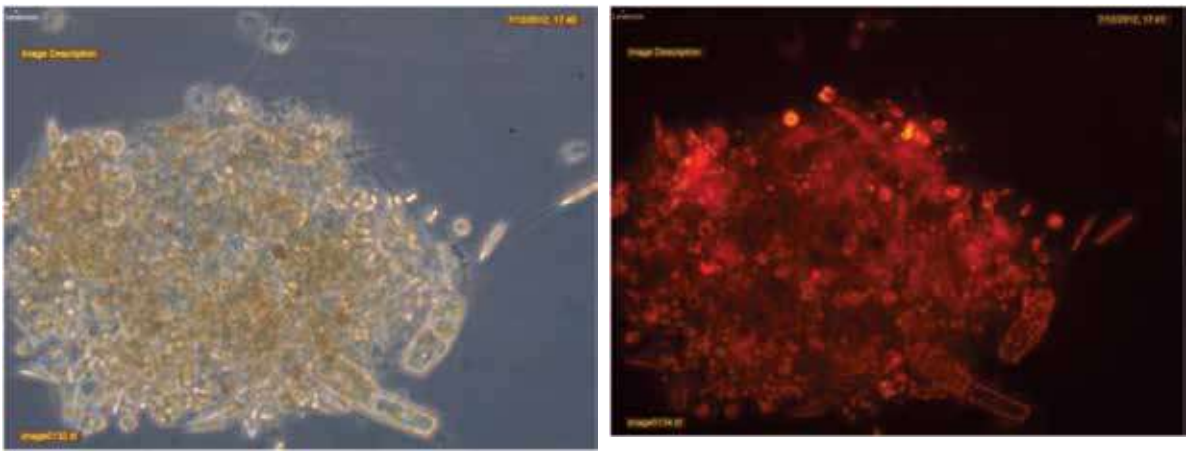


*Figure 2. Algal flocs formed in outdoor seawater raceway reactor. The consortium contains diatoms (Cylindrotheca), brown algae, and green algae. The same field in autofluorescence under UV illumination shows chlorophyll activity.*

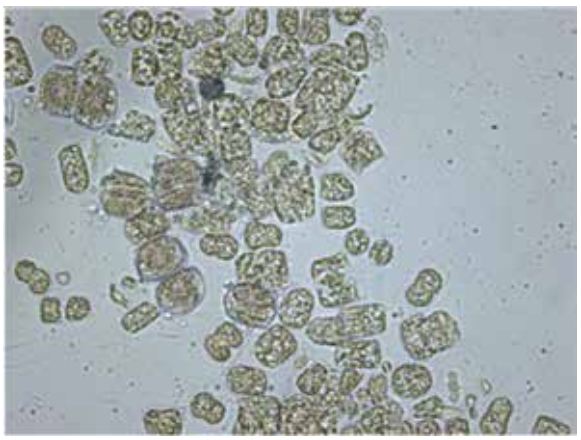


*Figure 3. Brown algae, (from morphology, close to Chaetoceros sp.). The biomass consortium in outdoor seawater raceway reactor became enriched in these algae, without the addition of silica.*

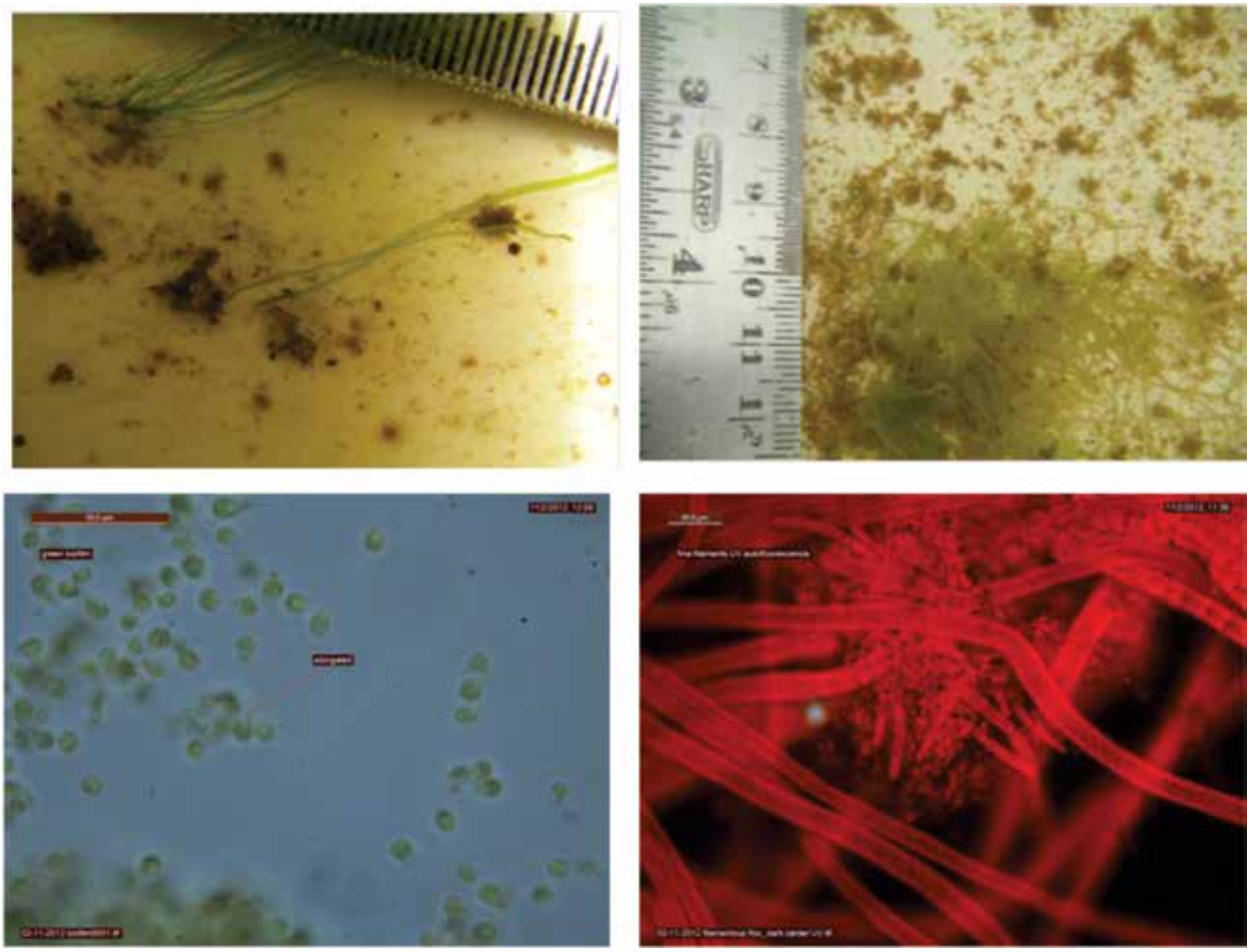


*Figure 4. Underwater photographs show wall growth of Enteromorpha sp. in the raceway pond. If the wall attached growth is not removed, it overruns the consortium, by producing motile zoospores that stick to surfaces and start forming filaments.*

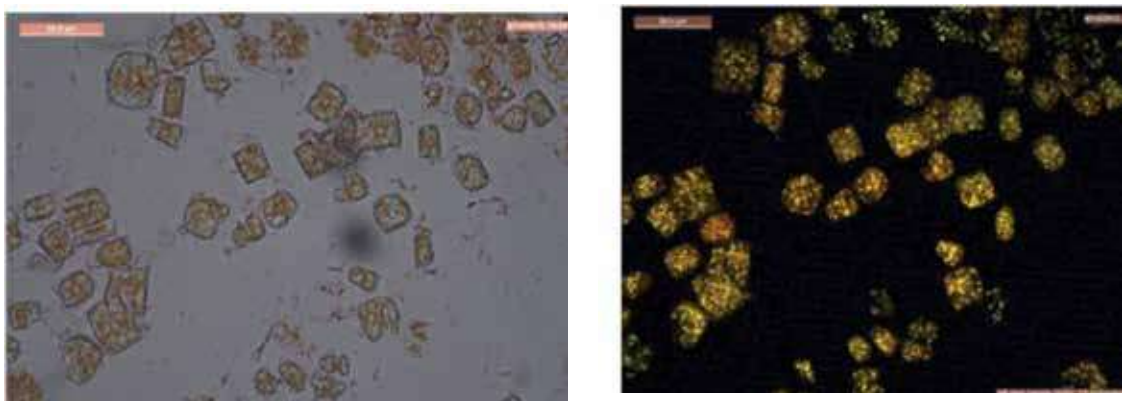


*Figure 5. Brown algae showing promiment transparent shell. Brown algae can be selected in the seawater outdoor raceway pond through control of process conditions. The same field in epifluorescence (Y3 filter) shows lipid drops (yellow). The sample is stained with Nile Red.*

*Figure 6. Outdoor 1m² area seawater raceway pond with brown algae. The pond is dark brown and measured light absorption exceeds 90%.*

A techno-economic analysis showed that cost of algal biomass production dominates the cost of algal biodiesel. The main item in the cost of biomass production is capital expenditure. Low cost construction such as clay lined ponds can substantially reduce overall cost. The technical feasibility of clay lined ponds needs to be established.

## Mango waste treatment

CSIR and National Innovation Council has started a scheme for innovative technologies for making the nation's small and medium scale (MSME) industries more competitive. The mango processing cluster at Krishnagiri was identified as one of the MSME clusters where CSIR can provide inputs. About 70 pulp factories in this area process 300,000 tonnes of mangoes and the quantity of waste generated per year is 150,000 tonnes. At present, the waste is dumped on land, mostly illegally. NIIST has examined the problem of mango waste to develop a treatment process. One of the main issues affecting the cost of treatment is the seasonal nature of the waste.

NIIST has proposed biomethanation for the treatment of mango waste, producing electric power, liquid fertilizer and boiler solid fuel, in a

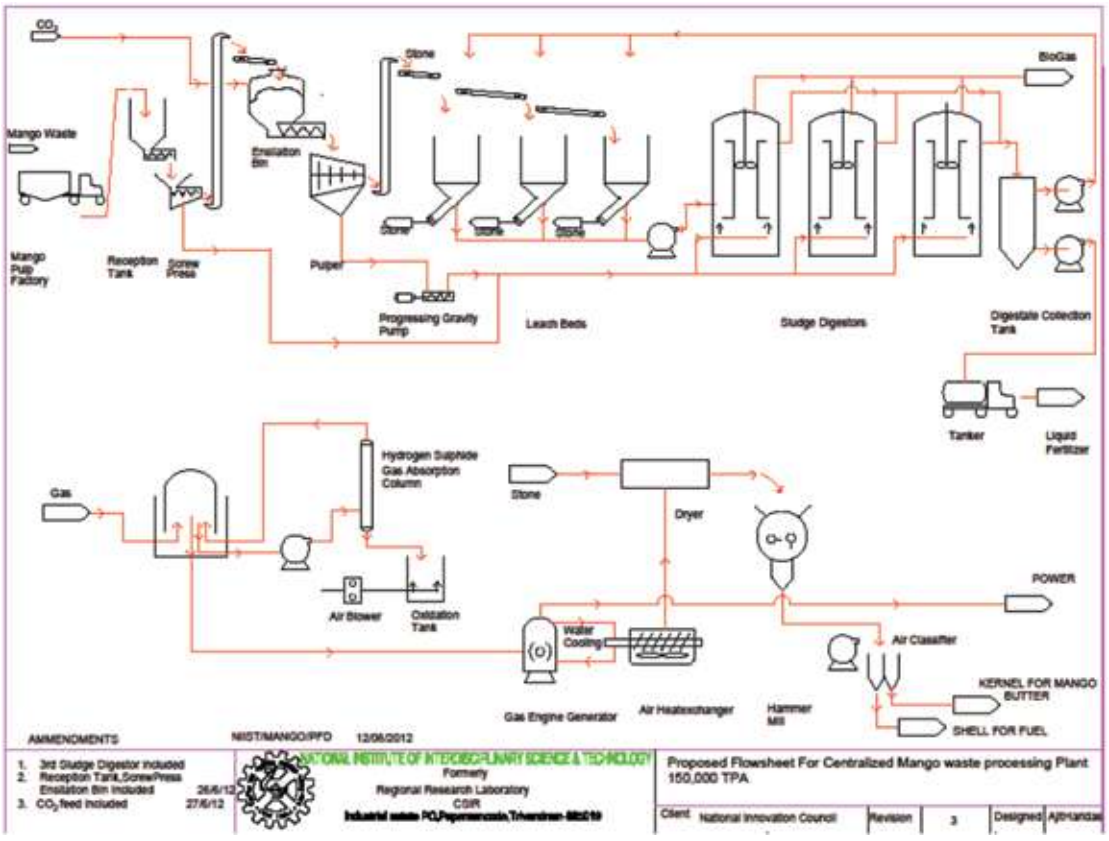



*Figure 7. Proposed flowsheet for mango waste treatment common facility*

common treatment facility for the entire cluster, covering a region of radius 20 km. The plant will run throughout the year. Mango waste will be preserved and stored by ensilation for year round availability to the power station. The preserved waste is separated to pulp and stone. The stone is dried as biofuel. The pulp is anaerobically digested to biogas and a liquid fertilizer that is ideal for mango plantations. Laboratory studies showed the feasibility of the process. Economic analysis showed that the treatment plant has a break even of less than 4 years.

## Assessment and remediation of perchlorate (rocket fuel)

Perchlorate is a toxic oxy-anion known to interfere with the functioning of thyroid gland leading to hypothyroidism. It was reported that around 15% of population in Kerala are suffering from hypothyroidism. The institute has been assessing perchlorate ($ClO_4^-$) contamination and developing perchlorate remediation technology for the last four years. The detailed assessment of perchlorate in ground water from regions around Ernakulum and Thiruvananthapuram was carried out. The samples were analyzed using ion chromatograph equipped with perchlorate specific column (US EPA method). 54 samples from around Aluva (Ernakulam Dist.) were tested. The maximum concentration, 7426 ppb, was found in a well water sample. In comparison, WHO and US EPA permitted level in drinking water is 24.5 ppb. 45 samples were tested from Veli (Thiruvananthapuram Dist.). The maximum perchlorate concentration was 300 ppb in a well water sample.

The study of perchlorate reducing bacteria was continued this year. A few novel perchlorate reducing bacteria tolerating high salt and perchlorate concentrations were isolated from the enrichment culture. These include *Halomonas* sp. NIIST3 (Genbank-JN935775) and *Bacillus* sp. NIIST2 (Genbank-JN935774). All isolates were found positive for the functional genes *pcrA* and *cld* involved in the perchlorate reduction pathway.

A phytoremediation approach for removal of perchlorate from water was tested this year. In this study, locally available floating macrophytes such as *Eicchornia, Pistia, Azolla* and *Lemna* were screened for their efficiency to remediate perchlorate. Among the plants tested, *Pistia* (water lettuce) showed the highest uptake of the compound (from ppb to ppm range). The study revealed that phyto-accumulation and rhizo-degradation (involving root associated micro-flora) were involved in perchlorate remediation process in *Pistia*. A new perchlorate reducing bacteria, *Acinetobacter* sp. NIIST (Genbank-JX467695) was isolated from the plant root enrichment culture.


Fig 8a Different free floating macrophytes in hydroponic study unit

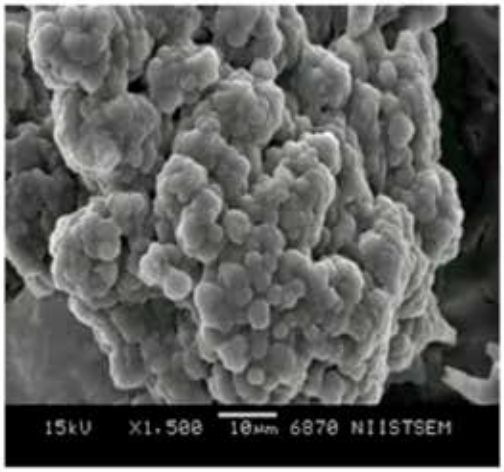



Fig: 8b Acinetobacter sp. NIIST cell aggregates

## Functional importance of protozoa in anaerobic digestion of ligno-cellulose

Studies to understand the microbial ecology of waste treating anaerobic reactors were continued this year. It supports process design and maintenance of anaerobic reactors. One of the significant finding in this area is the functional importance of anaerobic protozoa in complex waste water and anaerobic digestion systems. In an ongoing study for biomethanation of water hyacinth biomass, the community dynamics and niche of protozoa in a digester were studied. It was found that the protozoa number has a weak positive correlation with the major hydrolytic enzyme activity (cellulose, amylase, pectinase and xylanase), in the digestion process (figure 9).

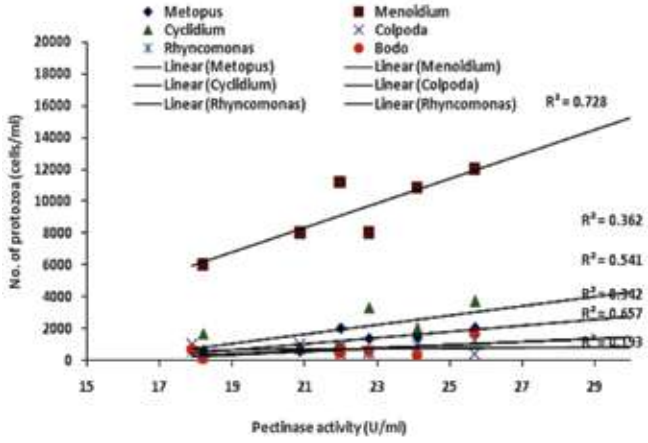



*Figure9. Weak dependence of enzyme activity on protozoa cell count*

Among the protozoa, there are specific organisms that exhibited stronger correlation with certain enzyme activity (eg. *Menoidium* and Pectinase activity) (figure 10 & 11). These findings underline the importance of higher trophic organisms in addition to Bacteria and Archaea in waste treating engineered biological systems.

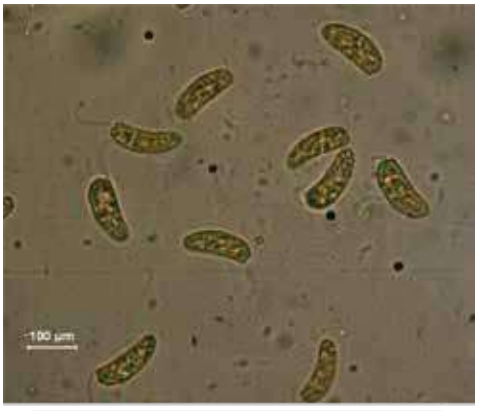



Figure10. *Menoidium enrichment culture*

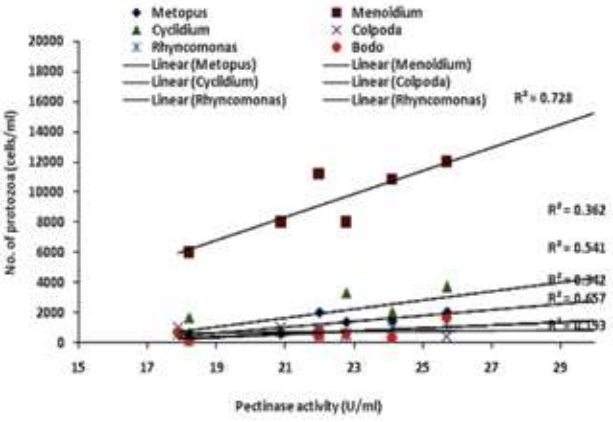



*Figure 11. Stronger dependence of enzyme activity on Menoidium*

## Bioactive compounds from environmental microorganisms

Continuing the study on microbial bioactive compounds, *Chromobacterium sp NIIST,* isolated from clay mine pit water, was used to produce violacein in a 3 liter fermenter. The compound was purified by column chromatography. The purified compound was screened for anti tumor property using three different cancer cell lines such as A549 (lung cancer cell line), DLD1 (Colon cancer cell line) and MCF7 (Human breast cancer cell line). The compound showed anticancer activity against all the cell lines tested. As shown in the following image, compared to control (diffused chromatin), the treated cells chromatin was highly condensed indicating cyto-toxicity.

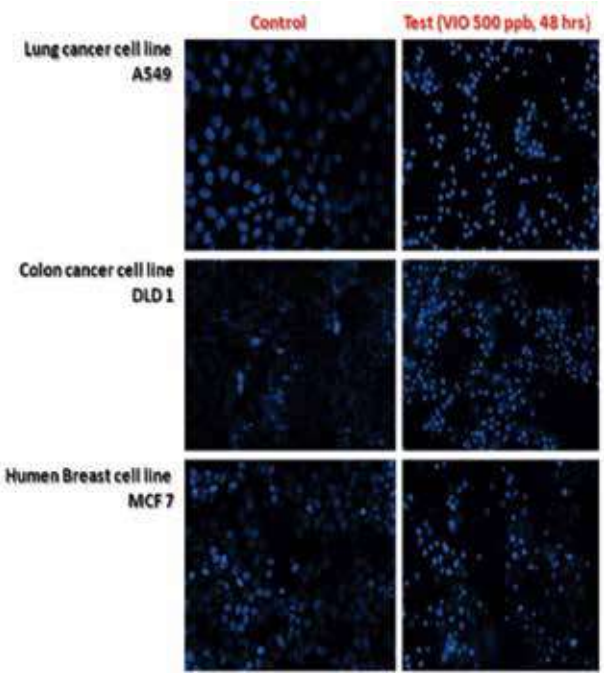



*Fig 12. Anti tumor screening in different cell lines*

A novel strain of *Serratia sp*., producing different bioactive compounds including Prodigiosin (a high value bioactive compound) was studied. The bacterium was isolated from one of the lab scale bioreactors for perchlorate remediation. The prodigiosin produced was purified and characterized by different spectrometric techniques. Characterization of novel compounds from the strain is currently in progress.

Fig. Extracted Prodigiosin and precipitated compound

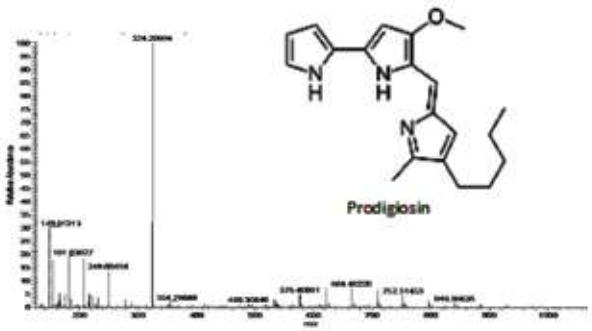



*Fig. 13. Prodigiosin from Serratia sp.*

## Clay and clay minerals processing

Clay is one of the most important mined minerals in Kerala. Kaolin ($Al_2O_3.2SiO_2.2H_2O$) or china clay is a versatile industrial mineral. The identification and quantification of the impurity mineral phases plays a crucial role in the selection of beneficiation processes and the sequence in which the processes are to be carried out. Iron minerals are important among the deleterious impurities in kaolin, because it imparts colour to the white kaolin. The work on process development for the beneficiation of kaolin from various locations in the country has been continued. Since process flow sheets and optimum conditions change depending on the characteristics of the deposits being mined, existing clay industries need R&D support on a continuing basis. Many of the better grade clay deposits used by the major clay producers have been mined out, and there is a need to have greater number of processing operations to maintain quality.

## Speciality products based on engineered clays

Among the 12$^{th}$ Plan projects of CSIR, NIIST is co-ordinating a network project involving 6 laboratories on the development of speciality products from engineered clays. Under this project, work has been initiated to develop speciality materials based on indigenous clays. The rich deposits of clay available within the country shall be explored to develop (i) state of the art processing of selected clay samples for getting pharmaceutical and cosmetic clays for standardized formulations and validation studies, and (ii) inorgano-organo hybrid clays for environmental clean-up operations. The division is entrusted with the work of identifying suitable clay deposits from across the country that can be developed into high value products such as cosmetic and pharmaceutical grade clay, and speciality clays for water clean-up operations with special emphasis to industrial wastewaters. The responsibility includes detailed characterization, impurity mineral iden-

tification, selection and optimization of suitable processing techniques for the value addition of indigenous clays. The objective is to obtain material specification suitable for production of speciality 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

Detailed characterization of china clay from Madai district, Kannur indicated that the kaolinitic mineral was contaminated with mica, quartz, anatase, goethite and other ferruginous impurities. Bulk clay content was around 34% indicating poor recovery. However, it was felt pertinent to beneficiate the clay since there is scarcity of good quality china clay deposits in the State. Total iron content was 2.1% of which 70% could be attributed to the presence of extra framework ferruginous impurities. By employing a series of hydrocyclones, < 2 micron size fraction clay content could be enhanced to 85% from an initial 14%. Further, by magnetic separation the ferruginous impurities as well as titania content could be reduced to 1.07% and 0.58% respectively. Hydros bleaching improved the brightness to 74.5%. However, a maximum of 78.1% brightness was achieved through a combination of size separation and calcination steps corresponding to an overall increase in brightness by 18 units. The product meets the specification requirement for ceramic industry (Grade II). Fine tuning including multiple pass WHIMS studies are under progress.

## Brightness improvement studies on China clays

In continuation of the clay beneficiation studies being carried out at NIIST, two china clays supplied by the sponsoring agency could be upgraded to products having significant brightness values with potential application in paper, paints etc. Granulometric, mineralogical, chemical and physical characterization of China clays established the level and nature of impurities present based on which the beneficiation steps were designed. Beneficiation included a series of successive techniques such as hydrocloning, wet high intensity magnetic separation (WHIMS), chemical bleaching and calcination under optimized conditions. WHIMS could effectively remove magnetic particles such as oxides of iron, titanoferrous and micaceous compounds etc. down to ultra fine sizes.

*Figure 14. Wet High Intensity Magnetic Separator (WHIMS)*

A yellow clay matrix with initial brightness value of 71% (ISO) could be beneficiated to give a hydrated product of 80.44 % brightness after hydrocyclone size separation and WHIMS followed by reductive bleaching which on calcination gave 89.5% (ISO) brightness. On similar lines, the brightness value of the clay from Bhuj could be enhanced by 9 units to 80.44 % brightness in hydrated clay. Enhancement by 18 units was achieved for calcined product to 89 %.

## Dust abatement studies in China clay mines

Fugitive emissions are traffic-generated dust and are the main problem associated with clay mines and also from mining operations. Water

sprinkling and green belt development are usually suggested to contain dust emissions in mines. As per USEPA, dust particles below particle size 10 μ are inhalable as it leads to occupational respiratory diseases. NIIST has therefore developed a method for suppression of dust pollution by spraying of $CaCl_2$ solution and topping it with a cover of water absorbent coir pith.

Extended pilot trials of the study were conducted in the China clay mine owned by M/s. English Indian Clays Ltd., Veli, and Thiruvananthapuram. The haul road had an average traffic density of 25-30 trucks per hour. Total dust emission was found to be significantly higher than the stipulated SPM and RSPM concentrations in the mine site. Effect of calcium chloride ($CaCl_2$) and magnesium chloride ($MgCl_2$) commonly used as dust suppressants were evaluated in lab/field experiments along a 400 m stretch to evaluate their effectiveness in suppressing china clay mine dust. The effectiveness of the dust suppressant was quantitatively measured in the field using gravimetric devices. Results indicated reduction in dust at dosage of 33% $CaCl_2$ which performed better than $MgCl_2$ at an application rate of 6L/m$^2$. A blanket of water absorbent coir pith enhanced the efficiency of the dust stabilizers. Laying coarse aggregate above this provided better grip to plying vehicles.

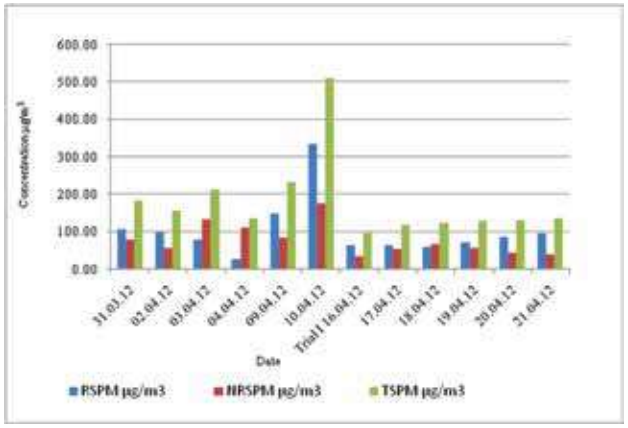



*Fig 15. A comparison of the ambient air quality at the mine site before and after the dust suppression by NIIST developed method*

With around 75-80% water retention capacity, coir pith provided a humid cover to the stabilizer thus preventing the loss of moisture from the treated surface. This evidently increased the longevity of the treatment efficiency. Laying of coarse aggregate of around 3.8 cm size over the pith blanket provided better grip to the plying vehicles. The respirable particulate matter remained below the limit of 100 μg/m$^3$ upto 10 -15 days after treatment resulting in an overall reduction in cost of dust control by water sprinkling by around 60%.

## Color removal from paddy parboiling effluent

Parboiled rice is staple food in Kerala and many other parts of the country. NIIST had developed an anaerobic treatment for reducing the COD levels of the effluent to a significant extent so that the treated effluent is reusable for consecutive cycles of parboiling with 20% fresh water addition. NIIST had found that the anaerobic treated effluent is suitable for reuse in parboiling and rice quality is not affected. However, there is need for a economically viable secondary treatment process for the removal of residual COD and color from the parboil effluent. Biological secondary treatment by activated sludge (aerobic) treatment reduces residual COD and ammonia, but increases color (from 300 to 600 Pt-Co unit). Rice mill effluent is also characterized by high dissolved silica content (>200 mg $SiO_2$/ l). Biological oxidation in algal pond was tested and found to increase color.

1

2

3

*Figure 16. Anaerobic reactors for the treatment of rice mill effluent. Picture 1 shows plant under construction. Picture 2 show heat exchangers for cooling parboil mill effluent. Picture 3 shows gas driven backwash system in new generation anaerobic reactor.*

Color removal by chemical treatment was tested using $H_2O_2$, alum and lime. Hydrogen peroxide was effective but the consumption of peroxide is too high and therefore not economical. Lime addition (3 g/l ) reduced COD by 70% and color by 90% reduction. Alum reduced COD by 42% and color by 80%. Lime treated effluent has high pH. It is neutralized by biogas absorption. Thus further chemical consumption is avoided. The lime treatment process is currently the most economical option for the secondary treatment of rice mill effluent. Process and plant design for the secondary treatment of rice mill effluent are in progress.

## Regional environmental impact assessment study in China clay mining areas of Mangalapuram, Thiruvananthapuram

The objective of the study was to identify the environmental impacts on the area due to the prevalent mining activity for china clay. The present study identified the existing environmental and social conditions of around 42 mines, determined the extent to which mining had contributed to actual and perceived environmental and social problems and suggested mitigation measures. Final report, which included (i) a concise documentation of reconnaissance survey of clay mines (ii) significant baseline data generation (iii) dust emission modeling (iv) environmental impacts and their mitigation (v) hydrological survey and management measures (vi) operation and reclamation status of clay mines, and (vii) social impact assessment, was submitted to the sponsor.

## Environmental impact assessment of beach washing & mineral separation plant of Kerala Minerals & Metals Ltd, Chavara, Kollam

The Form-1 for finalization of TOR has been submitted to the Ministry of Environment and Forests. New Delhi. The hydro geological survey of the mine leases has been completed. Other baseline data studies of the four leases are ongoing. The significant findings include sea erosion due to sea washing, R&R issues due to displacement of people from the mine leases and minor dust emissions.

*Fig 17. Hydrology survey for groundwater contour mapping*

## Preliminary environmental impact assessment for the proposed cement based precast unit at KINFRA, Kakkanad, Cochin

The objective of the study is to identify the various environmental impacts on the project area and its surroundings due to the precast factory. The preliminary EIA was based on the reconnaissance survey, study of proposed process and activity and identification of significant environmental issues. The study evaluates the existing environmental conditions, superimpose the proposed project activity and suggest environmental management measures to mitigate or minimize the impacts. During this period reconnaissance survey of the proposed site

and its surroundings was crried out. Collection of secondary data included air quality, noise, water, study of various process proposed, technical details, support services, identification of source of pollution, management measures proposed by the company / manufacturer etc.

*Fig 18. Snapshot view of the area proposed for the Pre-Cast Factory Plan in GIS*

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

The objective of the study is to carry out the Environmental Impact Assessment (EIA) of old ponds, used for storing iron oxide and ETP sludge as per the norms of State Pollution Control Board, on the environment. The study includes literature survey, collection of secondary data from KMML which includes plant production data, quantum of waste (iron oxide) disposal to pond, waste chemical characteristics, identification of impacts and delineation of environmental management plan (EMP) including options for reuse. The expected 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 reconnaissance survey of KMML Ponds was carried out this year. This includes preliminary identification of nearby affected villages, assessment of process details, technical examination of the existing records, hydrological survey of the wells surrounding the pond, water and soil sampling, digitization of the data and preparation of water contour maps and identification of contaminated sites.

*NABET Accreditation of NIIST as EIA consultant Organization .*

*CSIR-NIIST ha been accredited by Government of India for EIA studies in the mining sector NIIST is the only organization accredited in Kerala for undertaking EIA studies.*

## COMPUTATIONAL MODELLING AND SIMULATION

The Computational Modeling and Simulation Section develops computational models for a wide range of phenomena and processes like metal casting, chemical reactors and biological systems.

### Commercial release of AutoCAST-XI with Virtual Casting Technology

Virtual Casting is a software package developed by NIIST for the simulation of solidification process of industrial castings. In 2011, the Virtual Casting Solver technology was transferred to 3D Foundry Tech Pvt. Ltd., (3DFT) a company which maintains and markets AutoCAST-X, an integrated easy-to-use environment for casting method design, solid modeling, and simulation. This year, the teams from CSIR-NIIST and 3D Foundry Tech worked closely in integrating these two software codes in NET environment with new GUIs and visualization tools to release AutoCAST X1 which couples the quick fluid flow simulation, heat transfer and solidification simulation of Virtual casting into the AUTOCAST-X environment. With the

addition of Virtual Casting, AutoCAST XI has the capability to predict both flow related and solidification defects like misruns, cold shuts and shrinkage porosity. The integrated code was benchmarked with the experimental results generated by IIT-Mumbai. It was further validated with industrial scale castings. Some typical results of benchmarking are shown in Figures 19 and 20.

**a**

**b**

*Figure 19. Misrun prediction by AutoCAST X1.*

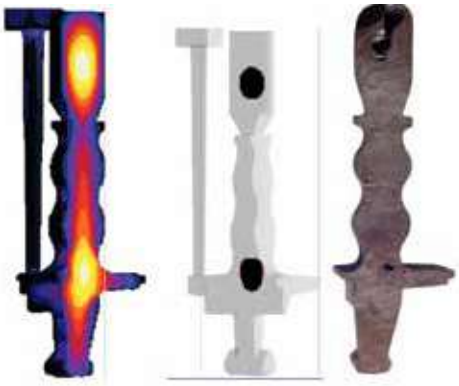


*Figure 20. Shrinkage defects as predicted by AutoCAST X1 for two industrial castings*

This software was given to 4 Indian foundries for beta testing. After testing, this module was launched during IFEX -2013 at Kolkatta and the first purchase order for AutoCAST X1 was received from Titagarh Wagons Limited (TWL), Kolkata. Virtual Casting won the second place in the Computer Society of India IT Excellence Awards for 2012 at Kolkata in the Engineering Solutions and Product Manufacturing Category.

## CFD simulation of pneumatic coal injection process in a rotary kiln

The pneumatic coal injection and combustion process in a commercial rotary kiln is modeled using a two phase flow theory approach. The physical and chemical phenomena of the turbulent reacting flow is simulated using a multiphase Eulerian-Lagrangian CFD approach where the gas phase is treated as a continuous phase and the pulverized coal particles are tracked in the flow field in a Lagrangian way. Three-dimensional, steady-state Reynolds averaged Navier-Stokes equations closed by the k-ε turbulence model are solved for the turbulent gas flow, including mass, momentum, tur-

bulence kinetic energy, turbulent dissipation rate, enthalpy, and a number of gaseous species mass fractions. All the relevant phenomena like coal devolatilization, homogeneous volatile combustion, heterogeneous char reaction, particle dispersion and radiation are included in the mathematical model proposed in this work and the commercial CFD code ANSYS-CFX 11.0 is used to obtain the numerical results.

After these validation tests, the results of CFD simulation of pneumatic coal injection process in a direct reduction rotary kiln of inner diameter 2.6 m and length 40 m is presented in terms of particle trajectories, particle and gas temperature profiles and mass fraction profiles of various gas components. Two different size distributions as depicted in Figure 21 were chosen for the current simulation.

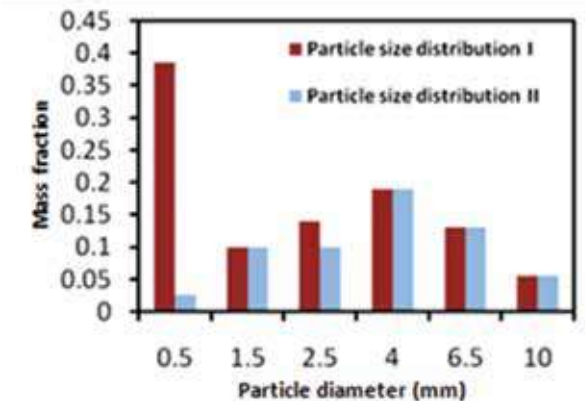



*Figure 21. Particle size distribution used for simulation*

In particle size distribution I, the mass fraction of 0.5 mm particles was around 38% whereas in particle size distribution II it was around 3%. The initial particle velocity chosen for both the distributions is 40 m/s and the particles are injected from the same location. The kiln wall temperature was kept at 1000 $^0$C.

The gas temperature and species mass fraction contours on a plane perpendicular to the solid bed surface along the axis of the kiln is shown in Figures 22(a) and (b) for particle size distribution I and particle size distribution II respectively. It can be seen clearly from Figure 22(a), that for the particle size distribution I, where the mass fraction of particles of size 0.5 mm is around 38%, the maximum gas temperature reaches around 1680 K and this occurs near the solid bed where the smaller size particles burn off just before reaching the solid bed. This was also confirmed by the $CO_2$ and $O_2$ profiles. Since smaller size particles get burned off easily, volatile and $CO_2$ release was also higher for this size distribution.

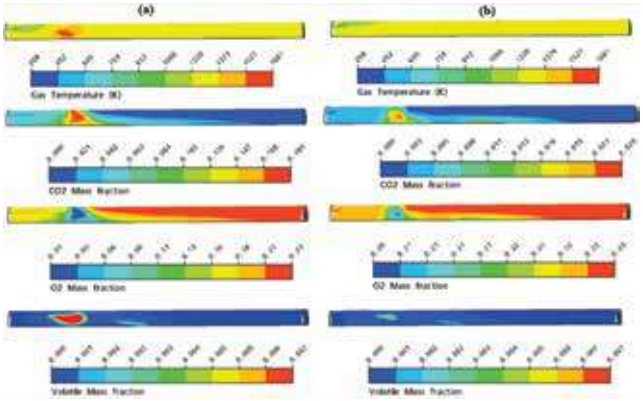



*Figure 22. Distribution of gas temperature, $CO_2$ mass fraction , $O_2$ mass fraction and volatile mass fraction in a plain perpendicular to the solid bed surface, along kiln axis for (a) particle size distribution I and (b) particle size distribution II*

Similar type of results is presented in Figure 22 (b) for particle size distribution II, where the mass fraction of particles of size 2.5 mm is 50%. It can be observed from Figure 22(b), that for particle size distribution II, the maximum gas temperature reaches around 1600 K in a very small region and the temperature reaches around 1200 K in other parts of the freeboard region. It can also be observed that $CO_2$ and volatile mass fractions are less compared to particle size distribution I. From these results it can be concluded that particle size distribution plays a major role in the distribution of heat load and volatile release and combustion of coal particles.

## A Programmable - Meta Search Engine

A Meta Search Engine (MSE) appears much like a regular search engine (SE). MSE, unlike an

SE does not have an index. Instead, by dynamically querying multiple search engines, it extracts fuses and re-ranks their results. Users can enter search criteria once and access several search engines simultaneously. Vertical MSEs like *NanoSpider* were developed for domain specific information retrieval in the area of nanotechnology. It helps the area specific information seeker to focus on his domain without having to surf through the general web. Developing a vertical MSE from scratch requires collaboration between computational scientists and the domain expert. A customizable MSE can save much time spent for such specialized engines to be designed. It can also be used for conducting experiments on the real web.

The programmable - Meta Search Engine (P-MSE) is a MSE which can be programmed with scripts to create custom fusion (search) services. The P-MSE is designed to be a standalone web server. It can handle HTTP request from any other program and work as a typical Unix daemon. So, it does not need C++/CGI based web servers like apache. It uses an embedded scripting language interpreter called T!, to provide programming capability. Multiple independent T! scripts, one corresponding to each search source, run in parallel queries and collect the results.

The P-MSE developed in C++, with T! scripts for communication with SEs has been used to implement a general MSE called SSIR. The MSE named SSIR, recursive acronym: SSIR for the Savvy Information Retriever, searches the popular SEs. Specific scripts for each search source page have been written. Engines like MS-Bing provide free API to get results in the form of XML. For other sources, raw HTML result pages are parsed. The live implementation can be accessed at http://ssir.in. Figure 23 is a screenshot of SSIR. It searches Yahoo, Bing, Google, Yandex and ODP taking a maximum of 10 phrases connected by boolean operatrors AND, OR or NOT. After fusion, duplicate


*Figure 23. SSIR Website*

## Computational Biology

Agent Based Modeling (ABM) is a natural way for describing and simulating a system composed of large number entities that behave differently. Agent-based models for biological systems can be perceived at different scales to model cell behaviour and interaction, functioning of the immune system, tissue growth, and disease processes. An agent based model for the colon crypt was developed with cells of the crypt epithelium as agents.

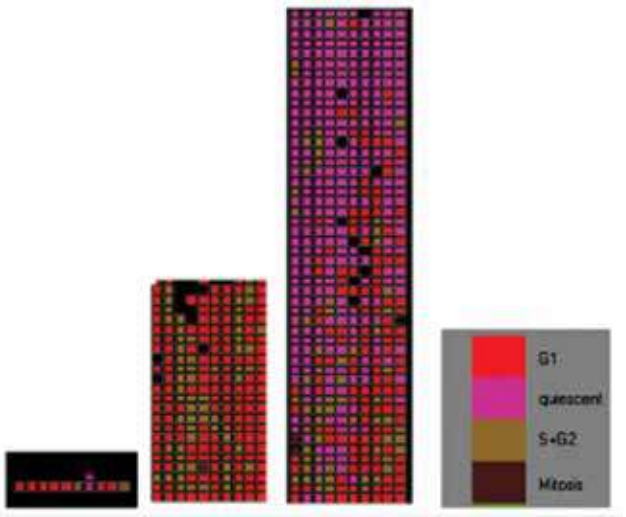



*Figure24. Development of a crypt from stem cells. Cell states represented by different colors Purple – "Quiescent" , Red –" G1", Brown "S+G2", Dark Brown – "Mitosis", Black shows the gaps where there are no cells.*

This model was used to investigate the role of heterozygous APC mutation in niche succession and initiation of colorectal cancer. Mutations in the adenomatous polyposis coli (APC) gene are found in most colorectal cancers. They cause constitutive activation of proliferative pathways when both alleles

of the gene are mutated. However studies on individuals with familial adenomatous polyposis (FAP) have shown that a single mutated APC allele can also create changes in the precancerous colon crypt, like increased number of stem cells, increased crypt fission, greater variability of DNA methylation patterns, and higher somatic mutation rates.

The crypt is represented as a simple 2D grid, as if the crypt is slit open and rolled out flat (Figure 24). The epithelial cells are anchored to the grid and can move on it. Each cell is an agent, characterized by attributes like cell cycle stage, position on the grid, ancestry and age. There are rules for insertion of daughter cells inside the crypt, differentiation on division, migration and death. Simulations are carried out to study the effect of heterozygous APC mutation on individual cell behaviour that would collectively lead to the kind of crypt level changes that have been indicated by different experimental studies.

Based on previous reports and the results from the ABM for colon crypt dynamics, the hypothesis was proposed that heterozygous APC mutation has the effect of increasing the chances for a stem cell to divide symmetrically, producing two stem cell daughters. This hypothesis was incorporated into the model and performed simulation experiments to investigate the consequences of the hypothesis. Mutations show that this hypothesis links together all the changes in FAP crypts observed in previous studies. It is also seen that an $APC^{+/-}$ stem cell gets selective advantages for dominating the crypt and progressing to cancer. This explains why most colon cancers are initiated by APC mutation. The results could have implications for preventing or retarding the onset of colon cancer in people with inherited or acquired mutation of one APC allele.

# S & T Service Sections

# PLANNING AND PERFORMANCE & BUSINESS DEVELOPMENT

## TECHNOLOGY LICENSING & TRANSFER AGREEMENTS / MOUs SIGNED

| Sl No | Title | Name of the firm / agency |
|---|---|---|
| 1 | Agreement for licensing of know-how for an anaerobic digester for treating household organic wastes | Shri. Mathews George, Pichappillil House, Kasdavoor P.O., PIN – 686 671 |
| 2 | Agreement for licensing of know-how for an anaerobic digester for treating household organic wastes | Shri. Sunil Kumar T.S., M/s K A Enterprises (Reg.No: MSME 5495/12), Estate Road, Pappanamcode, Thiruvananthapuram 695 019 |
| 3 | Agreement for licensing of know-how for an anaerobic digester for treating household organic wastes | CARRIS PIPES AND TUBES (PVT.) LTD., P.B. No.2, Koovappady, Cochin – 683 544 |
| 4 | Agreement for licensing of know-how for producing white pepper | Shri. Hitesh Khanna, M/s Khanna Brothers, 512, Katra Ishwar Bhawan, Khari Baoli, Delhi – 110006 |
| 5 | Agreement for licensing of know-how for producing white pepper | Shri. Moidutty E.K., "Baithul Aysha", Old Road Junction, Putakkulam, Koothuparamba, Kannur – 670 643 |
| 6 | Agreement for licensing of know-how for producing white pepper | Shri. B.M. Ibrahim, Proprietor, M/s SPICES OF COORG, Shop No. SGP 131, Muncipality Complex, Sunticoppa, Karnataka |
| 7 | Agreement for licensing of know-how for banana fiber extraction | Shri M.S Prasad, M/s Innovative Bio products, Flat No:304,Plot No:135,Green park residency, Rajeev Nagar, Amberpet, Hyderabad, Andhra Pradesh-500045 |
| 8 | MoU for commercialization of POLYCOIR | Kerala Furniture Consortium Pvt. Ltd, a registered MSME having its registered office at Kurichilakkode, Kodanaad PO, Perumbavoor, Ernakulam Dist |
| 9 | Agreement for executing the project 'A study on optimizing the material utilization in Ayurvedic industry by replacing herbal roots by benign herbal parts and by developing new bio active applications for herbal spent material' | DST & Arya Vaidya Sala, Kottakkal, a Charitable Trust having its Head office at Kottakkal, Kerala – 676 503 |
| 10 | Agreement for Collaboration in the area for Method development for Screening and quantification of dioxins and furans in Indian food matrices for Gas Chromatography coupled with Triple Quadrupole Mass spectrometer | "Agilent Technologies India Pvt. Ltd.", Unit Nos. 105 - 116, First Floor, Splendor Forum,Plot No – 3, District Center Jasola, New Delhi – 110025 |
| 11 | Agreement for setting up integrated spice processing facility at Wayanad | Director of Agriculture, Directorate of Agriculture, Dept of Agriculture, Govt of Kerala,Vikas Bhavan, Trivandrum-695033 |
| 12 | MoU with Directorate of Agriculture for setting up a Technology Business Incubation Centre | Directorate of Agriculture, Department of Agriculture, Govt. of Kerala, Vikas Bhavan, Thiruvananthapuram – 695 033 |

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| 13 | Agreement for "Setting up of demonstration plants for pineapple leaf fibre and banana fibre using anaerobic extraction" | Kudumbashree- State Poverty Eradication Mission, Trida buildings, Opposite Medical College, Thiruvananthapuram District, Kerala- 695 011 |
| 14 | Agreement for consultancy project | KINFRA, KINFRA House,31/2312, Sasthamangalam,Trivandrum-695010 |
| 15 | Agreement for consultancy services for conducting EIA for the old ponds of KMML chavara, kollam | M/s KMML, Chavara ,Kollam-691 583 |
| 16 | Agreement for collaborative research work titled" Development of ceramic adsorbants for gas and vapour molecules | M/s NORITAKE CO LTD,<br>1-36 Noritake shinmachi 3 chrome, Nishi-ku, Nagoya 4518501, Aichi, Japan |
| 17 | MoU in connection with the project " Development and pilot scale production of microwave ceramic substrates and LTTC green tapes suitable for microwave circuits" | M/s ANTS ceramics (p) Ltd<br>W-50(A), Near Mahindra sona, Nasik-422007 |
| 18 | MoU for sponsored Research | M/s Thermax Ltd, D13,MIDC Industrial Area,<br>RD Aga Road,Chinchuwad,Pune-411009 |
| 19 | Mutual Non Disclosure Agreement | M/s Mahindra Hinoday Industries Ltd, Bhosari Industrial Estate, Bhosari , Pune-411026 |

# CONTRACT RESEARCH PROGRAMMES

| SI No | Client | Project Title | Project Leader |
|---|---|---|---|
| | | **AGRO PROCESSING DIVISION** | |
| 1 | DST | Evaluation and control of acrylamide formation in traditional deep fried snack products | Dr. (Mrs) P. Nisha |
| 2 | DST | Synthesis of iminosugar variants of alphagalactosyl ceramide for tuning of selective cytikine release from natural killer T(NKT) cells | Dr. L. RaviShankar |
| 3 | DST | A study on optimizing the material utilization in ayurvedic industry by replacing herbal roots by benign herbal parts and by developing new bioactive application | Dr. Sunderesan |
| 4 | ICMR | Phenolic compounds from *Centalla asiatica, Boerhavia diffusa & Desmodium gangeticum* as protectors against arsenic trioxide induced cardio toxicity | Dr. K. R. Raghu |
| 5 | Dir.Vanaspathi,Min. Con.Affairs | Evaluation of trans fatty acids in hydrogenated vegetables oil products and their health implication in the context of Indian food habits | Mrs. M.V. Reshma |
| 6 | Dir.Vanaspathi,Min. Con.Affairs | Studies on improving storage stability of refined and unrefined vegetable oils by the addition of micronutrients and antioxidant phytochemicals and the development of a functional vegetable | Dr. (Mrs) P. Nisha |
| 7 | Bureau of Indian Standards | Development of Indian Standards for North East Ginger and its value added products | Mr. V .V. Venugopal |
| 8 | KSCSTE | Development and standardization of value added products for "Jackfruit" | Dr. (Mrs) P. Nisha |

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| 9 | Dept of Agriculture, GOK | Setting up a technology business incubation centre for agroprocessing | Mr. V .V. Venugopal |
| 10 | Dept of Agriculture, GOK | Setting up a ginger processing plant in Wayanad | Mr. V .V. Venugopal |
| | | **BIOTECHNOLOGY DIVISION** | |
| 11 | DBT | Development of a bioprocess for the production of polyhydroxybutyrate(PHB) from biodiesel industry generated glycerol | Dr. Ashok Pandey |
| 12 | DBT | Cost effective production of lactic acid for polylactide synthesis and studies on PLA application and biodegradation, | Dr. K. Madhavan Nampoothiri |
| 13 | DBT | Exploiting western ghat biodiversity for antifungal metabolites for plant disease control | Dr. K. Madhavan Nampoothiri |
| 14 | DBT | Cloning ad production of a genetically improved L asparaginase from *Escherichia coli* | Dr. Ashok Pandey |
| 15 | DST | Centre for bio fuels | Dr. Ashok Pandey |
| 16 | DST | Glycerol based carbon acid catalyst for the production of ethanol and value added chemicals from biomass | Dr. Ashok Pandey |
| 17 | MNRE, New Delhi | Sorghum stover based biorefinery for feuls and chemicals | Dr. Ashok Pandey |
| 18 | Thermax Ltd. | Bioprocess development for the production of L-lactic acid, PGA and cellulase enzymes | Dr. Ashok Pandey |
| | | **CHEMICAL SCIENCES & TECHNOLOGY DIVISION** | |
| 19 | DST | Novel synthetic protocol for carbon-carbon and carbon-heteroatom bond forming reactions employing nucleophilic heterocyclic carbene catalysis | Dr. Vijayan Nair |
| 20 | DST | Photodynamic therapy against the tumor vascular system | Dr. D. Ramaiah |
| 21 | DST | Cucurbit[n] uril homologues and their derivatives as receptors for a few Ionic and neutral analysis | Dr. Rakesh K. Misra |
| 22 | DST | Development of novel cyclophanes as probes for biomolecular recognition | Dr. D. Ramaiah |
| 23 | DST | The controlled carbopalladation of heterobicylic olefins: A novel stereo selective route to functionalized cyclopentanoids | Dr. K. V. Radhakrishnan |
| 24 | DST | Environmentally secure inorganic colorants | Dr. M.L.P. Reddy |
| 25 | DST | Organic and organic - inorganic hybrid solar cells: optimization of materials properties, bulk heterojunction morphology and device efficiencies (OISC/LARGE CELLS) | Dr. K. R. Gopidas |
| 26 | DST | Green methods towards pharmaceutically important heterocycles and cyclopentanoids | Dr. K. V. Radhakrishnan |
| 27 | DST | Investigation of conformational sub-states and low frequency vibrational dynamics of native and non native heme proteins | Dr. Karunakaran Venugopal |

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| 28 | DST | Design and synthesis of multifunctional organic - DNA conjugates for biomolecular application | Dr. Joshy Joseph |
| 29 | ISRO | Development of bulk heterojunction solar cell based demo structure conducting polymer in organic hybrid composite for broad band solar spectrum | Dr. J.D. Sudha |
| 30 | IFCPAR | Development of fulvene based Zr(II) and Ti(II) chemistry: organometallics,reactivity and applications in organic synthesis | Dr. K. V. Radhakrishnan |
| 31 | MNRE | Dye sensitized solar cell(DSSC)/quantum dot dye sensitized solar cell | Dr. Joshy Joseph |
| **MATERIAL SCIENCES & TECHNOLOGY DIVISION** | | | |
| 32 | DST | Optimization of aging parameters and alloy composition for improved age hardening response of AZ91 magnesium alloy | Dr. A. Sreenivasan |
| 33 | DST | Development of Mg antimony based alloy for high temperature applications | Dr. U .T .S .Pillai |
| 34 | DST | Synthesis and characterisation of *in-situ* Magnesium matrix composites | Dr. (Mrs) Sreeja Kumari |
| 35 | DST | An investigation on the potential beach placer deposits along Tiruchendur coast, Tamilnadu | Dr. M. Sunderarajan |
| 36 | DST | Development of novel powellite based red phosphor materials: $ARMMoO_8:Eu^{3+}$(A=Mg, Ca, Sr and Ba, R=Y, La and Gd: M=Nb and Ta) for white light emitting diodes (WLED's) | Dr. P. Prabhakar Rao |
| 37 | DST | Supramolecular polymeric nanomaterials with hierarchical morphologies | Dr. Boje Goud |
| 38 | DST | Preparation of M3AX2 phase ternary carbides and fabrication of its nanocomposites through novel methods | Dr. S. Ananthakumar |
| 39 | DST | Nanostructured double perovskites for spintronic applications, | Dr. Manoj Rama Verma |
| 40 | DST | Development of nanostructured spinel oxide materials for spintronic applications | Dr. Savitha Pilla |
| 41 | DST | Low temperature healing photo catalytic self cleaning coatings for solar cell covers and glass surfaces | Dr. K. G. K. Warrier |
| 42 | DST | Development of functionally graded porous ceramic preform and ceramic metal composites for engineering applications | Dr.T. P. D. Rajan |
| 43 | DST | Nanostructured Ni-based Heusler alloys for magentic refrigeration applications. Part I synthesis and physical characterization. Part II magnetic characterization | Dr. Manoj Rama Verma |
| 44 | DST | Development of iron based superconductors | Dr. U. Syamprasad |
| 45 | DRDO | Development of low loss low temperature co-fired ceramic glass composite (LTCC) tapes for future MIC device applications | Dr. M. T. Sebastian |
| 46 | DRDO | Design and development of environmentally friendly rare earth based NIR reflecting camouflague pigments for defence applications | Dr. P. Prabhakar Rao |

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| 47 | DRDO | Development of mono and hybrid discontinuously reinforced magnesium metal matrix composites for engineering applications | Dr. U. T. S. Pillai |
| 48 | BRNS | Development of photocatalytic reactor based on wide spectrum nanotitania-organic hybrids for decomposition of dyes and recovery of precious additive/solvent in spent laser dye solution | Dr. Saju Pillai |
| 49 | BRNS | Tailoring of magneto-structural phase transitions near the room temperatures in intermaetallic Heusler alloys for the magnetic refrigeration applications | Dr. M. Vasundara |
| 50 | BRNS, Mumbai | Synthesis and spray granulation of lanthanum phosphate powders for thermal barrier coatings | Dr. U. S. Hareesh |
| 51 | GTRE (Gas Turbine Res. Estt) | Development of metal matrix composites for aeroengine applications | Dr.T. P. D. Rajan |
| 52 | BARC | Development of self lubricating $AL_2O_3/ZrO_2$ ceramic composites for journal bearing applications in acid/ radiation environment | Dr. S. Ananthakumar |
| 53 | MHRD | The village community network: Technology development and pilot rollout plan for low cost opportunistic communication networks for rural areas of India | Dr. M. T. Sebastian |
| 54 | KSCSTE | Development of biodegradable composites | Dr. V. S. Prasad |
| 55 | Institute of Plasma Research | Development of long filamentary $MgB_2$ superconducting wires and tapes for fusion grade magnets and current leads | Dr. U. Syamaprasad |
| 56 | ICDD | Generation of experimental powder diffraction data of new ceramic complex oxides | Dr. P. Prabhakar Rao |
| 57 | M/s.Schneider Electric DRC | Nano ceramic smart fillers for improving the thermal dissipation property of epoxy polymer dielectrics, | Dr. S. Ananthakumar |
| **PROCESS ENGINEERING & ENVIRONMENTAL TECHNOLOGY DIVISION** | | | |
| 58 | NMITLI | Biofuel from marine microalgae | Mr. Ajit Haridas |
| 59 | DST | Setting up of demonstration plants for pineapple leaf fibre and banana fibre using anaerobic extraction | Dr. V. B. Manilal |
| 60 | MNRE | Anaerobic technology for biogas recovery and stabilization of unsorted municipal solid wastes | Dr. V. B. Manilal |
| 61 | KSCSTE | Bioremediation of percholate containing waste water under high saline conditions using chemotropic mixed microbial system | Dr. Krishnakumar |
| 62 | KSCSTE | Development of modern and eco friendly beneficiation process and flow sheet for Kasaragod and Kannur China clays | Dr. P. Raghavan |
| 63 | KSCSTE | Kinetics of respiratory enzymes involved in perchorate reduction | Mrs. V. N. Anupama |

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| 64 | KSCSTE | Setting up of a demonstration plant for quality coir fibre production and bioenergy recovery by closed retting | Dr. V. B. Manilal |
| 65 | KSIDC | Development of a suitable method to control fungal growth in screwpine leaf products | Dr. V. B. Manilal |
| 66 | Kerala State Pollution Control | Dust suppression: Field study in China clay mine | Dr. Rugmini Sukumaran |
| 67 | EICL | Brightness improvement studies on EICL China clays | Dr. P. Raghavan |
| 68 | Kalady Rice Millers Consortium | Secondary and tertiary treatment of rice mill effluent | Mr. Ajith Haridas |
| 69 | M/s. Associated Soapstone Dist | Beneficiation process development flow sheet design for china clay of Guda mines of M/s. Associated soapstone distn. Co. Pvt. Ltd | Dr. P. Raghavan |

# CONSULTANCY PROGRAMMES

| Sl No | Client | Project Title | Project Leader |
|---|---|---|---|
| 1 | Dept of agriculture, GOK | Setting up a ginger processing facility in Wayanad | Mr. V. V. Venugopal |
| 2 | KMML | EIA for KMML project | Mr. J. Ansari |
| 3 | Herald Marine Products Pvt. Ltd, Cochin | Fish meal factory odour control | Mr. Ajit Haridas |
| 4 | M/s.Pavizham treatment plant, Koovappady,Perumbavur | Augmentation of rice mill anaerobic treatment plant | Mr. Ajit Haridas |
| 5 | VSSC | Structural and micro structural characterisation of aerospace materials | Dr. Prabhakar Rao |
| 6 | WAPCO India Ltd | Fabrication of prototype aluminium alloy and composite cylinder liners for automotive air compressor applications | Dr. T.P.D. Rajan |
| 7 | Environmental Resources Research Centre, TVM | Taxonomy of species through morphological studies of pollen grain | Dr. Prabhakar Rao |
| 8 | M/s. Kinfra, Trivandrum | Creation of medicinal plant extraction facility at Biotechnology Incubation Centre, Kinfra Hi Tech Park. Kalamasssery | Dr. Sundaresan |
| 9 | Janatha fish meal and oil products, Udupi | Fish meal factory odour control | Mr. Ajit Haridas |
| 10 | KEF, Chelebra, Malappuram | Preliminary EIA for precast factory at Cochin | Mr. J. Ansari |

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| NFNO | Title | Inventors | Filing Date | Application No. |
|---|---|---|---|---|
| 0052NF2009/HK | NOVEL IMPRINTED POLYMER MATERIALS FOR SELECTIVE DETOXIFICATION OF ENDOSULPHAN CONTAMINATED NATURAL WATERS AND PROCESS FOR PREPARATION THEEREOF | Karamala Prasad, Joseph Mary Gladis, Talasila Prasada Rao | 09/05/2012 | 12104562.6 |
| 0091NF2009/US | NOVEL MAGNETIC DYE-ADSORBENT CATALYST | Shukla Satyajit Vishnu, Warrier Krishna Gopakumar, Manoj Raama Varma, Madadhin Thazhe Lajina, Narayani Harsha, Chalappurath Pattelath | 11/07/2012 | 13/521641 |
| 0147NF2009/EP | NOVEL PORPHYRIN DERIVATIVES FOR PHOTODYNAMIC THERAPY (PDT): A PROCESS FOR THE PREPARATION THEREOF AND THEIR USE AS PDT AGENTS AND FLUORESCENCE PROBES FOR BIOLOGICAL APPLICATIONS | Danoboyina Ramaiah, Suneesh C Karunakaran, Vadakkancheril S Jisha, Tavarekere K Chandrashekhar, Alagar Srinivasan, Madhavan Radhakrishna Pillai, Sivakumari Asha Nair, Saneesh Babu P Saras, Chintalagiri Mohan Rao, Kunchala Sridhar Rao | 19/07/2012 | 11711133.6 |
| 0147NF2009/JP | NOVEL PORPHYRIN DERIVATIVES FOR PHOTODYNAMIC THERAPY (PDT): A PROCESS FOR THE PREPARATION THEREOF AND THEIR USE AS PDT AGENTS AND FLUORESCENCE PROBES FOR BIOLOGICAL APPLICATIONS | Danoboyina Ramaiah, Suneesh C Karunakaran, Vadakkancheril S Jisha, Tavarekere K Chandrashekhar, Alagar Srinivasan, Madhavan Radhakrishna Pillai, Sivakumari Asha Nair, Saneesh Babu P Saras, Chintalagiri Mohan Rao, Kunchala Sridhar Rao | 20/07/2012 | 2012-549434 |
| 0147NF2009/CN | NOVEL PORPHYRIN DERIVATIVES FOR PHOTODYNAMIC THERAPY (PDT): A PROCESS FOR THE PREPARATION THEREOF AND THEIR USE AS PDT AGENTS AND FLUORESCENCE PROBES FOR BIOLOGICAL APPLICATIONS | Danoboyina Ramaiah, Suneesh C Karunakaran, Vadakkancheril S Jisha, Tavarekere K Chandrashekhar, Alagar Srinivasan, Madhavan Radhakrishna Pillai, Sivakumari Asha Nair, Saneesh Babu P Saras, Chintalagiri Mohan Rao, Kunchala Sridhar Rao | 20/07/2012 | 01180006844.1 |

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|---|---|---|---|---|
| 0147NF2009/US | NOVEL PORPHYRIN DERIVATIVES FOR PHOTODYNAMIC THERAPY (PDT): A PROCESS FOR THE PREPARATION THEREOF AND THEIR USE AS PDT AGENTS AND FLUORESCENCE PROBES FOR BIOLOGICAL APPLICATIONS | Danoboyina Ramaiah, Suneesh C Karunakaran, Vadakkancheril S Jisha, Tavarekere K Chandrashekhar, Alagar Srinivasan, Madhavan Radhakrishna Pillai, Sivakumari Asha Nair, Saneesh Babu P Saras, Chintalagiri Mohan Rao, Kunchala Sridhar Rao | 20/07/2012 | 13/574512 |
| 0139NF2011/US | FLUORESCENT MATERIAL AND PROCESS FOR THE PREPARATION THEREOF | Ayyappanpillai Ajayaghosh, Rajasekaran Thirumalai Kumaran | 10/08/2012 | 13/571763 |
| 0138NF2011/WO | DYE ENTRAPPED SOL-GEL FILM BASED TEST STRIP SENSOR FOR NITRITE AND A PROCESS THEREOF | Santhakumar Dhanya, Talasila Prasada Rao | 27/08/2012 | PCT/IB2012/001635 |
| 0033NF2010/BR | PROCESS FOR THE PRODUCTION OF VIOLACEIN AND ITS DERIVATIVES CONTAINING BIOACTIVE PIGMENT FROM CHROMOBACTERIUM SP. NIIST-CKK-01 | Krishnakumar Bhaskaran | 30/08/2012 | 1120120218468 |
| 0033NF2010/EP | PROCESS FOR THE PRODUCTION OF VIOLACEIN AND ITS DERIVATIVES CONTAINING BIOACTIVE PIGMENT FROM CHROMOBACTERIUM SP. NIIST-CKK-01 | Krishnakumar Bhaskaran | 11/09/2012 | 11718485.3 |
| 0109NF2008/AU | NOVEL SURFACE-MODIFICATION PROCESSES FOR FLYASH AND INDUSTRIAL APPLICATIONS THEREOF | Shukla Satyajit Vishnu, Warrier Krishna Gopakumar, Kizhakkelikoodayil Baiju Vijayan, Thachan Shijitha | 11/09/2012 | 2010348068 |
| 0109NF2008/US | NOVEL SURFACE-MODIFICATION PROCESSES FOR FLYASH AND INDUSTRIAL APPLICATIONS THEREOF | Shukla Satyajit Vishnu, Warrier Krishna Gopakumar, Kizhakkelikoodayil Baiju Vijayan, Thachan Shijitha | 12/09/2012 | 13/612363 |
| 0033NF2010/US | PROCESS FOR THE PRODUCTION OF VIOLACEIN AND ITS DERIVATIVES CONTAINING BIOACTIVE PIGMENT FROM CHROMOBACTERIUM SP. NIIST-CKK-01 | Krishnakumar Bhaskaran | 12/09/2012 | 13/634329 |
| 0109NF2008/CN | NOVEL SURFACE-MODIFICATION PROCESSES FOR FLYASH AND INDUSTRIAL APPLICATIONS THEREOF | Shukla Satyajit Vishnu, Warrier Krishna Gopakumar, Kizhakkelikoodayil Baiju Vijayan, Thachan Shijitha | 02/11/2012 | 01080066578.7 |
| 0188NF2011/WO | A NOVEL METHOD OF DEVELOPING NANO-STRUCTURED SILVER OXIDE FILM BASED AQUEOUS VOLTAMMETRIC PESTICIDE SENSOR | Panampillil Vijayammma Subha, Varghese Saumya, Talasila Prasada Rao | 31/01/2013 | PCT/IN2013/000064 |

# PATENTS FILED (INDIA)

| NFNO | Title | Inventors | Filing Date | Application No. |
|---|---|---|---|---|
| 0139NF2011/IN | FLUORESCENT MATERIAL FOR SELF-ERASABLE WRITING, AUTHENTIC SECURITY LABELING, CURRENCY COUNTERFEIT PREVENTION AND PROCESSES FOR THE PREPARATION THEREOF | Ayyappanpillai Ajayaghosh, Rajasekaran Thirumalai Kumaran | 13/08/2012 | 2294DEL2011 |
| 0138NF2011/IN | DYE ENTRAPPED SOL-GEL FILM BASED TEST STRIP SENSOR FOR NITRITE AND A PROCESS THEREOF | Santhakumar Dhanya, Talasila Prasada Rao | 27/08/2012 | 2419DEL2011 |
| 0188NF2011/IN | A NOVEL METHOD OF DEVELOPING NANO-STRUCTURED SILVER OXIDE FILM BASED AQUEOUS VOLTAMMETRIC PESTICIDE SENSOR | Panampillil Vijayammma Subha, Varghese Saumya, Talasila Prasada Rao | 30/01/2013 | 0264DEL2012 |
| 0010NF2012/IN | A PROCESS FOR THE PREPARATION OF AUTOFLOCCULANT ALGAL CULTURES WITH HIGH LIPID CONTENT | Ajit Haridas | 02/04/2012 | 1016DEL2012 |
| 0102NF2012/IN | A PROCESS FOR DECOMPOSITION OF ORGANIC SYNTHETIC DYES USING SEMICONDUCTOR-OXIDES NANOTUBES VIA DARK CATALYSIS. | Shukla Satyajit Vishnu, Warrier Krishna Gopakumar, Babu Babitha Kunnathuparambil | 17/08/2012 | 2555DEL2012 |
| 0009NF2012/IN | 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 | 30/08/2012 | 2686DEL2012 |
| 0183NF2012/IN | 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 | 28/01/2013 | 0206DEL2013 |

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| AMPHIPHILIC SQUARAINE DYES, A PROCESS FOR THE PREPARATION THEREOF AND THEIR USE AS NEAR INFRA-RED FLUORESCENCE PROBES FOR BIOLOGICAL BIOCHEMICAL AND INDUSTRIAL APPLICATIONS | Danaboyina Ramaiah, Kalliat Thazhathveetil Arun, Jyotish Kuthanapillil | 23/05/2012 | ZL200580052408.2 |
| NANOCOMPOSITE MATERIAL USEFUL FOR THE PREPARATION SUPERHYDROPHOBIC COATING AND A PROCESS FOR THE PREPARATION THEREOF | Ayyappanpillai Ajayaghosh, Sampath Srinivasan, Vakayil K Pravin | 04/12/2012 | 8323732 |

# PATENTS GRANTED (INDIAN)

| Title | Inventors | Grant Date | Patent No. |
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| PROCESS FOR THE SYNTHESIS OF TELECHELIC URETHANE ACRYLATE UV CURBLE PRE POLYMER MATERIALS | Syamakumari Asha, Chennakkattu Krishna Sadasivan Pillai | 12/04/2012 | 251853 |
| A NOVEL CYCLIC DONOR-ACCEPTOR CONJUGATE, PROCESS AND A SUPRAMOLECULAR FLUORESCENT MARKER THEREOF | Danaboyina Ramaiah, Prakash P Neelakandan, Mahesh Hariharan | 31/08/2012 | 253901 |
| NOVEL CHOLESTERIC LIQUID CRYSTAL CONTAINING PHOTORESPONSIVE BUTADIENE CHROMOPHORE AND A PROCESS FOR THE PREPARATION THEREOF | Suresh Das, Shibu Abraham, From RRL(T) Mobuyuki Tamoaki, Viswanath Ajay Mallia, From AIST, Japan | 21/11/2012 | 254577 |

# KNOWLEDGE RESOURCE CENTRE

The Knowledge Resource Centre (KRC) plays a prominent role in supporting the R & D activities of NIIST by providing the required information resources, services and knowledge dissemination. KRC continued to offer its services extensively to the S & T personnel of the institute during 2012-13 also and made significant progress. KRC is holding an excellent collection of documents including books, periodicals, CD-ROM databases etc., and providing access to electronic journals and databases. KRC is providing the high speed network through dedicated leased lines on OFC link with Ethernet connectivity to all researchers. These 24X7 services with 100% throughput and >99% network uptime cater to the bandwidth 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.

## Resources:

**Print collection:** As on March 2013, the total print collection is 43,107 plus documents which include 13,087 books, 10947 standards and 10877 bound volumes of periodicals. During 2012-13, 107 books were purchased and 83 foreign and 77 Indian periodicals were subscribed including 35 titles in online version. 10 periodicals were received as gratis.

**e-Resources**: Access to more than 4000 journals and 6 database were provided to NIIST researchers. These resources were utilized by NIIST researchers. Regular promotional programmes such as regular message broadcasting of new facilities/ services initiated, hosting in the intranet with search links to each item have enhanced the level of usage. Trail access to various e-resources were also enabled for researcher through NKRC (National Knowledge Resource Consortia). Access to these information resources contributes to the success of NIIST as a leader in R&D.

Full text journal database from various publishers such as American Chemical Society, Annual Reviews, American Society of Civil Engineers, American Society of Mechanical Engineers, American Society of Microbiology, American Institute of Physics, Association for Computing Machinery, Cambridge University Press, Elsevier, Emerald, Institute of Electrical and Electronics Engineers, Nature Publishing Group, Oxford University Press, Royal Society of Chemistry, Science Magazine, Springer, Taylor & Francis, Wiley – Blackwell, Indian Journals.com and journals and Theime journals are accessible. Bibliometric databses such as REAXYS Web of Science - Science Citation Index Expanded, SCOPUS were heavily used in addition to the available patent databases *viz.* Derwent Innovations Index and Qpat. The ASTM Standards also referred by NIIST.

## Library services

During the period, the in-house databases of books, periodicals, Ph.D. theses, publications of NIIST scientists, etc were updated regularly and

made available through NIIST website and as well as through intranet. The division conducted regular database searches including Standards and Patents for scientists, scholars and students. The resource facilities and services were extended to external users, primarily from research, industrial and academic sectors. About 400 persons from institutes and universities in and around Kerala visited NIIST-KRC and availed the services. Initiation of new members to services of KRC was done regularly. Creation of Institutional Repository of theses & research papers produced from NIIST are in progress. During the period 190 records were added to the IR. 302 volumes of periodicals were bound during the period. Rendered reprographic and photographic services as a general laboratory facility.

**Scientometric service**: Carried out Bibliometric/Scientometric/Impact Factor analysis of NIIST publications using Journal Citation Report, Web of Science - Science Citation Index Expanded and SCOPUS. Provided support service for publishing in journals with high Impact Factor. The total number of papers published by NIIST during 2012 is 169, of which 157 are SCI papers with an average IF value of 2.927.

**IT and Network Administration:** The IT Lab acts as the main hub of the communication network and bringing together information, knowledge tools and systems for research and management. All the buildings in the campus are interconnected through gigabit fibre optic backbone. Separate VLANs have been created to connect a large number of high end personal computers to the campus network. IT lab maintains around 500+ internet connections through wired and wireless network. A state-of-the-art data centre has been set up to maintain high end servers, storage devices, UTM devices and core switches.

IT lab upgraded its existing internet bandwidth from 9 mbps to 10 mbps of BSNL during the reporting year in addition to the 100 mbps leased line from National Knowledge Network to fulfill the internet requirement of the lab. The network uptime has been maintained at 99%. IT lab has implemented Wi-Fi facilities covering all areas of NIIST with a secured wireless network. The lab also maintains state-of-the-art server/storage hardware consisting of latest technology to manage the network and application resources. It also maintains UTM device for routing, load balancing, fail-over and secured data access. The lab also manages network switches deployed in various locations in the lab.

E-mail system has become a powerful and speedy means of communication and NIIST had implemented Zimbra e-mailing system. All scientist, staff and research students are provided with institutional e-mail id. The mail server is well equipped with adequate anti-virus, anti-spam and intrusion prevention systems. The deployment of this system has brought down SPAM control rate to a great extent. The lab has also developed and hosted its own institutional website in bilingual format and also an intranet website that provides all the related information, guidelines and announcements. The sites are maintained by regular updating of the contents. The lab is also involved in the development of websites for conferences organized by NIIST.

The lab has procured license for deploying server grade antivirus software which provides virus-free network environment at NIIST. The lab initiates an Annual Maintenance Contract for all the desktop, laptop as well as other computer peripherals in the lab. IT lab maintains a help desk that helps users solving issues related to installations, reinstallations, repairs, software updation, virus is-

sues etc. 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 lab has taken extensive initiatives in implementing the CSIR-ERP system. The lab also provides assistance in ensuring Quality assurance in the acquisition of IT products and devices of the lab.

The division organized following training programmes during 2012-13:

- Patent searching & mapping using Questel Orbit (QPAT), 16 May 2012.
- Workshop on Patinformatics for research planning and commercialization, 23-24 August, 2012.
- How to get published in research journals, 30 November, 2012.
- Emerging Trends in Open Access: Lecture on scholarly communications and impact measures in the open knowledge environment by Prof. Leslie Chan and Prof. Subbiah Arunachalam, 17 December, 2012.

# LIST OF PUBLICATIONS: 2012

1 **SINGH (K), BHATTI (H S), BAIJU (K V), SHUKLA (S), KUMAR(S), CHOUBEY (R K)**
Study of size dependent photo-induced exciton life-time and photocatalytic activity of nanocrystalline CdZnS
**Advanced Science Letters**
**16(1):237-243; Sep 2012**

2 **YAHAYA (L E), ADEBOWALE (K O), MENON (A R R) and OLU-OWOLABI (B I)**
Natural rubber/ organoclay nanocomposite from Tea (Camellia Sinensis) seed oil derivative.
**American Journal of Materials Science**
**2(2):1-5; 2012**

3 **THOMAS (T G), SREENATH (K) and GOPIDAS (K R)**
Colorimetric detection of copper ions in sub-micromolar Concentrations using a triarylamine- linked resin bead
***Analyst***
***137(22):5358-5362; 2012***

4 **SAUMYA (V) and PRASADA RAO (T)**
Copper quantum cluster-polypyrrole composite film based zero current chronopotentiometric sensor for glutathione
***Analytical Methods***
***4(7):1976-1982; Jul 2012***

5 **SANTHOSH BABU (S), AIMI (J), OZAWA (H), SHIRAHATA (N),SAEKI (A), SEKI (S), AJAYAGHOSH (A), MOHWALD (H) and NAKANISHI (T)**
Solvent-free luminescent organic liquids
***Angewandte Chemie - International Edition***
***51(14):3391-3395; 2012***

6 **ANESH GOPAL, HIFSUDHEEN (M), FURUMI (S), TAKEUCHI (M) and AJAYAGHOSH (A)**
Thermally assisted photonic inversion of supramolecular handedness
***Angewandte Chemie - International Edition***
***51(42):10505-10509; 2012***

7 **SANTHOSH BABU (S), PRASANTHKUMAR (S) and AJAYAGHOSH (A)**
Self-assembled gelators for Organic Electronics
***Angewandte Chemie - International Edition***
***51(8):1766-1776; 2012***

8 **VINOD KRISHNAN,RAVIKUMAR (K K), SUKUMARAN (K) and JYOTHINDRA KUMAR (K)**
In vitro evaluation of physical vapor deposition coated beta titanium orthodontic archwires
***Angle Orthodontist***
***82(1):22-29; Jan 2012***

9 **FERNANDES (N L M), ZANATA (S M), RONNAU (M), SOCCOL (C R), PANDEY (A) and THOM AZ-SOCCOL (V)**
Production of potential vaccine against dermatobia hominis for cattle
***Applied Biochemistry and Biotechnology***
***167(3):412-424; Jun 2012***

10 **ANGELIS (S), NOVAK (A C), SYDNEY (E B), SOCCOL (V T), CARVALHO (J C), PANDEY (A), NOSEDA (M D), THOLOZAN (J L), LORQUIN (J) and SOCCOL (C R)**
Co-culture of microalgae, cyanobacteria, and macromycetes for exopolysaccharides production: Process prliminary optimization and partial characterization
***Applied Biochemistry and Biotechnology***
***167(5):1092-1106; Jul 2012***

11 **DIVYA (J B), VARSHA (K K) and NAMPOOTHIRI (K M)**
Newly isolated lactic acid bacteria with probiotic features for potential application in food industry
***Applied Biochemistry and Biotechnology***
***167(5):1314-1324; Jul 2012***

12 **PANDEY (A), LARROCHE (C), LEE (D J) and SOCCOL (C R)**
New horizons in Biotechnology - Preface
***Applied Biochemistry and Biotechnology***
***167(5):929-930; Jul 2012***

13 **VIDYA (J) and PANDEY (A)**
Recombinant expression and characterization of L-Asparaginase II from a moderately thermotolerant bacterial isolate
***Applied Biochemistry and Biotechnology***
***167(5):973-980; Jul2012***

14 **USHASREE (M V), GUNASEKARAN (P) and PANDEY (A)**
Single-step purification and immobilization of MBP-phytase fusion on starch agar beads: Application in dephytination of soy milk
***Applied Biochemistry and Biotechnology***
***167(5):981-990; Jul2012***

15 **PREETI (V E), SANDHYA (S V), KUTTIRAJA (M), SINDHU (R), VANI (S), RAJEEV K SUKUMARAN, PANDEY (A), and BINOD PARAMESHWARAN**
An evaluation of chemical pretreatment methods for improving enzymatic saccharification of hili post-harvest residue
***Applied Biochemistry and Biotechnology***
***167(6):1489-1500; Jul 2012***

16 **SINDHU (R), KUTTIRAJA (M), BINOD PARAMESWARAN, PREETI (V E), SANDHYA (S V), VANI (S), RAJEEV K SUKUMARAN and PANDEY (A)**
Surfactant-assisted acid pretreatment of sugarcane tops for bioethanol production
***Applied Biochemistry and Biotechnology***
***167(6):1513-1526; Jul 2012***

17 **PRAJEESH GANGADHARAN (P V), ANUPAMA (V N), ARYA BHASI, KHAN (S) and KRISHNAKUMAR (B)**
Degradation of triclosan under aerobic, anoxic, and anaerobic conditions
***Applied Biochemistry and Biotechnology***
***167(6):1603-1612; Jul 2012***

18 **SOWMYA (P M), SITA (R), SUMI (J M), GAYATHRI (S), SAI SHYAM (N), HEMARAJ (N) and NAMPOOTHIRI (K M)**
Bioactives of microbes isolated from western ghat belt of Kerala show lactamase inhibition along with wide spectrum antimicrobial activity.
***Applied Biochemistry and Biotechnology***
***167(6):1753-1762; Jul 2012***

19 **VIPIN GOPINATH, ANUSREE (M), DHAR (K S) and NAMPOOTHIRI (K M)**
Corynebacterium glutamicum as a potent biocatalyst for the bioconversion of pentose sugars to value-added products.
***Applied Microbiology and Biotechnology***
***93(1):95-106; Jan 2012***

20 **MANIKANDAN (D), MANGALARAJA (R V), SIDDHESWARAN (R), AVILA (R E) and ANANTHAKUMAR (S)**
Fabrication of nanostructured clay-carbon nanotube hybrid nanofiller by chemical vapour deposition
***Applied Surface Science***
***258(10):4460-4466; 01 Mar 2012***

21 **JEYAKUMAR (T), KODISUNDARAM (P), RAJAVEL (A), KUMAR (R), ANBU (M), LATHA (P) and ROSELET (P)**
Triclosan residues in estuarine sediments from Valliyar estuary, Kanyakumari district, Tamil Nadu, India
***Asian Journal of Water, Environment and Pollution***
***9(1):53-58; 2012***

22 **PRIYA (R), PRATHAPAN (A), RAGHU (K G) and MENON (A N)**
Chemical composition and in vitro antioxidative potential of essential oil isolated from Curcuma longa L. leaves
***Asian Pacific Journal of Tropical Biomedicine***
***2(2 Suppl.2):S695-S699; Feb 2012***

23 **PRATHAPAN (A), MAHESH (S K), LEKSHMI (P C), RAGHU (K G) and NIRMALA MENON (A)**
Modulation of adipogenesis and glucose uptake by curcuma longa extract in 3T3LI and L6 cell lines - An in vitro study
***Asian Pacific Journal of Tropical Disease***
***2(Suppl.1):S163-S165;2012***

24 **NAMPOOTHIRI (S V), LEKSHMI (P C), VENUGOPALAN (V V) andNIRMALA MENON (A)**
Antidiabetic and antioxidant potentials of spent turmeric oleoresin, a by-product from curcumin production industry
***Asian Pacific Journal of Tropical Disease***
***2(Suppl.1):S169-S172; 2012***

25 **ALAN SHEEJA (D B) and MANGALAM S NAIR**
Phytochemical constituents of Curcuma amada
***Biochemical Systematics and Ecology***
***44:264-266; Oct 2012***

26 **VANI (S), BINOD PARAMESWARAN, KUTTIRAJA (M), SINDHU (R), SANDHYA (S V), PREETI (V E), RAJEEV K SUKUMARAN and PANDEY (A)**
Energy requirement for alkali assisted microwave and high pressure reactor pretreatments of cotton plant residue and its hydrolysis for fermentable sugar production for biofuel application
***Bioresource Technology***
***112:300-307; May 2012***

27 **KARP (S G), FARACO (V), AMORE (A), BIROLO (L), GIANGRANDE (C), SOCCOL (V T), PANDEY (A) and SOCCOL (C R)**
Characterization of laccase isoforms produced by Pleurotus ostreatus in solid state fermentation of sugarcane bagasse
***Bioresource Technology***
***114:735-739; Jun 2012***

28 **NIMISHA (R N), NAMPOOTHIRI (K M) and PANDEY (A)**
Preparation of poly (l-lactide) blends and biodegradation by Lentzea waywayandensis
***Biotechnology Letters***
***34(11):2031-2035; Nov 2012***

29 **CHRISTOPHE (G), KUMAR (V), NOUAILLE (R), GAUDET (G), FONTANILLE (P), PANDEY (A), SOCCOL (C R) and LARROCHE (C)**
Recent developments in microbial oils production: A possible alternative to vegetable oils for biodiesel without competition with human food?
***Brazilian Archives of Biology and Technology***
***55(1):29-46; Jan-Feb 2012***

30 **MANU KRISHNAN, SEEMA (S), SUKUMARAN (K) and PAWAR (V)**
Phase transitions in coated nickel titanium arch wires: A differential scanning calorimetric and X-ray diffraction analysis
***Bulletin of Materials Science***
***35(5):905-911; Oct 2012***

31 **MANIKANDAN (D), MANGALARAJA (R V), ANANTHAKUMAR (S) and SIVAKUMAR (T)**
Synthesis of metal intercalated clay catalysts for selective hydrogenation reactions
***Catalysis in Industry***
***4(4):215-230; 2012***

32 **MANJUSHA (C), DASGUPTA (S), SENGUPTA (S), CHAKRABORTY (J), GHOSH (S K), GHOSH (J), MITRA (M K), MISHRA (A), MANDAL (T K) and BASU (D)**
A facile synthetic strategy for Mg-Al layered double hydroxide material as nanocarrier for methotrexate
***Ceramics International***
***38(2):941-949; Mar 2012***

33 **SREEREMYA (T S), ASHA KRISHNAN, SREEVIDHYA (J I) and GHOSH (S K)**
Ultra-thin cerium oxide nanostructures through a facile aqueous synthetic strategy
***Ceramics International***
***38(4):3023-3028; May 2012***

34 **SANDHYA KUMARI (L), PRABHAKAR RAO (P), SAMEERA (S) and PETER KOSHY**
Synthesis and optical properties of Ce0.95 Pr0.05-x MxO2 (M= Mn, Si) as potential ecological red pigments for coloration of plastics
***Ceramics International***
***38(5):4009-4016; Jul 2012***

35 **SAM SOLOMON, SURESH (M K), THOMAS (J K), PRASAD (V S), WARIAR (P R S)**
Synthesis, structural analysis and dielectric properties of Ba-8(Mg1-xZnx) Nb6O24 hexagonal perovskites
***Ceramics International***
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***Materials Research Bulletin***
***47(12):4365-4375;2012***

126 **SANKAR (S), ATHIRA (N R), JYOTHI (C K), WARRIER (K G K) and PADMANABHAN (P V A)**
Room temperature synthesis of high temperature stable lanthanum phosphate-yttria nano composite
***Materials Research Bulletin***
***47(7):1835-1837; Jul 2012***

127 **SIDDHESWARAN (R), MANGALARAJA (R V), AVILA (R E), MANIKANDAN (D), ESTHER JEYANTHI (C) and ANANTHAKUMAR (S)**
Evaluation of mechanical hardness and fracture toughness of Co and Al co-doped ZnO
***Materials Science and Engineering A - Structural Materials:***
***Properties, Microstructure and Processing***
***558:456-461; 15 Dec 2012***

128 **MANIKANDAN (D), MANGALARAJA (R V), AVILA (R E), SIDDHESWARAN (R) and ANANTHAKUMAR (S)**
Carbon nanotubes rooted montmorillonite (CNT-MM) reinforced nanocomposite membrane for PEM fuel cells
***Materials Science and Engineering B - Advanced Functional Solid-State Materials***
***177(8):614-618; 15 May 2012***

129 **SUBOJ (B), PRIYA (P S), NANDINI (R J) SURESH KUMAR (M A), MANGALAM S NAIR, PRIYA (S) and SRINIVAS (G)**
Nimbolide retards tumor cell migration, invasion, and angiogenesis by downregulating MMP-2/9 expression via inhibiting ERK1/2 and reducing DNA-binding activity of NF-kappa B in colon cancer cells
***Molecular Carcinogenesis***
***51(6):475-490; Jun 2012***

130 **SAI SHYAM (N) and NAMPOOTHIRI (K M)**
Biochemical characterization of recombinant methionine aminopeptidases (MAPs) from Mycobacterium tuberculosis H37Rv
***Molecular and Cellular Biochemistry***
***365(1-2):191-202; Jun 2012***

131 **SINDHU R NAMBIAR, ANEESH (P K), SUKUMAR (C) and PRASADA RAO (T)**
Mixed monolayer protected gold atom-oxide cluster synthesis and characterization
***Nanoscale***
***4(14):4130-4137; 2012***

132 **LEKSHMI (P C), RANJITH ARIMBOOR, RAGHU (K G) and NIRMALA MENON (A)**
Turmerin, the antioxidant protein from turmeric (Curcuma longa) exhibits antihyperglycaemic effects
***Natural Product Research***
***26(17):1654-1658; 2012***

133 **INDU SASIDHARAN, VENUGOPALAN (V V) and NIRMALA MENON (A)**
Essential oil composition of two unique ginger (Zingiber officinale Roscoe) cultivars from Sikkim
***Natural Product Research***
***26(19):1759-1764; 2012***

134 **EZEMA (I C), MENON (A R R), EDELUGO (S O), OMAH (A D) and AGBO (I U)**
Ply tensile properties of banana stem and banana bunch fibres reinforced natural rubber composite
***Nigerian Journal of Technology (NIJOTECH)***
***31(1):25-30; Mar 2012***

135 **GOWRI SREEDEVI (K C), AJESH P THOMAS, RAMAKRISHNAN (S), SALINI (P S), HOLADAY (M G D), REDDY (M L P) and SRINIVASAN (A)**
4, 4, 9, 9-Tetraphenyl pyrroloindolizine: A structural analogue of calix[2]pyrrole
***Organic & Biomolecular Chemistry***
***10(18):3600-3605; 2012***

136 **VIJAY NAIR (G), ANU JOSE, SEETHA LAKSHMI (K C), REJITHAMOL (R) &SURESH (E)**
A facile four component protocol for the synthesis of dihydropyridine derivatives
***Organic & Biomolecular Chemistry***
***10(38):7747-7752; 2012***

137 **REKHA (R A), DHANYA (J T), ADARSH (N) and RAMAIAH (D)**
Squaraine dyes in PDT: From basic design to in vivo demonstration
***Organic & Biomolecular Chemistry***
***10(5):911-920; 2012***

138 **RAJAGANESH (R), ANESH GOPAL, MOHAN DAS (T) and AJAYAGHOSH (A)**
Synthesis and properties of amphiphilic photoresponsive gelators for aromatic solvents
***Organic Letters***
***14(3):748-751; 03 Feb 2012***

139 **RAMAKRISHNAN (S), ANJU (K S), AJESH P THOMAS, SREEDEVI (K C G), SALINI (P S), HOLADAY (M G D), SURESH (E) and SRINIVASAN (A)**
ansa-Ferrocene-incorporated calixpyrroles and calixphyrins: Syntheses and spectral /structural characterization.
***Organometallics***
***31(11):4166-4173; 11 Jun 2012***

140 **SURESH (C H) and FRENKING (G)**
1,3-metal-carbon bonding and alkyne metathesis: DFT investigations on model complexes of group 4, 5, and 6 transition metals
***Organometallics***
***31(20):7171-7180; 22 Oct 2012***

141 **PRIYA RANI (M) and PADMAKUMARI (K P)**
*In vitro* studies to assess the antidiabetic, antiperoxidative, and radical scavenging potential of Stereospermum colais
***Pharmaceutical Biology***
***50(10):1254-1260; Oct 2012***

142 **REJIYA (C S), JATISH KUMAR, RAJI (V), VIBIN (M) and ANNIE ABRAHAM**
Laser immunotherapy with gold nanorods causes selective killing of tumour cells
***Pharmacological Research***
***65(2):261-269; Feb 2012***

143 **SREEJITH (S), DIVYA (K P), JAYAMURTHY (P), MATHEW (J), ANUPAMA (V N), DIVYA SUSANA (P), ANEES (P) and AJAYAGHOSH (A)**
Heteroaromatic donors in donor-acceptor-donor based fluorophores facilitate zinc ion sensing and cell imaging
***Photochemical and Photobiological Sciences***
***11(11):1715-1723; 2012***

144 **SMITHA (S L), GOPCHANDRAN (K G), NIMISHA R NAIR, NAMPOOTHIRI (K M) and RAVINDRAN (T R)**
SERS and antibacterial active green synthesized gold nanoparticles
***Plasmonics***
***7(3):515-524; Sep 2012***

145 **SAJITH MENON and SURESH DAS**
A photoresponsive fluorescent glycopolymer
***Polymer Chemistry***
***3(9):2619-2624; 2012***

146 **NAIK (B), PRASAD (V S) and GHOSH (N N)**
Preparation of Ag nanoparticle loaded mesoporous gamma-alumina catalyst and its catalytic activity for reduction of 4-nitrophenol
***Powder Technology***
***232:1-6; Dec 2012***

147 **RAJI (R), DHAR (K S), NAMPOOTHIRI (K M) and PANDEY (A)**
Characterization of leucine amino peptidase from Streptomyces gedanensis and its applications for protein hydrolysis
***Process Biochemistry***
***47(2):234-242; Feb 2012***

148 **RAMAKRISHNAN (R), SUDHA (J D) and REENA (V L)**
Nanostructured polyaniline-polytitanate-clay composite for photocatalytic applications: Preparation and properties
***RSC Advances***
***2(15):6228-6236; 2012***

149 **PRASANTHKUMAR (K P), SURESH (C H) and ARAVINDAKUMAR (C T)**
Theoretical study of the addition and abstraction reactions of hydroxyl radical with uracil
***Radiation Physics and Chemistry***
***81(3):267-272; Mar 2012***

150 **BINOD PARAMESWARAN, SATYANAGALAKSHMI (K), SINDHU (R), JANU (K U), RAJEEV K SUKUMARAN and PANDEY (A)**
Short duration microwave assisted pretreatment enhances the enzymatic saccharification and fermentable sugar yield from sugarcane bagasse.
***Renewable Energy***
***37(1):109-116; Jan 2012***

151 **SHARON (H), KARUPPASAMY (K), SOBAN KUMAR (D R) and SUNDARESAN (A)**
A test on DI diesel engine fueled with methyl esters of used palm oil
***Renewable Energy***
***47:160-166; Nov 2012***

152 **BHEEMESWAR (D)**
Science behind - Natural methods
***Science India***
***36-37; Jan 2012***

153 **DHANYA (S), JAISY JOY and PRASADA RAO (T)**
Fabrication and characterization of rhodamine 6G entrapped sol-gel film test strip for virtually specific and sensitive sensing of nitrite
***Sensors and Actuators B: Chemical***
***173:510-516; Oct 2012***

154 **DASGUPTA (D), THIERRY (A), ROCHAS (C), AJAYAGHOSH (A) and GUENET (J M)**
Key role of solvent type in organogelation
***Soft Matter***
***8(33):8714-8721; 2012***

155 **NISHA (P), SAVITHA PILLAI (S), MANOJ RAAMA VARMA and SURESH (K G)**
Critical behavior and magnetocaloric effect in La0.67Ca0.33Mn1-xCrXO3 (x=0.1, 0.25)
***Solid State Sciences***
***14(1):40-47; Jan 2012***

156 **LINGAM (K A P), SHANMUGAM (P) and SELVAKUMAR (K)**
Stereoselective synthesis of geometrically strained Oxindole-appended Vinyl cyclopropanes and highly substituted cyclopentenes via sulfur ylide cyclopropanation and vinyl cyclopropane rearrangement
***Synlett***
***(2):278-284; Jan 2012***

157 **PAUL (R R)**
Mercuric triflate
***Synlett***
***23(13):1997-1998; 2012***

158 **REJITHAMOL (R), BABU (B P), AMIT KUMAR, PAUL (R R), SINU (C R), SURESH (E) and VIJAY NAIR (G)**
A facile multicomponent reaction involving isoquinoline, dimethyl allenedicarboxylate, and 2- oxo-1H-indol-3-ylidenes
***Synthesis -Stuttgart***
***44(3):417-422; Feb 2012***

159 **ANUPRIYA (S), SREEJA (T) and LUXMI VARMA (R)**
Synthesis of upper rim N-formamido and isocyanocalix [4]arenes: Adaptation of Ugi-4-CR on calix[4]arenes towards peptide-like architectures
***Tetrahedron***
***68(31):6323-6328; 05 Aug 2012***

160 **PRAVEEN (L), BABU (J), REDDY (M L P) and LUXMI VARMA (R)**
Unfolding with mercury: Anthracene-oxyquinoline dyad as a fluorescent indicator for Hg(II)
***Tetrahedron Letters***
***53(31):3951-3954; 01 Aug 2012***

161 **HARIDAS (V), SANDHYA (S), GEETHA (H) and SURESH (C H)**
1, 3-Phenyl linked urea-based receptors for anions and themfacile cyclization to imidazolidinedione
***Tetrahedron Letters***
***53(41):5523-5527; 10 Oct 2012***

162 **RAJAN (T P D), JAYAKUMAR (E) and PAI (B C)**
Developments in Solidification processing of functionally graded Aluminium Alloys and Composites by Centrifugal Casting Technique
***Transactions of the Indian Institute of Metals***
***65(6)Spl Iss S1:531-537;Dec 2012***

163 **PAI (B C), PILLAI (U T S), MANIKANDAN (P) and SRINIVASAN (A)**
Modification of AZ91 Mg Alloys for High Temperature Applications
***Transactions of the Indian Institute of Metals***
***65(6) Spl Iss S1:601-606; Dec 2012***

164 **JAYAKUMAR (E), RAJAN (T P D) and PAI (B C)**
Effect of Mg on solidification microstructures of homogenous and functionally graded A390 aluminum alloys
***Transactions of the Indian Institute of Metals***
***65(6) Spl Iss S1:677-681; Dec 2012***

165 **AJITH KUMAR (K K), ABHILASH (V), PILLAI (U T S), PAI (B C) &CHAKRABORTY (M)**
Changes in Solidification morphology of Mg-Si Alloys by Ca Additions
***Transactions of the Indian Institute of Metals***
***65(6)Spl Iss S1:695-699;Dec 2012***

166 **SRINIVASAN (A), WANG (Z), HUANG (Y D), BECKMANN (F), KAINER (K U& HORT (N)**
Hot Tearing Susceptibility of Magnesium-Gadolinium Binary Alloys
***Transactions of the Indian Institute of Metals***
***65(6)Spl Iss S1:701-706;Dec 2012***

167 **MANU (K M S), RESMI (V G), BRAHMAKUMAR (M), NARAYANASAMY (P), RAJAN (T P D), PAVITHRAN (C) and PAI (B C)**
Squeeze infiltration processing of functionally graded Aluminum-SiC metal ceramic composites
***Transactions of the Indian Institute of Metals***
***65(6)Spl Iss S1:747-751;Dec 2012***

168 **ANUPAMA (V N), KANNAN (K), PRAJEESH (P V G), RUGMINI SUKUMAR and KRISHNAKUMAR (B)**
Perchlorate, chlorate and bromate in water samples from the South-West coast of India
***Water Science and Technology: Water Supply***
***12(5):595-603; 2012***

169 **SINDHU (R), BINOD PARAMESWARAN, JANU (K U), RAJEEV K SUKUMARAN and PANDEY (A)**
Organosolvent pretreatment and enzymatic hydrolysis of rice straw for the production of bioethanol
***World Journal of Microbiology and Biotechnology***
***28(2):473-483; Feb 2012***

# GENERAL INFORMATION

## VISITS ABROAD

| Name | Country Visited | From | To | Purpose |
|---|---|---|---|---|
| Dr. M.T. Sebastian | Slovienia | 10.04.2012 | 25.04.2012 | Material Research laboratory, University of Nova Gorica - Indo-Slovenia joint project |
| | Germany | | | Erfut, Germany - Chair the session and invited talk in international conference, CICMT 2012 Germany<br><br>Technical University of Illmenau, Germany -Visit to Ilmenau Technical University |
| Dr. Rajeev K Sukumaran | Brazil | 18.04.2012 | 20.04.2012 | UNICAMP, Campinas,Sau Paulo - Workshop to forge research collaborations between India and Brazil |
| Dr. K .V. Radhakrishnan | France | 10.05.2012 | 24.05.2012 | University Of Reims - Indo French collaborative project |
| Dr. Ashok Pandey | France | 04.06.2012 | 29.06.2012 | University Blaise Pascal (UBP), Clermony Ferrand - UBP fellowship |
| | South Korea | 16.09.2012 | 21.09.2012 | Daegu, Korea - Invited speaker for 15th international symposium on Biotechnology ( IBS 2012) |
| | Taiwan | 07.10.2012 | 10.10.2012 | National Taiwan University of Science and Technology - Invited as General Chair of the international conference on bioprocess conducted by IFIBIOP |
| Dr. A. Srinivasan | Germany | 01.07.2012 | 31.08.2012 | GKSS, research Center, Geesthacht- Extension of Humboldt fellowship visit |
| Dr. C. H. Suresh | Germany | 01.07.2012 | 30.09.2012 | Marburg University- Humboldt Fellowship |
| Dr. P. Binod | Taiwan | 07.10.2012 | 10.10.2012 | National Taiwan University of Science and Technology - To attend the international conference on bioprocess conducted by IFIBIOP and to receive young scientist award |
| Dr. A. Ajayaghosh | Japan | 15.10.2012 | 26.10.2012 | AIST,Takamatsu & NIMS, Tsukuba - Indo Japan bilateral seminar on supramolecular nanomaterials for energy innovation |
| | Belgium | 25.11.2012 | 30.11.2012 | University of Namur - Member of the PhD examination board and also to give special departmental lecture. |
| | Tehran, IRAN | 03.02.2013 | 09.02.2013 | To receive 26th Khwarizmi International award (KIA) of Iranian research organization for science and technology (IROST) |
| Dr. Satyajith Shukla | Qingdao, China | 26.10.2012 | 28.10.2012 | Qingdao, China - To attend the 2nd annual world congress of nanosciences and technologies (Nano S&T 2012) |
| Dr. Suresh Das | Japan | 11.11.2012 | 20.11.2012 | Osaka University - To receive Asian and Oceaninan Photochemistry Association (APA) award 2012 and invited talk during the 7th Asian photochemistry conference; Visit to Tokyo Metropolitan University, Tokyo, Japan |

# HONOURS AND AWARDS

| | |
|---|---|
| Dr Suresh Das | MRSI Distinguished Lectureship Award |
| | Asian and Oceanian Photochemical Society Award |
| | Chair Person-Chemistry, DST-INSPIRE Faculty Scheme |
| Dr A Ajayaghosh | Infosys Science Foundation Award |
| | Fellow, Indian National Science Academy, New Delhi |
| | Associate Editor, Physical Chemistry Chemical Physics, Royal Society of Chemistry |
| | 26th Khwarizmi International Award, Iranian Research Organization for Science and Technology (IROST), Tehran, Iran |
| | CRSI Silver Medal, Chemical Research Society of India |
| Dr D Ramaiah | Prof. C. V. Asokan Memorial Lecture Award |
| | Member, Subject Expert Committee (2013-2015), Women Scientists Scheme, Department of Science and Technology, Government of India |
| Dr M L P Reddy | CRSI Bronze Medal, Chemical Research Society of India |
| Dr C H Suresh | CRSI Young Scientist, Chemical Research Society of India |
| Dr Joshy Joseph | Ramanujan Fellowship, DST, India |
| Dr C Vijayakumar | Ramanujan Fellowship, DST, India |
| Mr Shajan S | Best Research Paper Award, 13th National Conference on Technological Trends held at College of Engineering, Trivandrum during 10-11, August, 2012. |
| Ms Smitha V S | Best Poster (3rd prize) Second International Conference on Advanced oxidation Processes (AOP-2012) held at Mahatma Gandhi University, Kottayam, Kerala during 5-8th of October, 2012. |
| Ms Jaimy K B | Best Poster (3rd prize) Second International Conference on Advanced oxidation Processes (AOP-2012) held at Mahatma Gandhi University, Kottayam, Kerala during 5-8th of October, 2012. |
| Mr Shajesh P | Best Poster (3rd prize) Second International Conference on Advanced oxidation Processes (AOP-2012) held at Mahatma Gandhi University, Kottayam, Kerala during 5-8th of October, 2012. |
| Ms Jeena J K | Best Poster (3rd prize) Second International Conference on Advanced oxidation Processes (AOP-2012) held at Mahatma Gandhi University, Kottayam, Kerala during 5-8th of October, 2012. |
| Mr Jayakumar E | Best Research Paper Award, International Symposium for Research Scholars on Metallurgy, Materials Science and Engineering (ISRS-2012), December 13-15, IIT-Madras, Chennai |
| Ms Manjumol K A | Best Poster Award , 76th Annual Session of The Indian Ceramic Society (ICS), on 18-19 January, 2013 held at Ahmadabad |
| Mrs Priyanka A | Poster presentation award, International conference on "Phytochemicals in Health and Disease: Challenges and Future Opportunities (ICPHD-2013)", Annamalai University on January 23-25, 2013 |
| Mr Prajeesh G P V | Best paper award, Environmental science, forestry and wild life in the 25th Kerala Science Congress on January 29-February 1 ,2013 |
| Ms Soumya B | Best paper award, Environmental science, forestry and wild life in the 25th Kerala Science Congress on January 29-February 1 ,2013 |
| Mr Sankar S | Best Poster Award at the National Conference on Emerging Technologies for Processing and Utilization of Beach sand Minerals. 1-2 March 2013, Kochi, Kerala |
| Mrs Dhanya R | Best paper award, TKM Institute of Technology , Kollam in association with Association of Food Scientists and Technologies (AFST) Kollam chapter on 8-9 March, 2013 |

# PH.D. DEGREE AWARDED

| Student | Thesis title | Supervisor | University |
|---|---|---|---|
| Sai Shyam N | Molecular Studies on Peptide Deformylase and Methionine Aminopeptidase from Mycobacterium tuberculosis | Dr. K.Madhavan Nampoothiri | University of Kerala |
| Smitha Mohanlal | Phytochemical investigation on black-glumed njavara, the medicinal rice as compared to staple varieties and evaluation of their antioxidant, antiinflammatory and anticancer effects | Dr. A.Jayalekshmy | CUSAT |
| Pratheesh V Nair | Synthesis and photophysical properties of II-VI semiconductor nanostructures | Dr. K.George Thomas | University of Kerala |
| Divya K P | Donor-Acceptor-Donor (D-A-D) type Small Molecules and Oligomers: PhotoPhysical Properties, Analyte Responses and Conformational Changes | Dr. A. Ajayaghosh | University of Kerala |
| Nisha P | Structure, magnetic and magnetocaloric studies of some $La_{0.67}Ca_{0.33}MnO_3$ based perovskites | Dr. Manoj Rama Varma | University of Kerala |
| Sajith P K | Development of Quantitative Structure Property Relationship for predicting mutual transinfluence and ligand bond dissociation energies in Pa(II)Pt(II) and hypervalent iodine complexes | Dr. C.H.Suresh | University of Kerala |
| Neson Varghese | Studies on Transport and Magnetic properties of nanoparticle doped $MgB_2$ superconductor for technological applications | Dr. U.Syamaprasad | CUSAT |
| Balamurughan A | Conjugated polymer –Lanthanide hybrid materials for lumniscence applications | Dr. M.L.P.Reddy | University of Kerala |
| Sajith Menon | Design, synthesis and study of the self-assembly and photochemical properties of some light responsive amphiphilic block copolymers | Dr. Suresh Das | University of Kerala |
| Selvakumar K | Synthesis of functionalized 2-oxindoles and 3- spirocyclic 2- oxinoles from Morita-Daylis-Hillman abduct of isatin | Dr. P. Shanmugham | University of Kerala |
| Bindhumol I | Studies on Exopolysaccharide production by probiotic Lactic acid bacteria | Dr. K.Madhavan Nampoothiri | CUSAT |
| Suresh M | Grain refinement studies on Mg and Ma-Al based alloys | Dr. U.T.S.Pillai | CUSAT |

# MEMBERS OF THE RESEARCH COUNCIL

***CHAIRMAN***

**Dr. Dipankar Banerjee**
Department of Materials Engineering
Indian Institute of Science
Bengaluru-560 012

***MEMBERS***

**Shri. S. Vasudevan**
Professor
IPC Department, Indian Institute of Science
Bengaluru-560 012

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

**Prof. Y.N. Mohapatra**
Department of Physics
Indian Institute of Technology Kanpur
Kanpur-208 016

**Dr. L.S. Shashidhara**
Indian Institute of Science Education and Research
Professor and Coordinator- Biology
First Floor, Central Tower, Sai Trinity Building, Garware Circle, Sultarwadi, Pashan, Pune-411 021

**Prof. A .Bhattacharya**
Professor
School of Life Sciences
Jawaharlal Nehru University,
New Delhi-110 067

**Dr. M. Sastry**
Chief Scientific Officer
Tata Chemicals Innovation Centre
Ghotavde Phata, Urawde Road,
Pirangut Industrial Area, Gate No 1139/1
Mulshi, Pune- 412 108

**Dr. M.R.Pillai**
Director
Rajiv Gandhi entre for Biotechnology,
Jagathy, Trivandrum-695 014

***AGENCY REPRESENTATIVE***

**Dr. Arvind Duggal**
Adviser
Department of Biotechnology
Block No.2, 7$^{th}$Floor,
CGO Complex, Lodi Road
New Delhi-110 003

***DG NOMINEE***

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

***SISTER LABORATORY***

**Dr. Pushpito.K.Ghosh**
Director
Central Salt & Marine Chemicals Research Institute
Gijubhai Badheka Marg, Bhavnagar-364 002

***CLUSTER DIRECTOR***

**Dr. M.O.GARG**
Director
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

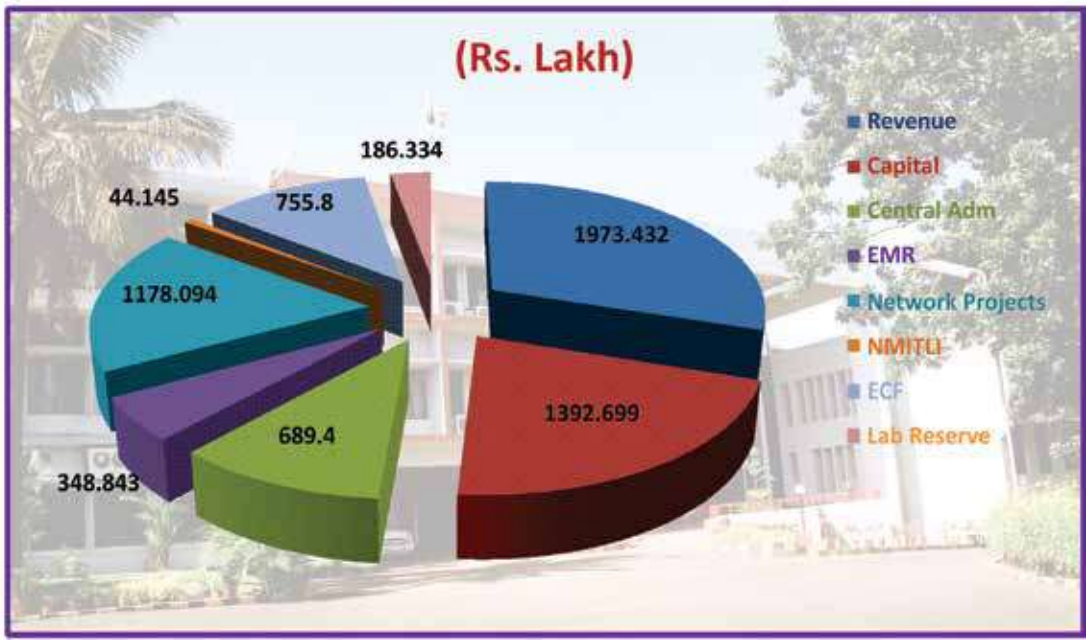
***MEMBERS***

Dr. K.R.Gopidas, Scientist, NIIST
Dr. Vijayamohanan K Pillai, Director, CECRI, Karaikudi
Dr. A. Ajayaghosh, Scientist, NIIST
Dr. M.T. Sebastian, Scientist, NIIST
Dr. (Mrs). S.Savithri, Scientist, NIIST
Dr. T.P.D. Rajan, Scientist, NIIST
Dr. B.Krishnakumar, Scientist, NIIST
Sri. S.Veluswamy, NIIST
COFA, NIIST
Head, PPD, NIIST

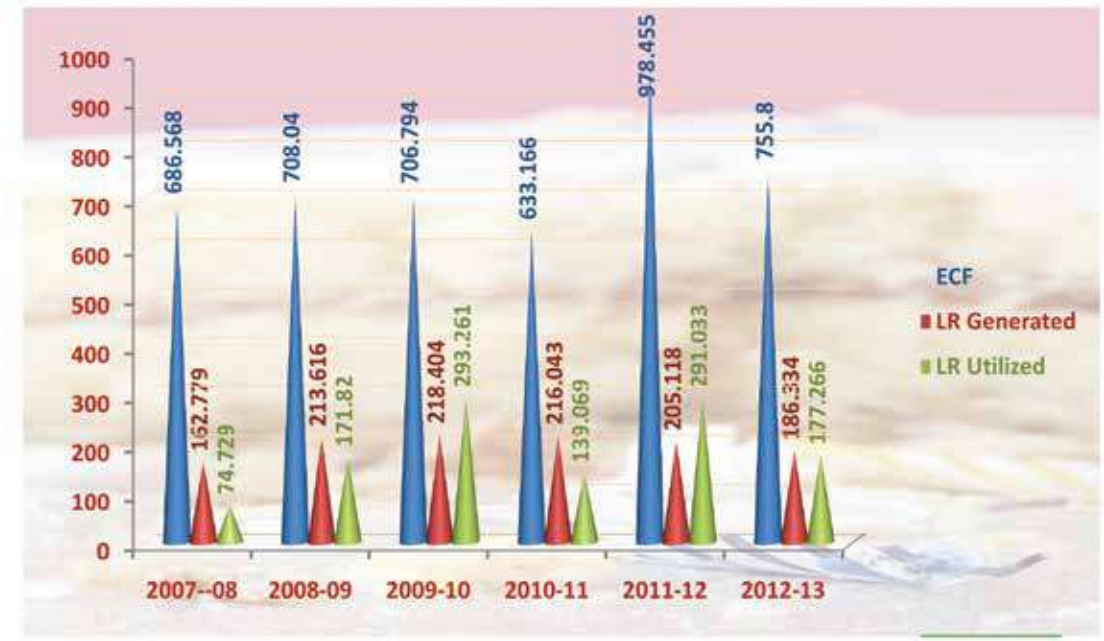
***MEMBER SECRETARY***

AO, NIIST

# BUDGET 2012-2013




# EXTERNAL CASH FLOW & LAB RESERVE (RS. LAKH)



# STAFF - New Recruitments

## Kaustabh Kumar Maiti, Sr. Scientist - 23 April 2012

Kaustabh Kumar Maiti obtained M.Sc. in organic chemistry and Ph.D. from Calcutta University in the year 2000. He started his professional carrier in leading pharmaceutical R&D's in India, 2000-2003 (Alembic Ltd. and Sun Pharmaceuticals Industries Ltd.) where he worked in process development and drug discovery program. He joined postdoctoral research at Pohang University of Science and Technology (POSTECH, 2003-2007), South Korea and in Complex Cabohydrate Research Center (CCRC), The University of Georgia, USA to continue second postdoctoral research. Before joining CSIR-NIIST, he worked at Singapore Bioimaging Consortium (under Biomedical Sciences Institute, A*STAR) as a research scientist (2009 May-2012 March). His current research interest is focused on the area of synthesis and biological evaluation of peptide and non-peptide scaffold based drug-delivery system for targeted delivery of small molecular drugs, proteins, nucleic acids and plasmid DNA. Also interested on the development of diagnostic probe for infectious diseases as well as cancer detection by ultrasensitive biocompatible surface enhanced Raman scattering (SERS) nanotags.

## Dr. Biswapriya Deb, Sr. Scientist - 25 May 2012

Before joining the Institute, Dr. Biswyapriya Deb has worked as Post Doctoral Researcher at Dept. of Chemical Eng and Materials Sc (CEMS), University of Minnesota, USA during 2003- 2004 and as Research Associate, Dept. of Chemical Eng. , University of Louisville, USA during 2004- 2007 and as Research Scientist (Industrial), Institute for Advanced Material & Renewable Energy (IAMRE), University of Louisville, USA during 2007- 2009 and as Post Doctoral Asscociate, National Institute for Materials Science (NIMS), Japan during 2010-2012. His research interest are focused on growth of functional nano materials for energy efficient devices, thin films, thermoelectricity and nano scale transport.

## Ms. M. Vasundhara, Scientist June 21 - 2012

Dr (Ms.) M Vasundhara obtained her Ph.D. on Physics from Indian Institute of Technology Kharagpur, India in the year 2009. Before joining as scientist at National Institute for Interdisciplinary Science and Technology, she worked as an Invited Researcher at Korea Advanced Institute of Science and Technology, Korea, (September 2008-March 2009), as Post doc. at Korea Advanced Institute of Science and Technology , Korea (March 2009 – June 2011) Post doc. at Riso National Laboratary for Sustainable Energy, Denmark, (July 2011 – June 2012) Her research interest are focused on magnetism: intermetallics, magnetic thin films, magnetic oxides, tunnel junctions and permanent magnets and advanced functional materials (such as spintronic, ferromagnetic, magneto caloric and thermoelectric) and nanostructural formation mechanism in rapidly solidified amorphous materials.

## Dr. R. Vijayanath, Medical Officer- 4 October 2012

Consequent on setting up of NIIST Dispensary at the Institute's premises, Dr. Vijayanath joined as Medical Officer of the Institute on 4.10.2012. He obtained his Degree in Bachelor of Medicine & Surgery from Kerala University in the year 2009. Prior to his joining the Institute, he was working as Medical Officer in ART Unit, Govt. Medical college, Kottayam, which functions as treatment Centre for persons affected with HIV.

## Dr. B.S. Sasidhar, Scientist- 17 October 2012

Dr. Sasidhar obtained Ph.D. in Organic Chemistry from Gulbarga University, India during 2012. He is a recipient of UGC- Research Fellowship in Science for Meritorious Students (RFSMS) University Merit Fellowship for Research, and Young Scientist Award (Best Oral Presenter) from University of Mysore. Synthesis and bio-applications of "Drug-Like" molecules, development of small molecular conjugates (SMC's) as DNA binding and DNA cleavage agents, green chemistry- rapid, economic and environmentally benign techniques for various organic transformations, synthesis of heterocyclic derived exotic materials for electronic applications are his areas of research interest.

## Shri K.Rishi Aravind, Scientist – 17 October 2012

Shri K. Rishi Aravind obtained Master of Technology (CSE -Bioinformatics) from IIIT-Hyderabad in 2006 and Post Graduate Diploma (Project Management) from Centennial College in 2010. Before joining CSIR- NIIST, he has worked as Research Engineer in he Bioinformatics Division, of Philips Research. He also possess academic and management experiences in various capacities. Bioinformatics, High performance computing, GPU computing, Health Informatics, Agent based modelling and simulation are his areas of research interest.

## Dr. Muthu Arumugham, Scientist- 25 October 2012

Dr. Muthu Arumugham obtained Ph.D. in Microbiology and Cell Biology from Indian Institute of Science (IISc), Bangalore in 2010. Infectious diseases, Industrial enzymes and bioenergy are his areas of research interest.

## Dr. S. Priya, Scientist – 29 October 2012

Dr. Priya obtained her Ph.D in Biochemistry form University of Kerala. She was awarded Postdoctoral fellowship at Dept. of Biochemistry, Hebrew University of Jerusalem, Israel during the year 2008 and DST-Fast track Young Scientist Award in 2012. Before joining as Scientist at CSIR- NIIST she has worked as Scientist at the Centre for Bio-Separation Technology (CBST), VIT University, Vellore, Tamil Nadu. Purification of biologically active compounds from natural sources, their cell based screening for therapeutic uses against various disorders, detailed study on the molecular mechanism of action using various cell based assay systems are her areas of research interest.

## Mr. M. Kiran Kumar, Scientist - 31 October 2012

Mr. Kiran Kumar obtained M.Tech Chemical Engineering (IIT Kharagpur), 2009. Before joining NIIST he has worked as Project Scientist at Centre for Bio-Fuels, CSIR(NIIST),Thiruvananthapuram and as Assistant Professor, Chemical Engineering Division, VIT University, Vellore. He is a recipient of MHRD Scholarship during 2007-2009. Bio-Fuels, Chemical Kinetics, Process Plant Design are his areas of research interest.

## Shri. S. Pushkin, Technical Officer – 3 October 2012

An engineering graduate in Electronics & Communication with Certificate in CCNA, IT Network designing and IT Security are his areas of Interest.

## Dr. C. Vijayakumar, Scientist – 1 January 2013

Dr. Vijayakumar received his PhD in Chemistry from University of Kerala in January 2008 based on the work done in the area of 'Functional Supramolecular Materials' under the guidance of Prof. A. Ajayaghosh at CSIR–NIIST, Trivandrum. Subsequently, he worked as a Postdoctoral Research Fellow (January 2008- December 2010) at the Organic Materials Group, National Institute for Materials Science (NIMS), Tsukuba, Japan. Later he worked as an Assistant Professor (January 2011- December 2012) at the Department of Applied Chemistry, Graduate School of Engineering, Osaka University, Japan. In January 2013, he joined at the Chemical Sciences and Technology Division of CSIR–NIIST, Trivandrum as a Scientist. His current research interests includes supramolecular chemistry, organic smart materials and sensors, organic semiconducting materials, organic-inorganic hybrid thermoelectric materials, photovoltaic devices, and light emitting diodes.

## Mr. Kiran Mohan, Technical Officer – 1 January 2013

Mr.Kiran Mohan completed his Bachelor's Degree (B-Tech) in Instrumentation and Control Engineering from NSS College of Engineering, Palakkad under the University of Calicut. He was with Icon Analytical Equipment Pvt. Ltd, Mumbai as a Senior Executive-Application Support. In January 2013, he joined in Chemical Science and Technology Division of CSIR-NIIST, Trivandrum as a Technical Officer. His area of interest includes various electron microscopic techniques, sample preparation techniques, EDS (Energy Dispersive Spectroscopy) analysis (Spectrum and mapping), EDS interpretation of images, analytical works with EDS, STEM (HAADF) IMAGING, interpretation of images and Troubleshooting.

## Mr. J.S. Kiran, Technical Assistant – 26 March 2013

Mr. Kiran holds a Diploma in Computer Engineering. He is a Cisco Certified Network Associate and a certified 3D Max and Photoshop Designer. In March 2013, he joined in Chemical Science and Technology Division of CSIR-NIIST, Trivandrum as a Technical Assistant. His areas of interest are computer aided design of molecular architecture and animation of chemical processes.

# STAFF LIST as on 31/03/2013

## DIRECTOR'S OFFICE

| | |
|---|---|
| DR SURESH DAS | DIRECTOR |
| MR S SURESHKUMAR | CHIEF SCIENTIST |
| MR G K NAIR | SR STENO(ACP) ( Retired on 31/3/2013) |
| MR A KRISHNANKUTTY | TECH GR 1-4 |
| MR P B VIJAYAKUMAR | TECH GR 1-4 |

## R & D DIVISIONS

### AGROPROCESSING & NATURAL PRODUCTS DIVISION

| | |
|---|---|
| DR A SUNDARESAN | CHIEF SCIENTIST & HEAD, ADMINISTRATIVE SERVICES |
| MR M M SREEKUMAR | CHIEF SCIENTIST & HEAD |
| MRS A NIRMALA MENON | SR PRINCIPAL SCIENTIST ( Retired on 30/6/2012) |
| MRS OMANAKUTTY AMMA | PRINCIPAL SCIENTIST |
| DR DILEEPKUMAR B S | PRINCIPAL SCIENTIST |
| DR (MRS) K P PADMAKUMARI AMMA | PRINCIPAL SCIENTIST(Retired on 31/1/2013) |
| DR K G RAGHU | PRINCIPAL SCIENTIST |
| MR V V VENUGOPALAN | SR SCIENTIST |
| MRS M V RESHMA | 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 |
| MRS L PRASANNA KUMARI | SR TECH OFF-3 (Retired on 31/3/2013) |
| MR D R SOBAN KUMAR | TECH OFF |
| MRS ANNAMMA MATHEW | SR STENO(ACP) (Retired on 31/5/2012) |

### BIOTECHNOLOGY DIVISION

| | |
|---|---|
| DR ASHOK PANDEY | CHIEF SCIENTIST & HEAD |
| DR K MADHAVAN NAMPOOTHIRI | PRINCIPAL SCIENTIST |
| DR RAJEEVKUMAR SUKUMARAN | SCIENTIST |
| DR N RAMESH KUMAR | SCIENTIST |
| DR P BINOD | SCIENTIST |
| DR MUTHU ARUMUGAM | SCIENTIST |
| MR KIRAN KUMAR M | SCIENTIST |
| MR K M PRAKASH | SR TECHNICIAN (2) |

## CHEMICAL SCIENCES & TECHNOLOGY DIVISION

| | |
|---|---|
| DR AJAYAGHOSH | SCIENTIST H |
| DR D RAMAIAH | CHIEF SCIENTIST & HEAD |
| DR T PRASADA RAO | CHIEF SCIENTIST |
| DR (MRS) MANGALAM S NAIR | CHIEF SCIENTIST |
| DR (MRS) A JAYALAKSHMI | CHIEF SCIENTIST |
| DR K R GOPIDAS | CHIEF SCIENTIST |
| DR M LAKSHMIPATHY REDDY | CHIEF SCIENTIST |
| DR (MRS) R LUXMI VARMA | SR PRINCIPAL SCIENTIST |
| DR K V RADHAKRISHNAN | SR SCIENTIST |
| DR C H SURESH | SR SCIENTIST |
| DR BISWAPRIYA DEB | SR SCIENTIST |
| DR KAUSTABH KUMAR MAITI | 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 |
| MR T S SASI KUMAR | PRIVATE SECRETARY |

## MATERIAL SCIENCES AND TECHNOLOGY DIVISION

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| DR M T SEBASTIAN | CHIEF SCIENTIST & HEAD |
| DR U SYAMAPRASAD | CHIEF SCIENTIST |
| DR P PRABHAKAR RAO | CHIEF SCIENTIST |
| MR K HARIKRISHNA BHAT | CHIEF SCIENTIST |
| DR JOSE JAMES | CHIEF SCIENTIST |
| DR A R R MENON | SR PRINCIPAL SCIENTIST |
| MR M C SHAJI | SR PRINCIPAL SCIENTIST |
| DR U T S PILLAI | SR PRINCIPAL SCIENTIST |
| DR M RAVI | SR PRINCIPAL SCIENTIST |
| MR SWAPAN KUMAR GHOSH | SR PRINCIPAL SCIENTIST (Transferred on 24/8/2012) |
| DR MANOJ RAAMA VARMA | SR PRINCIPAL SCIENTIST |
| MR S ANANTHAKUMAR | PRINCIPAL SCIENTIST |

| | |
|---|---|
| DR T P D RAJAN | SR SCIENTIST |
| DR HAREESH U S | SR SCIENTIST |
| DR E BHOJE GOWD | SR SCIENTIST |
| DR R P ALOYSIUS | SR SCIENTIST (On temporary transfer from 20/11/2012) |
| MR M SUNDARARAJAN | SCIENTIST |
| DR S V SHUKLA | SCIENTIST |
| DR A SRINIVASAN | SCIENTIST |
| DR K P SURENDRAN | SCIENTIST |
| DR SAJU PILLAI | SCIENTIST |
| DR (MISS) M VASUNDHARA | SCIENTIST |
| MR S VELUSAMY | PRINCIPAL TECH OFF |
| MR M BRAHMA KUMAR | PRINCIPAL TECH OFF |
| DR V S PRASAD | PRINCIPAL TECH OFF |
| MR K K RAVIKUMAR | SR TECH OFF-3 |
| MRS LUCY PAUL | SR TECH OFF-3 |
| MR P PERUMAL | SR TECH OFF-2 |
| MR P GURUSAMI | SR TECH OFF-2 |
| 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 DIVISION

| | |
|---|---|
| MR P RAGHAVAN | CHIEF SCIENTIST & HEAD( Retired on 31/5/2012) |
| DR (MRS) ROSCHEN SASIKUMAR | CHIEF SCIENTIST & HEAD |
| MR AJIT HARIDAS | CHIEF SCIENTIST |
| DR (MRS) S SAVITHRI | SR PRINCIPAL SCIENTIST |
| DR (MRS) ELIZABETH JACOB | SR PRINCIPAL SCIENTIST |
| MR J ANSARI | SR PRINCIPAL SCIENTIST |
| DR V B MANILAL | PRINCIPAL SCIENTIST |
| DR (MRS) RUGMINI SUKUMAR | PRINCIPAL SCIENTIST |
| DR M ANBU | PRINCIPAL SCIENTIST |
| DR B KRISHNAKUMAR | 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 | TECH GR 2-4 |
| MRS SAHARUBA P M | JTA |

## S & T SERVICES DIVISIONS

### ENGINEERING & SERVICES DIVISION

| | |
|---|---|
| MR P J VARGHESE | SR SUPER ENGR (Transferred on 30/4/2012) |
| MR R RAJEEV | SUP ENGG |
| MR K V OONNIKRISHNAN | SUP ENGG (Retired on 31/12/2012) |
| MR K PRASAD | AEE (ELEC) |
| 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 |
| MR P V THAMPY | TECH GR 2-4 |
| MR N J JACOB | TECH GR 2-4 ( Retired on 28/2/2013) |
| 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 |
| MR C P NARAYANAN | TECH GR 1-4 |
| MR P SOMAN | TECH GR 1-4 |
| MR R SUKUMARAN | TECH GR 1-4 |
| MR T V SATHEESH | GR C NON-TECH (MACP) |

### KNOWLEDGE RESOURCE CENTRE

| | |
|---|---|
| MRS P NISHY | SR PRINCIPAL SCIENTIST & HEAD |
| MRS SANTOSH BABU | PRINCIPAL SCIENTIST & HEAD (Retired on 31/8/2012) |
| 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 | TECHNICAL OFFICER |
| MR G SUDHAKARAN | TECH GR 2-4 |

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|---|---|
| MR G NAGASRINIVASU | SR TECHNICIAN (2) |
| MRS T S LATHA | AST(G)GR II |
| MR PUSHPAKUMAR K R NAIR | GR C NON-TECH |

## PLANNING AND BUSINESS DEVELOPMENT

| | |
|---|---|
| DR V G MOHANAN NAIR | CHIEF SCIENTIST |
| DR C CHANDRASEKARA BHAT | SR PRINCIPAL SCIENTIST |
| MR D BHEEMESWAR | PRINCIPAL SCIENTIST |
| MR C K CHANDRAKANTH | SR SCIENTIST |
| MR R S PRAVEEN RAJ | SCIENTIST |
| DR M SANKARANARAYANAN | PRINCIPAL TECH OFF |
| MRS V J SAROJAKUMARI | SR STENO(MACP) |
| MR K C CHACKO | GR C NON-TECH |

## ADMINISTRATION

| | |
|---|---|
| MR N S RAJU | AO |
| MRS S SOBHANA | AO |
| MR K F JOSEPH | SO (G) |
| MRS K S LATHIDEVI | HINDI OFFICER |
| MR T J BABU | SECU OFFICER |
| DR VIJAYNATH R | MEDICAL OFFICER |
| MR M K SIVADASAN | AST(G)GR I |
| MRS SISILY POULOSE | 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 |
| MRS MERCY JOSEPH | AST(G)GR II |
| MR R K RAMESH KUMAR | AST(G)GR II |
| MRS SUSAN MATHEW | AST(G)GR II (Retired on 31/10/2012) |
| MISS PARVATHI RAJEEVAN | ASSISTANT |
| MR D JAYAPRASAD | AST(G)GR II (MACP) |
| MRS K SARASWATHY | AST(G)GR II(ACP) |
| MRS PADMINI P S | SR STENO (MACP) |
| MRS ELIZABETH THOMAS | SR STENO(ACP) |
| MRS SREELETHA NAIR | SR STENO(MACP) |
| MR B VENUGOPAL | TECH GR 2-4 |
| MR P SURENDRAN | 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 |
| 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 |
| 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 | ASSISTANT GR(G) I |
| MR K G PILLAI | AST(F&A)GR I (MACP) |
| MRS REMANI DEVARAJ | AST(F&A)GR I |
| 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 |
| MRS R REMADEVI | RECORD KEEPER |

## STORES & PURCHASE

| | |
|---|---|
| MR M R DEVASIS | SPO |
| MR SANJAY SUMAN | SEC OFFICER |
| MR K SATHEESAN NAIR | AST(S&P)GR I (Retired on 31/3/2013) |
| MR C M KRISHNADAS | AST(S&P)GR I |
| MR M ANILKUMAR | AST(S&P)GR II |
| 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 |

# CELEBRATIONS & OTHER ACTIVITIES

## NATIONAL TECHNOLOGY DAY CELEBRATION

The National Technology Day was celebrated at CSIR NIIST on May 11, 2012. Shri. Narayana Murthy, Sr Advisor to Director, VSSC, Thiruvananthapuram was the chief guest. Shri. Narayana Murthy delivered the National Technology Day Lecture on the topic "Risk Management" within the prestigious GSLV and PSLV Projects of ISRO. He highlighted in his talk the standard operational procedures to be adopted in the event of any exigency in an organization. The lecture was attended by the Research Fraternity and students of CSIR NIIST.


*Shri. Narayana Murthy, Sr Advisor to Director, VSSC, delivering lecture on the topic "Risk Management"*

## CSIR FOUNDATION DAY CELEBRATION

Dr. K.V. Raghavan, INAE Distinguished Professor and Former Director of CSIR-IICT, was the chief guest for the foundation day celebrations at CSIR-NIIST. In his foundation day lecture, Dr. K.V. Raghavan heralded the contributions of CSIR in the past 70 years. Highlighting CSIR's contributions to society and Indian industry, he reminded the audience that CSIR had partnered with almost 50,000 companies and it had more than 4500 patents to its credit. He also pointed out the role played by CSIR in achieving the targets of various five year plans. The major objective of 12th five year plan viz. 'Promoting innovations' could only be achieved if CSIR changed its focus from process-oriented research to products. He said he is concerned about low number of patent filings from our country. He urged the scientists of NIIST to identify the niche areas where the laboratory could take leadership in interdisciplinary research. He also emphasized the need to generate more intellectual property products from the laboratory. 26th September 2012 was observed as open day and laboratory visits of students from educational institutes were arranged.


*Dr. K.V. Raghavan, INAE Distinguished Professor and Former Director of CSIR-IICT delivering the CSIR Foundation day lecture*

## NIIST FOUNDATION DAY CELEBRATED

Prof. Samir K. Brahmachari, Director General, CSIR was the chief guest for NIIST foundation day celebrations. Addressing the CSIR-NIIST

family, Prof. Brahmachari said many of the CSIR laboratories, including CSIR-NIIST, had grown over the years to the status of centres of excellence. It is high time that CSIR laboratories, which are situated near the coast, focused research on technology development for utilizing marine resources such as algae as a potential source for food, energy and as raw materials for products. Prof. Brahmachari released the Hindi and Malayalam versions of the CSIR Vision 2022 document. He also inaugurated a state-of-the-art photonics and photoscience laboratory at NIIST. In his foundation day lecture, he congratulated the laboratory for its commendable achievements in terms of international publications and delivering social goods. The Outreach programs of CSIR NIIST have tapped the immense potential of the best brains of the state for tackling health hazards affecting the developing nations including our country through OSDD platform. He also appreciated large proportion of women scientist at NIIST.

*Prof. Samir K. Brahmachari, DG, CSIR inaugurating a state-of-the-art photonics and photoscience laboratory at NIIST*

*Prof. Samir K. Brahmachari, DG, CSIR handing over the Hindi and Malayalam versions of the CSIR Vision -2022 documents to Dr. Suresh Das, Director- NIIST*

## OPEN SOURCE DRUG DISCOVERY PROGRAMME

OSDD is a CSIR led team India Consortium with global partnership aimed to provide affordable healthcare to the developing world by rendering a global platform where the best minds can collaborate and collectively endeavour to solve the complex problems associated with discovering novel therapies for neglected tropical diseases like Malaria, Tuberculosis, Leshmaniasis, etc. The project is based on a portal that provides an open source platform for scientists, doctors, technocrats, software professionals, and students to share knowledge.

According to Prof. Samir K. Brahmachari, the trial of a drug molecule for treatment of tuberculosis synthesized under the Open Source Drug Discovery (OSDD) programme was expected to take place in 2012 itself. Speaking at a function organized by NIIST on 4th October 2012 for felicitating M.Sc students, who are part of OSDD Outreach programme, He said 'The Council of Scientific and Industrial Research (CSIR) is moving ahead with its plans to conduct clinical trials of molecules synthesized under OSDD over the next five years.'


*Prof. Samir K. Brahmachari, DG, CSIR speaking on the OSDD Programme*

CSIR-NIIST collaborated with the Academy of Chemistry Teachers, Kerala, for the outreach

programme. Students were trained by NIIST scientists in latest techniques in drug research and usage of sophisticated analytical instruments. Dr. Suresh Das, Director, NIIST; Dr. Zakir Thomas, Project Director, OSDD; and Dr. K.V. Radhakrishnan, coordinator of the student outreach programme also spoke during the function.

## VISIT OF DR. KASTURI RANGAN, MEMBER, PLANNING COMMISSION, GOVERNMENT OF INDIA

Dr. Kasturi Rangan, Member(S&T) Planning Commission visited the Institute on 18.08.2012. A discussion meeting with senior scientists and functionaries was arranged on the occasion. Director made a brief presentation on the various activities of the Institute highlighting the achievements of Institute's scientists. Dr.Kasturi Rangan explained in detail the importance given to science and technology by Government of India and the increase in budget for science and technology. He stressed the need to be innovative and competitive to enable us to be in the fore front of science and technology and societal development.

*Dr. Kasturi Rangan, Member (S&T) Planning Commission, discussing with Institutate Scientists and functionaries*

## CENTRE FOR BIOFUELS INAUGURATED

The biotechnology division has set up a Centre for Biofuels. The pilot plant is the first public sector initiative of its kind in India and has been installed on the CSIR-NIIST campus to produce bioethanol from biomass. This facility comes up as research project funded jointly by Technology Information, Forecasting and Analysis (TIFAC), Department of Science and Technology and the Council of Scientific and Industrial Research (CSIR) to develop technology for production of bioethanol as an alternative fuel for transportation. The pilot plant was inaugurated by Dr. T. Ramasamy, Secretary, Department of Science & Technology (DST), New Delhi on 23rd April 2012. CSIR-NIIST Director, Dr. Suresh Das, presided over the inaugural function. The plant set up has 80-kg/batch capacity for ethanol production from lignocellulosic biomass including agro-residues and forestry by-products and has an efficiency of 70 per cent in the conversion of biomass to ethanol. The process of production goes through three basic stages - pre-treatment, enzymatic hydrolysis to produce free sugars, and fermentation of sugars to ethanol. Centre for Biofuels has also initiated activities on biomass-based butanol production and on algal biofuels. NIIST CFB also undertook a study for the International Energy Agency (IEA), France to develop the biofuels policy by the IEA country-wise. The Centre is initiating collaborations with international universities and institutions for advanced studies on biomass-based fuels and energy and on the life cycle and on techno-economic analyses. The Centre would also serve to impart knowledge and training for skilled manpower development in the field of biofuels and bioenergy.

## TECHNICAL WORKSHOP ON 'NATIONAL KNOWLEDGE NETWORK'

The Institute hosted a two-day workshop on 'National Knowledge Network (NKN)' during 9 – 10 May 2012. The technical workshop was organized by National Informatics Centre (NIC) to educate the participants about National Knowledge

Network, which is a state-of –the-art Multi-Gigabit-Pan-India network for providing unified High Speed Network backbone for all knowledge related institutions in the country. The workshop was meant to illustrate the methodology for integration of NKN with internal network of institutions and discuss other network related topics through a series of technical sessions to enable the institutions in using the NKN services in a more effective and enhanced manner.


*Shri. P.H. Kurian IAS, Principal Secretary, IT Department, Govt. of Kerala and former Controller General of Patents, India delivering the inaugural address.*

The workshop was inaugurated by Shri. P.H. Kurian IAS, Principal Secretary, IT Department, Govt. of Kerala and former Controller General of Patents, India. Addressing the inaugural function over a video conference network from New Delhi, R. Chidambaram, Principal Scientific Advisor to the Government of India and Chairman, High level committee on NKN, said NKN was designed to provide a platform for knowledge exchange and to promote collaboration between scientists within the country and abroad. Prof. S.V. Raghavan, Chairman of the technical advisory committee, NKN, Dr. B.K. Gairola, Director General, National Informatics Centre (NIC), Dr. Suresh Das, Director, CSIR-NIIST and Dr. K.S. Raman, State Informatics Officer, NIC also spoke in the inaugural function. There were two technical sessions held on the opening day of the workshop and another two technical sessions on the following day.

## TRAINING PROGRAMME ON "PATENT SEARCHING & MAPPING USING QUESTEL ORBIT(QPAT)

This programme was conducted on 11th May 2012 for the benefit of Scientists, researchers and students. Mr. Roshan Aggarwal, Managing Director of Siddhast IP in Innovation, New Delhi was the invited speaker of the training programme. With his vast experience and knowledge in the field of intellectual property (IPR), Mr. Roshan Aggarwal gave the training on Questal QPAT databases and Orbit platform with special emphasis on chemical and biological sciences searches.


*Mr. Roshan Aggarwal, Managing Director,Siddhast IP in Innovation, New Delhi speaking on Patents & Its importance*

## WORKSHOP ON PATINFORMATICS FOR RESEARCH PLANNING AND COMMERCIALIZATION

A workshop on patinformatics, a newly emerging science, which involves analyzing set of patent data to discover relationship and trends was conducted during 23-24th August 2012. . Eminent scientists from CSIR-URDIP Dr. R R Hirwani, Ms. Sivakami Dhulap and Mr. Nishad Deshpande were invited speakers in the workshop. Scientists, research fellows and students from CSIR-NIIST attended the workshop.

## HEALTH AWARENESS LECTURE AND FREE MEDICAL CHECK-UP ORGANISED

NIIST Staff Recreation Club organized a Health awareness lecture and Free Medical Check-up on 26th September, 2012 in association with Kerala Institute of Medical Sciences (KIMS) Hospital, Thiruvananthapuram. Dr. Praveen Sreekumar from KIMS Hospital delivered a very informative lecture on 'Causes, Prevention, Symptoms and Treatment of Heart Diseases'. The prevalence of cardiac disease in Kerala is 10 – 12% and that of diabetes is 20%. He also mentioned that the cardiac diseases account for 40-50% of deaths in Kerala. The talk was followed by a lively interactive session. Free Medical Check-up was arranged in the afternoon. Blood Sugar, Blood Pressure and Body Mass Index (BMI) of 154 persons were checked.

*Dr. Praveen Sreekumar from KIMS Hospital delivering lecture on 'Causes, Prevention, Symptoms and Treatment of Heart Diseases'*

## WORKSHOP ON "HOW TO GET PUBLISHED IN RESEARCH JOURNALS"

A publishing connect workshop was conducted in collaboration with M/s Elsevier Science, to train and inform the researchers on various aspects of scholarly communication process on 30th November 2012. Faculty and students from various research organizations in Trivandrum also attended the workshop apart from scientists and student from NIIST. Dr. Suresh Das, Director, NIIST inaugurated the workshop. Mr. David Sleeman, publisher of Analytical chemistry & sensor journals talked about scholarly publication and Ms. Priyanka Neogi, sales manager, Elsevier, covered the session on ORCID and Scopus.

## OBSERVANCE OF HINDI DAY/HINDI WEEK

CSIR – NIIST observed September 14, 2012 as the Hindi Day and the week succeeding as the Hindi Week. The formal inauguration of the Hindi Day was held on September 14 and the programme started with the welcome address of Dr Ashok Pandey, Chairman of the Organizing Committee.


*Director Dr Suresh Das delivering the Hindi Day message and inaugural address*


*Dr. A. Ajayaghosh delivering the presidential address*

Institute Director Dr. Suresh Das delivered his Hindi Day message to the participants and

later on he formally inaugurated the ceremony by lighting the lamp. In his speech he said that Hindi is the largest link language of our country and is used by the majority of the people for their interpersonal communication. Mr. Sanjay Suman, Section Officer (stores and purchase) and Member, Organizing Committee delivered a talk on the topic "Official Language Hindi - simple and useful". During the entire week, various competitions like Hindi Essay writing, Noting/ Drafting, Technical report writing, Hindi translation, Hindi quiz, Hindi antakshari, Hindi song etc. were organized for the staff members of the Institute including research students, project staff and their school children. Valedictory function and prize distribution was held on 21.9.2012. Dr. P.J. Sivakumar, former Professor and Head, Hindi department, University College, Thiruvananthapuram and Principal, Graduate and Research Centre, Kerala Hindi Prachar Sabha Thiruvananthapuram was the chief guest for the function.

## OBSERVANCE OF VIGILANCE AWARENESS WEEK


*Shri A. Hemachandran, IPS, Director General, Police Headquarters delivering the Valedictory*

The Vigilance Awareness Week was observed in this institute from 29th October to 4th November 2012. The week started with administration of pledge in Hindi and English. Various competitions such as Essay writing, Elocution, Cartoon drawing and Slogan writing were conducted for staff members and students during the week. The valedictory function and prize distribution were held on 2nd November, 2012. Dr. A. Ajayaghosh, Director-in-Charge presided over the function. Shri A. Hemachandran, IPS, Director General, Police Headquarters delivered the Valedictory Lecture and gave away the prizes to the winners of various competitions.

## "NIIST NEER"-PROJECT INAUGURATED

The Institute installed a fully automated drinking water plant on 24th August 2012. The plant provides purified drinking water which is christened "NIIST NEER". It uses the reverse osmosis and UV treatment technology. The quality of drinking water provided adheres to WHO standards. The plant has a capacity of 500 liter per hour with an efficiency of 50%. With the addition of this facility the Institute now makes substantial savings on public exchequer by getting rid of the external agency for drinking water supply.

*Director, NIIST, inaugurating the Drinking Water Plant*

## NIIST DISPENSARY INAUGURATION

The long cherished dream of the staff members and pensioners in opening a dispensary at the Institute's premises came true on 21st December 2012. Prof. Dipankar Banerjee, Chairman, Research Council of the Institute formally inaugurated the Dispensary on 21st December 2012. Recruitment of the Medical Officer was made before the opening of the dispensary. The dispensary's facilities are

open to research scholars, staff members as well as pensioners and their families.

## ONAM CELEBRATIONS AT NIIST

As in the previous years Onam, the most popular festival of Kerala, was celebrated in the Institute with great enthusiasm. Onam marks the homecoming of King Mahabali, a legendary king, who ruled Kerala in ancient times. A number of activities such as Athapookkalam, Onapattukal, Vanchipattukal, Tug-of war, etc were organized in the Institute. Pulikali, in which performers dress up as tigers, was the most attractive item of the function. A delicious feast was also offered to all staff members in the canteen.


*A glimpse of various activities on the occasion of the Onam Festival*

# हिंदी रूपांतर

## एस एंड टी सेवा प्रभाग

# योजना व निष्पादन एवं व्यवसाय विकास

## प्रौद्योगिकी लाइसेंसिंग एवं हस्तांतरित करारों / हस्ताक्षर किये समझौता ज्ञापनों

| क्रम सं | शीर्षक | फर्म / एजेंसी का नाम |
|---|---|---|
| 1 | घरेलू जैविक कचरे के उपचार के लिए अवायवीय डाईजेस्टर की तकनीकी जानकारी के लाइसेंस के लिए करार | श्री मैथ्यूस जॉर्ज, पिचाप्पिल्लिल हाउस, कसदावूर पी.ओ., पिन - 686 671 |
| 2 | घरेलू जैविक कचरे के उपचार के लिए अवायवीय डाईजेस्टर की तकनीकी जानकारी के लाइसेंस के लिए करार | श्री सुनील कुमार टी.एस., मेसेर्स के ए इंटरप्राइजेज (रजि.सं. : एमएसएमई 5495/12), एस्टेट रोड, पाप्पनंकोड, तिरुवनंतपुरम - 695 019 |
| 3 | घरेलू जैविक कचरे के उपचार के लिए अवायवीय डाईजेस्टर की तकनीकी जानकारी के लाइसेंस के लिए करार | कार्रिस पाइप्स एंड ट्यूब्स (प्रा.) लिमिटेड पी.बी. सं.2, कूवप्पडी, कोचीन - 683 544 |
| 4 | सफेद मिर्च के उत्पादन की तकनीकी जानकारी के लाइसेंस के लिए करार | श्री हितेश खन्ना, मेसेर्स खन्ना ब्रोथेर्स, 512, कटरा ईश्वर भवन, खारी बओली, दिल्ली - 110006 |
| 5 | सफेद मिर्च के उत्पादन की तकनीकी जानकारी के लाइसेंस के लिए करार | श्री मोइदूट्टि ई.के, "बेइतुल आइशा",ओल्ड रोड जंक्शन, पूतक्कुलम, कूत्तुपरम्ब, कन्नुर - 670 643 |
| 6 | सफेद मिर्च के उत्पादन की तकनीकी जानकारी के लाइसेंस के लिए करार | श्री बी एम इब्राहिम, प्रोप्राइटर, मेसेर्स स्पाइसस ऑफ कूर्ग, शॉप सं: एसजीपी 131, मुनिसिपालिटी कॉम्प्लेक्स, सुन्तिकोप्पा, कर्नाटका |
| 7 | केले फाइबर की निकासी की तकनीकी जानकारी के लाइसेंस के लिए करार | श्री एम.एस प्रसाद, मेसेर्स इन्नोवेटीव बयो प्रोडक्टस, फ्लाट सं: 304, प्लोट सं: 135, ग्रीन पार्क रेज़िडेंसी, राजीव नगर, अम्बरपेट, हैदराबाद, आंध्रा प्रदेश-500045 |
| 8 | पॉली कॉयर के व्यावसायीकरण के लिए समझौता ज्ञापन | केरला फर्नीचर कन्सोशियम प्राइवट लिमिटड, रेजिस्टेर्ड औफीस, कुरिचिलाकोड, कोडनाड पी ओ, पेरुम्बावूर, एरणाकुलम जिला |
| 9 | "ए स्टडी ओण ओप्टिमाइजिग दि मैटीरियल यूटिलाइजेशन इन आयुर्वेदिक इंडस्ट्री बाय रीप्लेसिंग हर्बल रूट्स बाय बेन्गिन हर्बल पार्ट्स एंड बाय डेवलपिंग न्यू बायो एक्टिव अप्लिकेशन्स फॉर हर्बल स्पेंट मैटीरियल" नामक परियोजना को क्रियान्वित करने के लिए करार | डीएसटी एवं आर्यावैद्यशाला, कोट्टक्कल,- कोट्टकल में अपने मुख्यालय होने एक चारिटबिल ट्रस्ट, केरला - 676 503 |

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|---|---|---|
| 10 | ट्रिपल क्वाट्रूपॉल मास स्पेक्ट्रोमीटर के साथ युग्मित गैस क्रोमैटोग्राफी के लिए भारतीय खाद्य मेट्रिसेस में डाइऑक्सीन और फ्यूरेनों की परिमाणन और स्क्रीनिंग के लिए पद्धति विकास के क्षेत्र में सहयोग के लिए करार | एजिलेंट टेकनोलॉजीस इंडिया प्राइवट लिमिटड, यूनिट नम्बेर्स. 105-116, फस्ट फ्लोर, स्प्लेन्डर फोरम, प्लोट सं: - 3, जिला सेंटर, जसोला, नई दिल्ली - 110025 |
| 11 | वायनाड में एकीकृत मसाला प्रसंस्करण सुविधा की स्थापना के लिए करार | कृषि निदेशक, कृषि निदेशालय, कृषि विभाग, केरल सरकार, विकास भवन, तिरुवनन्तपुरम - 695033 |
| 12 | प्रौद्योगिकी व्यापार ऊष्मायन केन्द्र की स्थापना के लिए कृषि निदेशक के साथ समझौता ज्ञापन | कृषि निदेशक, कृषि निदेशालय, कृषि विभाग, केरल सरकार, विकास भवन, तिरुवनन्तपुरम -695033 |
| 13 | अवायवीय निकासी का उपयोग करके अनानास पत्ती फाइबर और केले फाइबर के लिए प्रदर्शन संयंत्रों की स्थापना" के लिए करार | कुडुम्बश्री - राज्य गरीबी उन्मूलन मिशन, ट्रिडा बिल्डिंग्स, मेडिकल कॉलेज के सामने, तिरुवनंतपुरम जिला, केरल - 695 011 |
| 14 | परामर्श परियोजना के लिए करार | किन्फ्रा, किन्फ्रा हाऊस, 31/2312, शास्तमंगलम, तिरुवनन्तपुरम - 695010 |
| 15 | केएमएमएल, चवरा, कोल्लम में पुराने तालाबों के लिए ईआईए के संचालन के लिए परामर्श सेवाओं के लिए करार | मेसेर्स केएमएमएल, चवरा, कोल्लम - 691 583 |
| 16 | गैस और वाष्प अणु के लिए चीनी मिट्टी अधिशोषक का विकास " शीर्षक सहयोगात्मक अनुसंधान कार्य के लिए करार | मेसेर्स नोरिटेक कं. लिमिटड, 1-36 नोरिटेक शिन्माची 3 क्रोम, निशि -कु, नागोया 4518501, आइची, जापान |
| 17 | “माइक्रोवेव सर्किट के लिए उपयुक्त माइक्रोवेव सिरेमिक क्रियाधार और एसटीटीसी हरे रंग की टेप के पायलट पैमाने पर उत्पादन एवं विकास" संबंधी परियोजना के लिए समझौता ज्ञापन | मेसेर्स अन्टस सिरेमिक्स (प्रा.) लिमिटड, डब्ल्यू-50(ए), महीन्द्रा सोना के पास, नासिक - 422007 |
| 18 | प्रायोजित अनुसंधान के लिए समझौता ज्ञापन | मेसेर्स थेर्माक्स लिमिटड, डी 13, एमआईडीसी इंडस्ट्रियल एर्या, आरडी अगा रोड़, चिंजुवाड, पुणे - 411009 |
| 19 | पारस्परिक गैर प्रकटीकरण समझौता | मेसेर्स महीन्द्रा हिनोदे इंडस्ट्रीज़ लिमिटड, भोसारी इंडस्ट्रियल इस्टेट, भोसारी, पुणे - 411026 |

# अनुबंध अनुसंधान कार्यक्रम

| क्रम सं. | ग्राहक | परियोजना शीर्षक | परियोजना प्रधान |
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| **कृषि प्रसंस्करण प्रभाग** | | | |
| 1 | डीएसटी | इवाल्युवेशन एंड कण्ट्रोल ऑफ़ एक्रिलामाइड फ़ोर्मेशन इन ट्रडीशनल डीप फ्राइड स्नैक प्रोडक्ट्स | डॉ. (श्रीमती) पी. निशा |
| 2 | डीएसटी | सिंथेसिस ऑफ़ इमिनोशुगर वारिएट्स ऑफ़ एल्फागालेक्टोसिल सिरामिड फॉर टुनिंग ऑफ़ सेलेक्टिव साइटीकिन रिलीज़ फ्रम नाचुरल किल्लर टी (एनकेटी) सेल्स | डॉ. एल.रविशंकर |
| 3 | डीएसटी | ए स्टडी ओन ओप्टिमाइजिंग दि मैटीरियल यूटिलाइजेशन इन आयुर्वेदिक इंडस्ट्री बाय़ रीप्लेसिंग हर्बल रूट्स बाय़ बेन्गिन हर्बल पार्ट्स एंड बाय़ डेवलपिंग न्यू बायोएक्टिव अप्लीकेशन | डॉ. ए. सुन्दरेशन |
| 4 | आईसीएमआर | फेनोलिक कॉम्पाड्स फ्रॉम सेन्ताल्ला असेटिका , बोर्हाविया डिफ्फुसा & डेस्मोडियम गन्गेटिकम आस प्रोटक्टेर्स एगेंस्ट आर्सेनिक ट्रायोक्साइड इन्ड्सूस्ड कार्डियोटोक्सिसिटि | डॉ. के.जी.रघु |
| 5 | वनस्पति निदेशालय उपभोक्ता कार्य मंत्रालय | इवाल्युवेशन ऑफ ट्रांस फैट्टी असिड्स इन हाइड्रोजनेटड वेजिटबिल्स ऑयल प्रोडक्ट्स एंड देयर हेल्थ इम्प्लिकेशन्स इन दि कांटेक्स्ट ऑफ़ इंडियन फ़ूड हबिट्स | श्रीमती एम.वी.रेश्मा |
| 6 | वनस्पति निदेशालय उपभोक्त कार्य मंत्रालय | स्टडीस ऑण इम्प्रूविंग स्टोरेज स्टेबिलिटी ऑफ़ रिफैन्ड् एंड अनरिफैन्ड् वेजिटबिल ऑयल्स बाय दि अडिशन ऑफ माइक्रोन्यूट्रियन्ट्स एंड एंटीऑक्सिडेन्ट फाइटोकेमिकैल्स एंड दि डेवेलप्मेंट ऑफ़ ए फंग्शनल वेजिटबिल | डॉ. (श्रीमती) पी. निशा |
| 7 | भारतीय मानक ब्यूरो | डेवलप्मेंट ऑफ़ इंडियन स्टैन्डेर्ड्स् फॉर नोर्थ ईस्ट जिंजर एंड इट्स वाल्यु आडड् प्रोडक्ट्स | श्री वी.वी.वेणुगोपाल |
| 8 | केएससीएसटीई | डेवलप्मेंट एंड स्टैन्डेडाइसेशन ऑफ़ वाल्यु आडड् प्रोडक्ट्स फोर "जैकफ्रूट " | डॉ. (श्रीमती) पी. निशा |
| 9 | कृषि विभाग, केरल सरकार | सेटिंग अप् ए टेक्नोलॉजी बिज़नस इन्क्यूबेशन सेंटर फॉर एग्रोप्रोसेसिंग | श्री वी.वी.वेणुगोपाल |
| 10 | कृषि विभाग, केरल सरकार | सेटिंग अप् ए जिंजर प्रोसेसिंग प्लांट इन वायानाड | श्री वी.वी.वेणुगोपाल |
| **जैवप्रौद्योगिकी प्रभाग** | | | |
| 11 | डीबीटी | डेवेलप्मेंट ऑफ़ ए बायोप्रोसस फॉर दि प्रोडक्शन ऑफ़ पॉलीहाइड्रोक्सी ब्यूटिरेट (पीएचबी) फ्रम बायोडीजल इन्डस्ट्री जनरेटड ग्लिसरॉल | डॉ. अशोक पाण्डेय |
| 12 | डीबीटी | कोस्ट एफेक्टिव प्रोडक्शन ऑफ़ लैक्टिक असिड फ़ोर पॉलीलैक्टाइड सिंथेसिस एंड स्टडीस ऑण पीएलए अप्लिकेशन एंड बायोडीग्रेडेशन | डॉ. के.माधवन नंपूतिरि |
| 13 | डीबीटी | एक्सप्लोइटिंग वेस्टर्न घाट बायोडाइवेर्सिटि फॉर एंटीफंगल मेटाबोलैट्स फॉर प्लांट डिसीस कण्ट्रोल | डॉ. के.माधवन नंपूतिरि |

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| 14 | डीबीटी | क्लोनिंग एंड प्रोडक्शन ऑफ़ ए जेनेटिकली इंप्रूव्ड एल- ऐस्पैरागिनसे फ्रम एशरिकिआ कोली | डॉ. अशोक पाण्डेय |
| 15 | डीएसटी | सेंटर फोर बायोफ्यूवल्स | डॉ. अशोक पाण्डेय |
| 16 | डीएसटी | ग्लिसरॉल बेस्ड कार्बन एसिड कैटेलिस्ट फॉर दि प्रोडक्शन ऑफ़ एथेनॉल एंड वैल्यू एडेड केमिकल्स फ्रम बायोमास | डॉ. अशोक पाण्डेय |
| 17 | एमएनआरई | सोरघम स्टोवर बेस्ड बायोरिफैनरी फॉर फ्यूल्स एंड केमिकल्स | डॉ. अशोक पाण्डेय |
| 18 | थेर्मक्स लिमिटेड | बायोप्रोसेस डेवलपमेंट फॉर दि प्रोडक्शन ऑफ़ एल- लैक्टिक एसिड, पीजीए एंड सल्लुलेस एंजाइम | डॉ. अशोक पाण्डेय |
| **रसायन विज्ञान तथा प्रौद्योगिकी प्रभाग** | | | |
| 19 | डीएसटी | नोवल सिंथेटिक प्रोटोकॉल फॉर कार्बन -कार्बन एंड कार्बन - हेटेरोअटम बॉड फोर्मिंग रिअक्शन्स एम्प्लोयिंग न्युक्लिओफिलिक हेटरोसाइक्लिक कार्बीन कैटालिसिस | डॉ. विजयन नायर |
| 20 | डीएसटी | फोटो डायनामिक थेरेपी अगेंस्ट दि ट्यूमर वास्कुलर सिस्टम | डॉ. डी. रामय्या |
| 21 | डीएसटी | ककुर्बिट (एन) यूरिल होमोलोगस एंड देयर डेरिवेटिव्स आस रिसेप्टेर्स फॉर ए फ्यू आयनिक एंड न्यूट्रल एनालिसिस | डॉ. राकेश के. मिश्रा |
| 22 | डीएसटी | डिवलप्मेंट ऑफ़ नोवेल साइक्लोफेन्स आस प्रोब्स फॉर बायोमोलिकुलर रकेग्निशन | डॉ. डी.रामय्या |
| 23 | डीएसटी | दि कंट्रॉल्ड कार्बोपल्लाडेशन ऑफ़ हेटरोबाइसाईक्लिक ओलिफिंस : ए नोवल स्टिरिओ सिलेक्टिव रूट टु फंग्शनलैस्ड साइक्लोपेन्टानोइड्स | डॉ. के.वी.राधाकृष्णन |
| 24 | डीएसटी | एनवयोर्मेंटली सेक्युअर इनोर्गानिक कोलोरंट्स | डॉ. एम.एल.पी.रेड्डी |
| 25 | डीएसटी | ओर्गानिक एंड ओर्गानिक - इनोर्गानिक हाइब्रिड सोलार सेल्स : ओप्टिमाइसेशन ऑफ़ मैटिरिअल्स, प्रोपर्टीस, बल्क हेटरोजंक्शन मोर्फोलॉजी एंड डिवाइस एफीशियन्सीस (ओआईएससी /लार्ज सेल्स ) | डॉ. के.आर.गोपिदास |
| 26 | डीएसटी | ग्रीन मेथेड्स टुवेर्ड्स फार्मास्यूटिकली इम्पोर्टन्ट हेटरोसाइकिल्स एंड साइक्लोपेन्टानोइड्स | डॉ. के.वी.राधाकृष्णन |
| 27 | डीएसटी | इन्वेस्टिगेशन ऑफ़ कन्फ़ोर्मेशनल सब -स्टेट्स एंड लो फ्रिक्युवन्सी वाइब्रेशनल डाइनामिक्स ऑफ़ नेटिव एंड नॉन नेटिव हेमी प्रोटीन्स | डॉ. करुणाकरन वेणुगोपाल |
| 28 | डीएसटी | डिजाईन एंड सिंथेसिस ऑफ़ मल्टी फंक्शनल आर्गेनिक- डीएनए कॉजुगेट्स फॉर बायोमॉलिक्यूलर अप्लिकेशन | डॉ. जोशी जोसफ |
| 29 | आईएसआरओ | डेवलपमेंट ऑफ़ बल्क हेटेरो जंक्शन सोलर सेल बेस्ड डेमो स्ट्रक्चर कंडक्टिंग पॉलीमर इनआर्गेनिक हाइब्रिड कम्पोजिट फॉर ब्रॉड बैंड सोलर स्पेक्ट्रम | डॉ. जे.डी. सुधा |
| 30 | आईएफसीपीएआर | डेवलपमेंट ऑफ़ फुल्वेन बेस्ड Zr(II) and Ti(II) केमिस्ट्रि ओर्गानामैटाल्लिक्स, रिअक्टिविटी एंड अप्लिकेशन्स इन ओर्गानिक सिंथेसिस | डॉ. के.वी.राधाकृष्णन |
| 31 | एमएनआरई | डाई सेंसिटैस्ड सोलर सेल (डीएसएससी) / क्वांटम डॉट डाई सेंसिटैस्ड सोलर सेल | डॉ. जोशी जोसफ |

| पदार्थ विज्ञान तथा प्रौद्योगिकी प्रभाग | | | |
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| 32 | डीएसटी | ओप्टिमैसेशन ऑफ़ एजिंग पैरामीटेर्स एंड अल्लोय कौम्पोसिशन फॉर इम्प्रूव्ड एज हार्डेनिंग रेस्पोण्स ऑफ़ AZ91 मैग्नीशियम अल्लोय | डॉ. ए.श्रीनिवासन |
| 33 | डीएसटी | डेवलपमेंट ऑफ़ मैग्नीशियम, एंटीमनी बेस्ड एलाय फॉर हाई टेम्परेचर अप्लिकेशन्स | डॉ. यू.टी.एस.पिल्लै |
| 34 | डीएसटी | सिंथेसिस एंड कैरक्टरैसेशन ऑफ़ इनसिट्यू मैग्नीशियम मैट्रिक्स कॉम्पोसिट्स | डॉ. (श्रीमती) श्रीजा कुमारी |
| 35 | डीएसटी | आन् इन्वेस्टिगेशन ऑण दि पोटेंशियल बीच प्लेसर डेपोसिट्स एलोंग तिरुचेंदुर कॉस्ट , तमिलनाडु | डॉ. एम.सुन्दरराजन |
| 36 | डीएसटी | डेवलपमेंट ऑफ़ नोवेल पोवेल्लैट बेस्ड रेड फोस्फोर मैटेरियलस : $ARMMoO_8:Eu^{3+}$(A=Mg, Ca, Sr and Ba, R=Y, La and Gd: M=Nb and Ta) फॉर वैट लाइट एमिट्टिंग डयोड्स (WLED's) | डॉ. प्रभाकर राव |
| 37 | डीएसटी | सुप्रामोलिकुलर पोलिमेरिक नैनोमैटीरियल्स विथ हैरार्किकल मोर्फोलॉजीस | डॉ. ई.भोजे गाउड |
| 38 | डीएसटी | प्रिपरेशन ऑफ़ M3AX2 फेस टेर्नारी कार्बाइड्स एंड फ़ैब्रिकेशन ऑफ़ इट्स नैनोकोम्पोसिट्स थ्रू नोवल मेथेड्स | डॉ. एस.अनन्तकुमार |
| 39 | डीएसटी | नैनोस्ट्रक्चेर्ड डबल पेरोव्स्केट्स फॉर स्पिन्ट्रॉनिक अप्लिकेशन्स, | डॉ. मनोज राम वर्मा |
| 40 | डीएसटी | डेवलपमेंट ऑफ़ नैनोस्ट्रक्चेर्ड स्पिनेल ऑक्साइड मैटीरियल्स फॉर स्पिन्ट्रॉनिक अप्लिकेशन्स | डॉ. सविता पिल्लै |
| 41 | डीएसटी | लो टेंपरेचर हीलिंग फोटो कैटलिटिक सेल्फ क्लिनिंग कोटिंग्स फॉर सोलार सेल कवेर्स एंड ग्लास सर्फसस | डॉ. के.जी.के.वार्यर |
| 42 | डीएसटी | डेवलपमेंट ऑफ़ फ़ंग्शनली ग्रेडड पोरस सिरेमिक प्रिफोर्म एंड सिरेमिक मेटल कॉम्पोसिट्स फॉर इंजीनियरिंग अप्लिकेशन्स | डॉ. टी.पी.डी.राजन |
| 43 | डीएसटी | नैनो स्ट्रक्चर्ड निकैल बेस्ड हेउस्लेर अल्लॉय्स फॉर मैग्नेटिक रेफ्रेजरेशन अप्लिकेशन्स । पार्ट 1- सिंथेसिस एंड फिजिकल कैरक्टरैसेजन पार्ट -2 मैग्नेटिक कैरक्टरैसेजन | डॉ. मनोज राम वर्मा |
| 44 | डीएसटी | डेवलपमेंट ऑफ़ आयरन बेस्ड सुपर कंडक्टर्स | डॉ. यू.श्यामप्रसाद |
| 45 | डीआरडीओ | डेवलपमेंट ऑफ़ लो लोस लो टेंपरेचर को फायेर्ड सिरेमिक ग्लास कॉम्पोसिट (एलटीसीसी ) टेप्स फॉर फ्यूचर एमआईसी डिवाइस अप्लिकेशन्स | डॉ एम.टी.सेबास्टीयन |
| 46 | डीआरडीओ | डिजाइन एंड डेवलपमेंट ऑफ़ एन्विरोर्नमेटली फ्रण्डली रेअर अर्थ बेस्ड एनआईआर रिफ्लक्टिंग कामौफ्लाग पिगमेंट्स फॉर डिफेन्स अप्लिकेशन्स | डॉ. प्रभाकर राव |
| 47 | डीआरडीओ | डेवलपमेंट ऑफ़ मोणो एंड हैब्रिड डिस्कंटिन्युवस्लि रीइंफोर्सड मैग्नीशियम मेटल मैट्रिक्स कॉम्पोसिट्स फॉर इंजीनियरिंग अप्लिकेशन्स | डॉ. यू.टी.एस.पिल्लै |

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| 48 | बीआरएनएस | डेवलपमेंट ऑफ़ फोटो कैटेलिटिक रिएक्टर बेस्ड ओन वाइड स्पेक्ट्रम नैनो टाइटानिया - आर्गेनिक हाइब्रिड्स फॉर डिकम्पोजीशन ऑफ़ डाइज एंड रिकवरी ऑफ़ प्रश्यस अडिक्टीव-साल्वेंट इन स्पेंट लेज़र डाई सोलूशन | डॉ. सजु पिल्लै |
| 49 | बीआरएनएस | टाइलरिंग ऑफ़ मैग्नेटो- स्ट्रक्चरल फेज ट्रांसीशन्स नियर दि रूम टेंपरेचेर्स इन इंटरमैटेलिक हेउस्लेर अलॉय्ज फॉर दि मैग्नेटिक रेफ्रेजरेशन अप्लिकेशन्स । | डॉ. वसुंधरा |
| 50 | बीआरएनएस, मुम्बई | सिंथेसिस एंड स्प्रे ग्रनुलेशन ऑफ़ लेण्टेनियुम फॉस्फेट पाऊडेर्स फॉर थर्मल बैरियर कोटिंग्स | डॉ. यू.एस. हरीश |
| 51 | जीटीआरई( गैस टरबाइन रेस. ईएसटीटी) | डेवलपमेंट ऑफ़ मेटल मैट्रिक्स कॉपोजिट्स फॉर एरो इंजन अप्लिकेशन्स | डॉ. टी.पी.डी.राजन |
| 52 | बीएआरसी | डेवलपमेंट ऑफ़ सेल्फ लुब्रिकेटिंग $Al_2O_3/ZrO_2$ सिरेमिक कॉम्पोजिट्स फॉर जर्नल बेअरिंग अप्लिकेशन्स इन असिड /रेडियेशन एन्विरोन्मेंट | डॉ. एस.अनन्तकुमार |
| 53 | एमएचआरडी | दि विल्लेज कम्युनिटि नेटवर्क : तकनोलॉजी डेवलपमेंट एंड पाइलट रोल्लौट प्लान फॉर लो कोस्ट ओप्पर्ट्यूनिस्टिक कम्मयूनिकेशन नेटवर्क्स फॉर रुरल एरियास ऑफ़ इंडिया | डॉ एम.टी.सेबास्टियन |
| 54 | केएससीएसटीई | डेवलपमेंट ऑफ़ बायो डिग्रेडेबल कॉपोजिट्स | डॉ. वी.एस. प्रसाद |
| 55 | भारतीय प्लाज्मा अनुसंधान संस्थान | डेवलपमेंट ऑफ़ लोंग फिलमेंटरी $MgB_2$ सुपरकंडक्टिंग वर्येस एंड टेप्स फॉर फ्यूशन ग्रेड मैग्नेट्स एंड करेंट लीड्स | डॉ. यू.श्यामप्रसाद |
| 56 | आईसीडीडी | जनरेशन ऑफ़ एक्सपिरिमेंटल पाऊडर डिफ्रक्शन डाटा ऑफ़ न्यू सिरेमिक कॉम्प्लेक्स ऑक्साइड्स | डॉ. प्रभाकर राव |
| 57 | मेसर्स शिनिडेर इलेक्ट्रिक डीआरसी | नैनो सिरेमिक स्मार्ट फिल्लेर्स फॉर इम्प्रूविंग दि थेरमल डिस्सिपेशन प्रोपर्टी ऑफ एपोक्सी पॉलिमर डाइइलेक्ट्रिक्स | डॉ. एस.अनंतकुमार |
| | | **प्रक्रिया इंजीनियरिंग और पर्यावरण प्रभाग** | |
| 58 | एनएमआईटीएलआई | बायोफ्यूवल फ्रम मराईन माइक्रोअल्गे | श्री अजित हरिदास |
| 59 | डीएसटी | सेटिंग उप् ऑफ़ डिमोण्स्ट्रेशन प्लांट्स फॉर पाईन एप्पल लीफ फाइबर एंड बनाना फाइबर यूसिंग एनारोबिक एक्सट्रैक्शन | डॉ. वी.बी.मणिलाल |
| 60 | एमएनआरई | एनरोबिक तकनोलॉजी फॉर बायोगैस रिकवरी एंड स्टेबिलासेज़न ऑफ़ अन्सोर्टड् मुनिसिपल सोलिड वेस्ट्स | डॉ. वी.बी.मणिलाल |
| 61 | केएससीएसटीई | बायोरेमडियेशन ऑफ़ पेर्कोलेट कंटैनिंग वेस्ट वाटर अंडर हाई सलैन कंडीशन्स यूसिंग केमोट्रोफिक मिक्सड माइक्रोबियल सिस्टम | डॉ. कृष्णकुमार |
| 62 | केएससीएसटीई | डेवलप्मेंट ऑफ़ मोडेर्न एंड इको फ्रण्ड्ली बेनिफ़िसिएशन प्रोसेस एंड फ्लो शीट फ़ोर कासरगोड एंड कन्नूर चीना क्लेस् | डॉ. पी.राघवन |

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| 63 | केएससीएसटीई | कैनेटीक्स ऑफ़ रेस्पिरेटरी एन्जाइम्स इन्वोल्व्ड इन पेरकोरेट रिडक्शन | सुश्री वी.एन. अनुपमा |
| 64 | केएससीएसटीई | सेटिंग उप ऑफ़ डिमोण्स्ट्रेशन प्लांट्स फॉर कोयर फाइबर प्रोडक्शन एंड बायो एनर्जी रिकवरी बाय क्लोस्ड रेट्टिंग | डॉ. वी.बी.मणिलाल |
| 65 | केएसआईडीसी | डेवलपमेंट ऑफ़ ए स्यूटबिल मेथेर्ड टु कण्ट्रोल फंन्गल ग्रोथ इन स्क्रूपाइन लीफ प्रोडक्ट्स | डॉ. वी.बी.मणिलाल |
| 66 | केरल राज्य प्रदूषण नियंत्रण | डस्ट सेप्प्रेशन : फील्ड स्टडी इन चीना क्ले | डॉ. रुग्मिणी सुकुमारन |
| 67 | ईआईसीएल | ब्राइटनेस इम्प्रूवमेंट स्टडीज ओन ईआईसीएल चीना क्लेस् | डॉ. पी.राघवन |
| 68 | कालड़ी राइस मिल्लेर्स कंसोर्शियम | सेकेंडरी एंड टेर्टरी ट्रीटमेंट ऑफ़ राइस मिल एफ़्फ़्लुवन्ट्स | श्री अजित हरिदास |
| 69 | मेसेर्स एसोशियेटड सोपस्टॉण डिस्ट्रिब्यूटेर्स | बेनिफीसियेशन प्रोसेस डेवलपमेंट फ्लो शीट डिजाइन फॉर चीना क्ले ऑफ़ गुडा माइन्स ऑफ़ मेसेर्स. एसोशियेटड सोप्सस्टोन डिस्टिलेशन कं. प्रा. लिमिटेड | डॉ. पी.राघवन |

# कंसल्टेंसी कार्यक्रम

| क्रम सं. | ग्राहक | परियोजना शीर्षक | परियोजना प्रधान |
|---|---|---|---|
| 1 | कृषि विभाग,केरल सरकार | सेटिंग उप ए जिंजर प्रोसस्सिंग फेसिलिटी इन वायानाड | श्री वी.वी. वेणुगोपाल |
| 2 | केएमएमएल | ईआईए फॉर केएमएमएल प्रोजेक्ट | श्री जे.अंसारी |
| 3 | हेराल्ड मैरीन प्रोडक्ट्स प्रा. लिमिटेड, कोचीन | फिश मील फैक्ट्री ओड़ौर कण्ट्रोल | श्री अजित हरिदास |
| 4 | मेसेर्स पविष़म ट्रीटमेंट प्लांट, कूवप्पडी, पेरुंबावूर | औग्मेन्टेशन ऑफ़ राइस मिल एनारोबिक ट्रीटमेंट प्लांट | श्री अजित हरिदास |
| 5 | वीएसएससी | स्ट्रक्चरल एंड माइक्रोस्ट्रक्चरल कैरक्टराइसेशन ऑफ एरोस्पेस मैटीरियल्स | डॉ. प्रभाकर राव |
| 6 | वापको इंडिया लिमिटेड | फैब्रिकेशन ऑफ़ प्रोटोटाइप एलुमिनियम अल्लोय एंड कॉपोसिट सिलिंडर लाइनेर्स फॉर ओटोमोटीव एयर कम्प्रेस्सर अप्लिक्केशन्स | डॉ. टी.पी.डी.राजन |
| 7 | एनवायर्नमेंटल रिसोर्सेज रिसर्च सेंटर, तिरु. | टैक्सोनोमी ऑफ़ स्पाइसेस थ्रू मोर्फोलॉजिकल स्टडीज ऑफ़ पोलन ग्रेन | डॉ. प्रभाकर राव |
| 8 | मेसेर्स किन्फ्रा, तिरु. | क्रिएशन ऑफ़ मेडिसिनल प्लांट एक्सट्रैक्शन फैसिलिटी अट बायो टेक्नोलॉजी इन्कुबेशन सेंटर , किन्फ्रा हाई टेक पार्क, कलमश्शेरी | डॉ. सुन्दरेशन |
| 9 | जनता फिश मील एंड ऑयल प्रोडक्ट्स | फिश मील फैक्ट्री ओड़ौर कण्ट्रोल | श्री अजित हरिदास |
| 10 | केईएफ, चेलेब्रा, मलप्पुरम | प्रिलिमिनरी ईआईए फॉर प्रीकास्ट फैक्ट्री अट कोचीन | श्री जे.अंसारी |

# फाइल किए गए पेटेंटों (विदेशी)

| एनएफएनओ | शीर्षक | आविष्कारकों | फाइल करते की तारीख | आवेदन सं. |
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| 0052एनएफ 2009/एचके | नोवल इम्प्रिंटड पॉलिमर मैटीरियल्स फॉर सेलेक्टीव डीटोक्सिफिकेशन ऑफ एंडोसल्फान कण्डामिनेटड नाचुरल वाटेर्स एंड प्रोसेस फॉर प्रिपरेशन देयर ऑफ | करमला प्रसाद, जोसफ मेरी ग्लाडिस, तलशीला प्रसादा राव | 09/05/2012 | 12104562.6 |
| 0091एनएफ 2009/यूएस | नोवल मैग्नेटिक डाइ अब्सोर्बन्ट कैटेलिस्ट | शुक्ला सत्यजित विष्णु, वार्यर कृष्णा गोपकुमार, मनोज राम वर्मा, मदादिन ताषे लजीना, नारायणी हर्षा, चालाप्पुराथ पट्टेलथ | 11/07/2012 | 13/521641 |
| 0147एनएफ 2009/ईपी | नोवल पोरफ्रीन डेरिवेटीव्स फॉर फोटोडाइनामिक थेरापी (पीडीटी) : ए प्रोसेस फॉर दि प्रिपरेशन देयर ऑफ एंड देयर यूस आस पीडीटी एजेंट्स एंड फ्लूरेसेन्स प्रोब्स फॉर बायोलॉजिकल अप्लिकेशन्स | डानबोयिना रामय्या, सुनीश सी करुणाकरन, वडक्कांचेरिल एस जिशा, तवारेकेरे के चन्द्रशेखर, अलगार श्रीनिवासन, माधवन राधाकृष्णा पिल्लै, शिवकुमारी आशा नायर, सनीश बाबु पी सारास, चिन्तालागिरि मोहन राव, कुचंला श्रीधर राव | 19/07/2012 | 11711133.6 |
| 0147एनएफ 2009/जेपी | नोवल पोरफ्रीन डेरिवेटीव्स फॉर फोटोडाइनामिक थेरापी (पीडीटी) : ए प्रोसेस फॉर दि प्रिपरेशन देयर ऑफ एंड देयर यूस आस पीडीटी एजेंट्स एंड फ्लूरेसेन्स प्रोब्स फॉर बायोलॉजिकल अप्लिकेशन्स | डानबोयिना रामय्या, सुनीश सी करुणाकरन, वडक्कांचेरिल एस जिशा, तवारेकेरे के चन्द्रशेखर, अलगार श्रीनिवासन, माधवन राधाकृष्णा पिल्लै, शिवकुमारी आशा नायर, सनीश बाबु पी सारास, चिन्तालागिरि मोहन राव, कुचंला श्रीधर राव | 20/07/2012 | 2012-549434 |
| 0147एनएफ 2009/सीएन | नोवल पोरफ्रीन डेरिवेटीव्स फॉर फोटोडाइनामिक थेरापी (पीडीटी) : ए प्रोसेस फॉर दि प्रिपरेशन देयर ऑफ एंड देयर यूस आस पीडीटी एजेंट्स एंड फ्लूरेसेन्स प्रोब्स फॉर बायोलॉजिकल अप्लिकेशन्स | डानबोयिना रामय्या, सुनीश सी करुणाकरन, वडक्कांचेरिल एस जिशा, तवारेकेरे के चन्द्रशेखर, अलगार श्रीनिवासन, माधवन राधाकृष्णा पिल्लै, शिवकुमारी आशा नायर, सनीश बाबु पी सारास, चिन्तालागिरि मोहन राव, कुचंला श्रीधर राव | 20/07/2012 | 201180006844.1 |

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| 0147एनएफ 2009/यूएस | नोवल पोरफ्रीन डेरिवेटीव्स फॉर फोटोडाइनामिक थेरापी (पीडीटी) : ए प्रोसेस फॉर दि प्रिपरेशन देयर ऑफ एंड देयर यूस आस पीडीटी एजेंट्स एंड फ्लूरेसेन्स प्रोब्स फॉर बायोलॉजिकल अप्लिकेशन्स | डानबोयिना रामय्या, सुनीश सी करुणाकरन, वडक्कांचेरिल एस जिशा, तवारेकेरे के चन्द्रशेखर, अलगार श्रीनिवासन, माधवन राधाकृष्णा पिल्लै, शिवकुमारी आशा नायर, सनीश बाबु पी सारास, चिन्तालागिरि मोहन राव, कुचंला श्रीधर राव | 20/07/2012 | 13/574512 |
| 0139एनएफ 2011/यूएस | फ्लूरेसेंट मैटीरियल एंड प्रोसेस फॉर दि प्रिपरेशन देयर ऑफ | अय्यप्पनपिल्लै अजयघोष, राजशेखरन तिरुमलै कुमारन | 10/08/2012 | 13/571763 |
| 0138एनएफ 2011/डब्ल्यूओ | डाई एन्ट्राप्पड सॉल-जेल फिल्म बेस्ड टेस्ट स्ट्रिप सेंसर फॉर नाइट्राइट एंड ए प्रोसेस देयरऑफ | शान्तकुमार धन्या, तलशीला प्रसादा राव | 27/08/2012 | पीसीटी/आईबी 2012/001635 |
| 0033एनएफ 2010/बीआर | प्रोसेस फॉर दि प्रोडेक्शन ऑफ़ वियोलासीन एंड इट्स डेरिवेटीव्स कण्डैनिंग बयोआक्टीव पिगमेंन्ट फ्रम क्रोमोबैक्टीरियम एसपी. एनआईआईएसटी-सीकेके-01 | कृष्णकुमार भास्करन | 30/08/2012 | 1120120218468 |
| 0033एनएफ 2010/ईपी | प्रोसेस फॉर दि प्रोडेक्शन ऑफ़ वियोलासीन एंड इट्स डेरिवेटीव्स कण्डैनिंग बयोआक्टीव पिगमेंन्ट फ्रम क्रोमोबैक्टीरियम एसपी. एनआईआईएसटी-सीकेके-01 | कृष्णकुमार भास्करन | 11/09/2012 | 11718485.3 |
| 0109एनएफ 2008/एयू | नोवल सर्फस मोडिफिकेशन प्रोसेसस फॉर फ्लाई ऐश एंड इंडस्ट्रियल अप्लिकेशन्स देयरऑफ | शुक्ला सत्यजित विष्णु, वार्यर कृष्णा गोपकुमार, किष़क्केलिकूडायिल बैजु विजयन, तचन षिजिता | 11/09/2012 | 2010348068 |
| 0109एनएफ 2008/यूएस | नोवल सर्फस मोडिफिकेशन प्रोसेसस फॉर फ्लाई ऐश एंड इंडस्ट्रियल अप्लिकेशन्स देयरऑफ | शुक्ला सत्यजित विष्णु, वार्यर कृष्णा गोपकुमार, किष़क्केलिकूडायिल बैजु विजयन, तचन षिजिता | 12/09/2012 | 13/612363 |
| 0033एनएफ 2010/ यूएस | प्रोसेस फॉर दि प्रोडेक्शन ऑफ़ वियोलासीन एंड इट्स डेरिवेटीव्स कण्डैनिंग बयोआक्टीव पिगमेंन्ट फ्रम क्रोमोबैक्टीरियम एसपी. एनआईआईएसटी-सीकेके-01 | कृष्णकुमार भास्करन | 12/09/2012 | 13/634329 |
| 0109एनएफ 2008/सीएन | नोवल सर्फस मोडिफिकेशन प्रोसेसस फॉर फ्लाई ऐश एंड इंडस्ट्रियल अप्लिकेशन्स देयरऑफ | शुक्ला सत्यजित विष्णु, वार्यर कृष्णा गोपकुमार, किष़क्केलिकूडायिल बैजु विजयन, तचन षिजिता | 02/11/2012 | 2010800 66578.7 |
| 0188एनएफ 2011/डब्ल्यूओ | ए नोवल मेथेर्ड ऑफ डेवलपिंग नैनो स्ट्रक्चेर्ड सिलवर ऑक्साइड फिल्म बेस्ड एक्वस वोल्टामेट्रिक पेस्टिसाइड सेंसर | पनंपिल्लिल विजयम्मा शुभा, वर्गीस सौम्या, तलशीला प्रसादा राव | 31/01/2013 | पीसीटी/आईएन 2013/000064 |

# फाइल किए गए पेटेंटों (भारतीय)

| एनएफएनओ | शीर्षक | आविष्कारकों | फाइल करते की तारीख | आवेदन सं. |
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| 0139एनएफ 2011/आईएन | फ्लूरसेंट मैटीरियल फॉर सेल्फ-इरेसबिल रैटिंग, ऑथेंटिक सेक्यूरिटि लेबलिंग, करेन्सी काऊंटरफीट प्रिवेन्शन एंड प्रोसेसस फॉर दि प्रिपरेशन देयरऑफ | अय्यप्पनपिल्लै अजयघोष, राजशेखरन तिरुमलै कुमारन | 13/08/2012 | 2294डीईएल 2011 |
| 0138एनएफ 2011/ आईएन | डाई एन्ट्राप्पड सॉल-जेल फिल्म बेस्ड टेस्ट स्ट्रिप सेंसर फॉर नाइट्राइट एंड ए प्रोसेस देयरऑफ | शान्तकुमार धन्या, तलशीला प्रसादा राव | 27/08/2012 | 2419 डीईएल 2011 |
| 0188एनएफ 2011/ आईएन | ए नोवल मेथेर्ड ऑफ डेवलपिंग नैनो स्ट्रक्चेर्ड सिलवर ऑक्साइड फिल्म बेस्ड एक्वस वोल्टामेट्रिक पेस्टिसाइड सेंसर | पनंपिल्लिल विजयम्मा शुभा, वर्गीस सौम्या, तलशीला प्रसादा राव | 30/01/2013 | 0264 डीईएल 2012 |
| 0010एनएफ 2012/ आईएन | ए प्रोसस फॉर दि प्रिपरेशन ऑफ ऑटो फ्लोक्कुलंट आल्गल कल्चेर्स विथ हाई लिपिड कंटेंट | अजित हरिदास | 02/04/2012 | 1016 डीईएल 2012 |
| 0102एनएफ 2012/ आईएन | ए प्रोसस फॉर डि -कम्पोजीशन ऑफ ओर्गानिक सिंथेटिक डाइस यूसिंग सेमिकंडक्टर-ऑक्साइड्स नैनोट्यूब्स वया डार्क कटैलिसीस | शुक्ला सत्यजित विष्णु, वार्यर कृष्णा गोपकुमार, बाबु बबिता कुन्नत्तुपरम्बिल | 17/08/2012 | 2555 डीईएल 2012 |
| 0009एनएफ 2012/ आईएन | ब्ल्यू कलेर्ड इनोर्गानिक पिगमेंट्स, हाविंग नियर इन्फ्रारेड रिफ्लेक्टन्स, बेस्ड ऑन मिक्सचेर्स ऑफ लेण्टेनियम, स्ट्रोन्शियम, कोप्पर एंड लिथियम सिलिकेट एंड प्रोसस देयर ऑफ | मुण्डलापुडि लक्ष्मीपति रेड्डि, शीतु जोस | 30/08/2012 | 2686 डीईएल 2012 |
| 0183एनएफ 2012/ आईएन | ए नोवल अज़ा बोडिपी डेरिवेटीव फॉर दि सिलेक्टीव डिटेक्शन ऑफ नाइट्राइट इओन्स इन वाटर : ए प्रोसस देयर ऑफ एंड इट्स आप्लिकेशन इन वेस्ट वाटर मानेजमेंट | डानबोयिना रामय्या, नागप्पन पिल्लै आदर्श, मधेश शंमुगासुन्दरम | 28/01/2013 | 0206 डीईएल 2012 |

# मंजूर किए गए पेटेंटों (विदेशी)

| शीर्षक | आविष्कारकों | मंजूरी की तारीख | पेटेंट संख्या |
|---|---|---|---|
| अम्फिफिलिक स्कुरन डाइस, ए प्रोसेस फॉर दि प्रिपरेशन देयर ऑफ एंड देयर यूस आस नियर इन्फ्रारेड फ्लूरसेंस प्रोब्स फॉर बायोलॉजिकल, बयोकेमिकल एंड इंडस्ट्रियल अप्लिकेशन्स | डानबोयिना रामय्या, कल्लियाट ताष़त्तुवीट्टिल अरुण, ज्योतिश कुत्तनापिल्लिल | 23/05/2012 | इज़डएल 200580052408.2 |
| नैनोकंपोसिट मैटीरियल यूसफुल फॉर दि प्रिपरेशन ऑफ सूपरहाइड्रोफोबिक कोटिंग एंड ए प्रोसेस फॉर दि प्रिपरेशन देयर ऑफ | अय्यप्पन पिल्लै अजयघोष, संपत्त श्रीनिवासन, वकायिल के प्रवीण | 04/12/2012 | 8323732 |

# मंजूर किए गए पेटेंटों (भारतीय)

| शीर्षक | आविष्कारकों | मंजूरी की तारीख | पेटेंट संख्या |
|---|---|---|---|
| प्रोसेस फॉर दि सिंथेसिस ऑफ टेलेचेलीक यूरिथेन अक्रिलेट यूवी क्यूरबिल प्री पॉलिमर मैटीरियल्स | श्यामाकुमारी आशा, चेन्नाकाट्टु कृष्णा सदाशिवन पिल्लै | 12/04/2012 | 251853 |
| ए नोवल साइक्लिक डोनर अक्सप्टर कोंजुगेट, प्रोसस एंड ए सुप्रामोलिकुलार फ्लूरसेंट मार्कर देयरऑफ | डानबोयिना रामय्या, प्रकाश पी नीलकण्डन, महेश हरिहरन | 31/08/2012 | 253901 |
| नोवल कोलेस्ट्रिक लिक्विड क्रिस्टल कण्डैनिंग फोटो रेसपोन्सीव ब्यूटाडीन क्रोमोफोर एंड प्रोसेस फॉर दि प्रिपरेशन देयर ऑफ | आरआरएल (ति.) से सुरेश दास, शिबु एब्रहाम एआईएसटी, जापान से मोबुयुकी तमॉकि, विश्वनाथ अजय मल्लिया | 21/11/2012 | 254577 |

# ज्ञान संसाधन केंद्र

ज्ञान संसाधन केंद्र ( केआरसी) आवश्यक जानकारी संसाधनों, सेवाओं और ज्ञान का प्रसार प्रदान करके एनआईआईएसटी की अनुसंधान एवं विकास गतिविधियों के समर्थन में एक प्रमुख भूमिका निभाता है । केआरसी ने वर्ष 2012-13 के दौरान संस्थान के विज्ञान तथा प्रौद्योगिकी के कर्मियों को बड़े पैमाने पर अपनी सेवाएं प्रदान की हैं और इस दिशा में महत्वपूर्ण प्रगति की है । पुस्तकों, पत्रिकाओं, सीडी रॉम डेटाबेसस आदि सहित दस्तावेजों के एक विशेष संग्रह उपलब्ध कराने के साथ ही साथ केआरसी द्वारा इलेक्ट्रॉनिक पत्रिकाओं और डेटाबेस के लिए भी पहुँच प्रदान करती है । केआरसी द्वारा ऑप्टिकल फाइबर केबल लिंक पर ईथरनेट कनेक्टिविटी के साथ समर्पित पट्टे लाइनों के माध्यम से सभी शोधकर्ताओं को उच्च गति नेटवर्क प्रदान करता है । 100 प्रतिशत प्रवाह क्षमता और 99 प्रतिशत से ऊपर नेटवर्क उपरिकाल के साथ इस तरह की 24x7 सेवा बैंडविड्थ महत्वपूर्ण अनुप्रयोगों और इंटरनेट ब्राउज़िंग, डेटा अपलोड / डाउनलोड, ईमेल, वीडियो कॉन्फ्रेंसिंग आदि की आवश्यकताओं की पूर्ति करती हैं । अनुभाग ने बुनियादी ढांचे, संसाधनों तथा सेवाओं को मजबूत करने में महत्वपूर्ण प्रगति हासिल की है ।

## संसाधन:

प्रिंट संग्रह: मार्च 2013 तक के कुल प्रिंट संग्रह 43,107 से अधिक दस्तावेज हैं , जिनमें 13,087 पुस्तकों, 10,947 मानकों और पत्रिकाओं की 10,877 जिल्दवाली शामिल हैं । वर्ष 2012-13 के दौरान 107 पुस्तक खरीदी गयीं और 35 ऑनलाइन ख़िताब सहित 83 विदेशी और 77 भारतीय पत्रिकाओं के लिए सदस्यता ली गयी । दस पत्रिकाएं मुफ्त प्राप्त हुई थीं ।

ई - संसाधनों : एनआईआईएसटी शोधार्थियों को 4000 से अधिक पत्रिकाओं और छ: डेटाबेस के लिए पहुंच प्रदान की गयी । इन संसाधनों को एनआईआईएसटी शोधकर्ताओं द्वारा उपयोग किया गया है । शुरू की गयी नई सुविधाओं / सेवाओं का नियमित संदेश प्रसारण, प्रत्येक आइटम के लिए खोज लिंक के साथ इंट्रानेट में होस्टिंग जैसे नियमित प्रचार कार्यक्रमों ने उपयोगिता स्तर में वृद्धि पैदा की है।

विभिन्न ई- संसाधनों के लिए एनकेआरसी (राष्ट्रीय ज्ञान संसाधन भागीदारी) के माध्यम से शोधकर्ताओं के लिए परीक्षण अभिगम्यता प्रदान की गयी । इन जानकारी संसाधनों के लिए पहुँच, अनुसंधान और विकास में एक अग्रणी के रूप में एनआईआईएसटी की सफलता के लिए योगदान देता है। विभिन्न प्रकाशकों से पूर्ण पाठ पत्रिका डेटाबेस जैसे अमेरिकन केमिकल सोसायटी, वार्षिक समीक्षा, अमेरिकन सोसायटी ऑफ सिविल इंजीनियर्स,अमेरिकन सोसायटी ऑफ मैकेनिकल इंजीनियर्स,अमेरिकन सोसायटी ऑफ माइक्रोबायोलॉजी,अमेरिकी भौतिकी संस्थान,एसोसिएशन फॉर कम्प्यूटिंग मशीनरी,कैम्ब्रिज यूनिवर्सिटी प्रेस,एल्सेवियर, एमराल्ड,इलेक्ट्रिकल और इलेक्ट्रॉनिक्स इंजीनियर्स संस्थान,नेचर पब्लिशिंग समूह,ऑक्सफोर्ड यूनिवर्सिटी प्रेस,रसायन विज्ञान की रॉयल सोसाइटी, विज्ञान पत्रिका,स्प्रिंगर,टेलर और फ्रांसिस,विले - ब्लैकवेल,इंडियन जर्नल्स.कोम, जर्नल्स एंड थीमे जर्नल्स आदि के लिए पहुँच है। उपलब्ध पेटेंट डेटाबेस अर्थात डेरवेन्ट इन्नोवेशन्स सूचकांक, क्यूपेट के अलावा ग्रन्थसूची डेटाबेस जैसे विज्ञान की रिएक्सिस वेब, विज्ञान- वेब, विज्ञान प्रशस्ति पत्र सूचकांक विस्तारित, स्कोपस आदि का अत्यधिक इस्तेमाल किया गया। एनआईआईएसटी द्वारा एएसटीएम मानकों का भी संदर्भित किया गया ।

## सेवाएं:

पुस्तकालय सेवाएं: इस अवधि के दौरान पुस्तकों, पत्रिकाओं, पीएचडी थीसिस, एनआईआईएसटी के वैज्ञानिकों के प्रकाशनों आदि के इन-हाउस डेटाबेस को

नियमित रूप से अद्यतन किया गया और एनआईआईएसटी की वेबसाइट और इंट्रानेट के माध्यम से इन्हें उपलब्ध कराया गया । प्रभाग ने वैज्ञानिकों , शोध छात्रों और छात्रों के लिए मानकों और पेटेंटों सहित नियमित डेटाबेस खोजों का संचालन किया । संसाधन सुविधाओं और सेवाओं को मुख्य रूप से अनुसंधान, औद्योगिक और शैक्षिक क्षेत्रों से बाहरी उपयोगकर्ताओं के लिए बढ़ाया गया। केरल और उसके आसपास के संस्थानों और विश्वविद्यालयों से करीब 400 व्यक्तियों ने एनआईआईएसटी - केआरसी का दौरा किया और उसकी सेवाओं का लाभ उठाया । केआरसी की सेवाओं के लिए नए सदस्यों की शुरूआत नियमित रूप से किया गया था । एनआईआईएसटी से उत्पन्न शोध और अनुसंधान कागजात की संस्थागत रिपोजिटरी का निर्माण प्रगति पर है । इस अवधि के दौरान 190 रिकॉर्ड आईआर में जोड़ा गया था । इस अवधि के दौरान पत्रिकाओं की 302 वॉल्यूम्स बाउंड किया गया । एक आम प्रयोगशाला सुविधा के रूप में रिप्रोग्रफिक और फ़ोटोग्राफी सेवाओं का विस्तार किया गया ।

साइन्टोमीट्रिक सेवा: जर्नल प्रशस्ति पत्र की रिपोर्ट और विज्ञान की वेब- विज्ञान प्रशस्ति पत्र सूचकांक विस्तारित और स्कोपस का उपयोग करके एनआईआईएसटी प्रकाशनों के इंपैक्ट फैक्टरों का ग्रंथमापीय / साइन्टोमीट्रिक विश्लेषण जारी किया । उच्च प्रभाव फैक्टर के साथ पत्रिकाओं में प्रकाशित करने के लिए सहायता सेवा प्रदान की गयी । वर्ष 2012 के दौरान एनआईआईएसटी द्वारा प्रकाशित शोधपत्रों की कुल संख्या 169 हैं, जिनमें से 157 कागजात 2.927 के औसत आईएफ मूल्य के साथ एससीआई कागजात हैं ।

आईटी और नेटवर्क प्रशासन: आईटी प्रयोगशाला संचार नेटवर्क के मुख्य केंद्र के रूप में कार्य करती है और अनुसंधान एवं प्रबंधन के लिए सूचना, ज्ञान उपकरणों और प्रणालियों को एक साथ लाने का कार्य करती है । कैम्पस में सभी भवन जिगाबिट फाइबर ऑप्टिक बैकबोन के माध्यम से जुड़े रहते हैं । उच्च अंत पर्सनल कंप्यूटर की एक बड़ी संख्या को कैंपस नेटवर्क के साथ जोड़ने के लिए अलग वीएलएएन का सृजन किया गया है । वायर्ड और वायरलेस नेटवर्क के माध्यम से आईटी प्रयोगशाला द्वारा करीब 500 से ज्यादा इंटरनेट कनेक्शन को बनाये रखते है। उच्च अंत सर्वर, भंडारण उपकरणों, युटीएम उपकरणों और कोर स्विचों को बनाए रखने के लिए एक अत्याधुनिक डाटा सेंटर स्थापित किया गया है ।

आईटी प्रयोगशाला ने संस्थान की इंटरनेट की आवश्यकता को पूरा करने के लिए रिपोर्टिंग वर्ष के दौरान राष्ट्रीय ज्ञान नेटवर्क से लीज्ड लाइन 100 एमबीपीएस के अलावा बीएसएनएल की मौजूदा 9 एमबीपीएस इंटरनेट बैंडविड्थ को 10 एमबीपीएस तक उन्नत किया है । नेटवर्क उपरिकाल को 99 प्रतिशत पर बनाया रखा । आईटी प्रयोगशाला ने एक सुरक्षित वायरलेस नेटवर्क के साथ एनआईआईएसटी के सभी क्षेत्रों को कवर करनेवाली वाई फाई सुविधा लागू की है। नेटवर्क और अनुप्रयुक्त संसाधनों का प्रबंधन के लिए प्रयोगशाला द्वारा नवीनतम प्रौद्योगिकी युक्त एक अत्याधुनिक सर्वर / भंडारण हार्डवेयर को बनाया रखता है । रूटिंग, भार संतुलन, असफल ओवर और सुरक्षित डेटा का उपयोग के लिए प्रयोगशाला द्वारा युटीएम डिवाइस का भी रख- रखाव होता है । आईटी लैब द्वारा प्रयोगशाला में विभिन्न स्थानों में परिनियोजित नेटवर्क स्विच का भी प्रबंधन होता है ।

ई-मेल प्रणाली संचार की एक शक्तिशाली और तेजी साधन बन गयी है और एनआईआईएसटी ने ज़िम्ब्रा ई मेल सिस्टम को लागू किया है । सभी वैज्ञानिकों, कर्मचारियों और शोध छात्रों को संस्थागत ई - मेल आईडी प्रदान की जाती है । मेल सर्वर पर्याप्त एंटी वायरस, एंटी स्पैम और अन्तर्वेधी रोकथाम प्रणाली से सुसज्जित है । इस प्रणाली का परिनियोजन स्पैम नियंत्रण दर को काफी हद तक नीचे लाया है । प्रयोगशाला ने द्विभाषी रूप में संस्थागत वेबसाइट का विकास किया है और साथ ही साथ एक इंट्रानेट वेबसाइट का भी विकास किया है जो, सभी संबंधित जानकारी, दिशानिर्देशों और घोषणाओं को उपलब्ध कराता है । विषयवस्तुओं के नियमित अद्यतनीकरण द्वारा साइटों का रख-रखाव होता है । एनआईआईएसटी द्वारा आयोजित सम्मेलनों की वेबसाइटों के विकास में भी प्रयोगशाला शामिल है । प्रयोगशाला ने एनआईआईएसटी में वायरस मुक्त नेटवर्क वातावरण प्रदान करने के लिए सर्वर ग्रेड एंटीवायरस

सॉफ्टवेयर के लिए लाइसेंस खरीदा है । प्रयोगशाला ने संस्थान के सभी डेस्कटॉप, लैपटॉप तथा अन्य कंप्यूटर बाह्य उपकरणों के लिए एक वार्षिक रखरखाव अनुबंध शुरू किया है । आईटी प्रयोगशाला द्वारा उपयोगकर्ताओं को कंप्यूटरों की संस्थापनाओं, पुन: संस्थापनाओं, मरम्मत, सॉफ्टवेयर अद्यतन, वायरस आदि से संबंधित मुद्दों को सुलझाने में मदद करने के लिए एक मदद डेस्क का प्रबंधन होता है । प्रयोगशाला द्वारा भंडार व क्रय सॉफ्टवेयर, संस्थागत रिपोजिटरी के लिए डी-स्पेस, लिब्स्यूट, केमड्रो, सिग्माप्लॉट, ओर्जिन जैसे विभिन्न अनुप्रयोगों का प्रबंधन भी होता है । अनुप्रयोगों के आवधिक बैकअप तथा मेल और वेबसाइट की सामग्री के बैकअप सृजित करने के लिए एक बैकअप समाधान स्थापित किया गया है ।

प्रयोगशाला ने सीएसआईआर- ईआरपी सिस्टम को लागू करने में विस्तृत कदम उठाए हैं । आईटी उत्पादों और प्रयोगशाला के उपकरणों के अधिग्रहण में गुणवत्ता आश्वासन सुनिश्चित करने में प्रयोगशाला सहायता प्रदान करती है ।

प्रभाग ने वर्ष 2012-13 के दौरान निम्नलिखित प्रशिक्षण कार्यक्रम का आयोजन किया है:

1. पेटेंट खोज और क्युस्टल ओर्बिट (क्युपीएटी) का उपयोग करके मैपिंग- 16 मई 2012
2. अनुसंधान योजना और व्यावसायीकरण के लिए पेटइन्फोमैटिक्स पर कार्यशाला-23-24 अगस्त 2012
3. शोध पत्रिकाओं में कैसे प्रकाशन पा सकते हैं -30 नवंबर, 2012
4. ओपन एक्सेस में उभरती प्रवृत्तियों: खुले ज्ञान वातावरण में विद्वत संचार और इंपैक्ट उपायों पर प्रो लेस्ली चान और प्रोफेसर सुब्बय्याअरुणाचलम द्वारा व्याख्यान- 17 दिसम्बर, 2012

# विदेश में दौरा

| नाम | दौरा किया गया देश | से | तक | उद्देश्य |
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| डॉ. एम.टी. सेबास्टियन | स्लोवानिया | 10.04.2012 | 25.04.2012 | पदार्थ अनुसंधान प्रयोगशाला, नोवा गोरिका- इंडो - स्लोवानिया संयुक्त परियोजना |
| | जर्मनी | | | एर्फुत, जर्मनी- में सत्र की अध्यक्षता और जर्मनी तकनिकल यूनिवर्सिटि ऑफ ईमेनु, जर्मनी में अंतर्राष्ट्रीय सम्मेलन, सीआईसीएमटी 2012में आमंत्रित व्याख्यान एवं ईमेनु तकनिकल यूनिवर्सिटि का दौरा |
| डॉ. राजीव के. सुकुमारन | ब्राज़ील | 18.04.2012 | 20.04.2012 | भारत और ब्राज़ील के बीच अनुसंधान सहयोग को बढ़ावा देने के लिए यूनीकैंप, कैंपिनास साव पाउलो कार्यशाला |
| डॉ. के.वी. राधाकृष्णन | फ्रांस | 10.05.2012 | 24.05.2012 | यूनिवर्सिटी ऑफ रीम्स- इंडो फ्रेंच सहकारी परियोजना |
| डॉ. अशोक पाण्डेय मुख्य वैज्ञानिक | फ्रांस | 04.06.2012 | 29.06.2012 | यूनिवर्सिटी ब्लेस पास्कल( यूबीपी), क्लार्मेनी, फेरेंड- यूबीपी फेलोशिप |
| | दक्षिण कोरिया | 16.09.2012 | 21.09.2012 | डेगू, कोरिया - बायोतकनोलॉजी पर 15वें अंतर्राष्ट्रीय सम्मेलन( आईबीएस-2012) में आमंत्रित व्याख्यान |
| | ताइवान | 07.10.2012 | 10.10.2012 | नाशनल ताइवान यूनिवर्सिटी ऑफ साइंस एंड तकनोलॉजी- आईएफआईबीआईओपी द्वारा जैव प्रक्रिया पर आयोजित अंतर्राष्ट्रीय सम्मेलन में सामान्य अध्यक्ष के रूप में आमंत्रित |
| डॉ. ए. श्रीनिवासन | जर्मनी | 01.07.2012 | 31.08.2012 | जीकेएसएस, रिसर्च सेंटर, गीस्थाच्त- हम्बोल्ट फेलोशिप का एक्सटेंशन दौरा |
| डॉ. सुरेश सी.एच | जर्मनी | 01.07.2012 | 30.09.2012 | मारबर्ग यूनिवर्सिटी हम्बोल्ट फैलोशिप |
| डॉ. बिनोद पी. | ताइवान | 07.10.2012 | 10.10.2012 | नाशनल ताइवान यूनिवर्सिटी ऑफ साइंस एंड तकनोलॉजी- आईएफआईबीआईओपी द्वारा जैव प्रक्रिया पर आयोजित अंतर्राष्ट्रीय सम्मेलन में भाग लेने तथा युवा वैज्ञानिक पुरस्कार प्राप्त करने के लिए |

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| डॉ. ए. अजयघोष | जापान | 15-10.2012 | 26.10.2012 | एआईएसटी, ताकामात्सु, तथा निम्स, त्सुबका - ऊर्जा नवाचार के लिए सुप्रामोलिकुलर नैनोपदार्थों पर आयोजित जापान - भारत द्विपक्षीय संगोष्ठी |
| | बेल्जियम | 25.11.2012 | 30.11.2012 | नमुर यूनिवर्सिटी- पीएचडी परीक्षा बोर्ड के सदस्य और विभागीय विशेष व्याख्यान देने के लिए |
| | तेहरान, ईरान | 03.02.2013 | 09.02.2013 | इरानियन विज्ञान तथा प्रौद्योगिकी अनुसंधान संगठन (आईआरओएसटी) के 26वें ख्वारिज्मी इंटरनेशनल अवार्ड (केआईए) प्राप्त करने के लिए |
| डॉ. सत्यजित शुक्ला वैज्ञानिक | क़िंगदाओ, चीन | 26.10.2012 | 28.10.2012 | क़िंगदाओ, चीन -नैनोसाईंसिस और प्रौद्योगिकी पर आयोजित द्वितीय वार्षिक वर्ल्ड कांग्रेस (नैनो एस एंड टी 2012 ) में भाग लेने के लिए । |
| डॉ. सुरेश दास निदेशक | जापान | 11.11.2012 | 20.11.2012 | ओसाका यूनिवर्सिटी- एशियाई और औशेयनियन प्रकाश रसायनविज्ञान एसोसिएशन (एपीए- 2012 ) पुरस्कार प्राप्त करने के लिए और 7वें एसियन फोटोकेमिस्ट्री सम्मेलन में आमंत्रित व्याख्यान ; टोक्यो मेट्रोपोलिटन यूनिवर्सिटी,टोक्यो, जापान का दौरा |

# सम्मान और पुरस्कार

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| डॉ. सुरेश दास | एमआरएसआई प्रतिष्ठित लेक्चररशिप अवार्ड |
| | एशियन एंड औशेयनियन फोटोकेमिकल सोसाइटी अवार्ड |
| | अध्यक्ष-रसायनविज्ञान, डीएसटी -इन्सपॉयर फैकल्टी स्कीम |
| डॉ. ए अजयघोष | इनफ़ोसिस साइंस फाउंडेशन अवार्ड |
| | फेलो, इंडियन नेशनल साइंस अकादमी , नई दिल्ली |
| | एसोसिएट एडीटर, भौतिक रसायन विज्ञान, रासायनिक भौतिकी, रसायन विज्ञान की रॉयल सोसाइटी |
| | 26वीं ख्वारिज्मी इंटरनेशनल अवार्ड, इरानियन विज्ञान तथा प्रौद्योगिकी अनुसंधान संगठन (आईआरओएसटी), तेहरान, इरान |
| | सीआरएसआई सिल्वर मेडल, केमिकल रिसर्च सोसाइटी ऑफ इंडिया |
| डॉ. डी रामय्या | फ्रोफ़. सी.वी.अशोकन मेमोरियल लेक्चर अवार्ड |
| | सदस्य, विषय विशेषज्ञ समिति (2013-2015), महिला वैज्ञानिक स्कीम, विज्ञान तथा प्रौद्योगिकी विभाग, भारत सरकार |
| डॉ. एम एल पी रेड्डी | सीआरएसआई ब्रोनज़ मेडल, भारतीय रासायनिक अनुसंधान सोसाइटी |
| डॉ. सी एच सुरेश | सीआरएसआई युवा वैज्ञानिक, भारतीय रासायनिक अनुसंधान सोसाइटी |
| डॉ. जोशी जोसफ | रामानुजन फेलोशिप, डीएसटी, इंडिया |
| डॉ. सी विजयकुमार | रामानुजन फेलोशिप, डीएसटी, इंडिया |
| श्री एस शाजन | सर्वश्रेष्ठ शोध पत्र पुरस्कार, 10-11 अगस्त, 2012 के दौरान इंजीनियरिंग कॉलेज, तिरुवनंतपुरम में तकनीकी प्रवृत्तियों पर आयोजित राष्ट्रीय सम्मेलन |
| सुश्री वी एस स्मिता | सर्वश्रेष्ठ पोस्टर (तृतीय पुरस्कार) अक्टूबर 5-8, 2012 के दौरान महात्मा गांधी विश्वविद्यालय, कोट्टयम, केरल में उन्नत ऑक्सीकरण प्रक्रियाओं (एओपी -2012) पर आयोजित दूसरा अंतर्राष्ट्रीय सम्मेलन |
| सुश्री के बी जैमी | सर्वश्रेष्ठ पोस्टर (तृतीय पुरस्कार) अक्टूबर 5-8, 2012 के दौरान महात्मा गांधी विश्वविद्यालय, कोट्टयम, केरल में उन्नत ऑक्सीकरण प्रक्रियाओं (एओपी -2012) पर आयोजित दूसरा अंतर्राष्ट्रीय सम्मेलन |
| श्री पी शजेश | सर्वश्रेष्ठ पोस्टर (तृतीय पुरस्कार) अक्टूबर 5-8, 2012 के दौरान महात्मा गांधी विश्वविद्यालय, कोट्टयम, केरल में उन्नत ऑक्सीकरण प्रक्रियाओं (एओपी -2012) पर आयोजित दूसरा अंतर्राष्ट्रीय सम्मेलन |
| सुश्री जे के जीना | सर्वश्रेष्ठ पोस्टर (तृतीय पुरस्कार) अक्टूबर 5-8, 2012 के दौरान महात्मा गांधी विश्वविद्यालय, कोट्टयम, केरल में उन्नत ऑक्सीकरण प्रक्रियाओं (एओपी -2012) पर आयोजित दूसरा अंतर्राष्ट्रीय सम्मेलन |
| श्री ई जयकुमार | सर्वश्रेष्ठ शोध पत्र अवार्ड, धातुकर्म, सामग्री विज्ञान एवं इंजीनियरिंग(आईएसआरएस-2012), पर 13-15, दिसंबर 2012 के दौरान आईआईटी- मद्रास, चेन्नै में रिसर्च स्कॉलर्स के लिए आयोजित अंतर्राष्ट्रीय संगोष्ठी |

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|---|---|
| सुश्री के ए मंजुमॉल | सर्वश्रेष्ठ पोस्टर अवार्ड, 18-19 जनवरी, 2013 के दौरान अहमदाबाद में आयोजित भारतीय सिरेमिक सोसायटी (आईसीएस) के 76वें वार्षिक सत्र |
| श्रीमती ए प्रियंका | पोस्टर प्रस्तुति पुरस्कार, स्वास्थ्य और रोगों में पादप रसायनों: चुनौतियां और भविष्य के सुनहरे अवसर ( आईसीपीएचडी-2013) पर 23-25, जनवरी 2013 के दौरान अन्नामलाई विश्वविद्यालय में आयोजित अंतर्राष्ट्रीय सम्मेलन |
| श्री जी पी वी प्रजीश | सर्वश्रेष्ठ शोधपत्र अवार्ड, पर्यावरण विज्ञान, वानिकी और जंगली जीवन पर जनवरी 29-फरवरी 1, 2013 के दौरान आयोजित 25वें केरल विज्ञान कांग्रेस |
| सुश्री बी सौम्या | सर्वश्रेष्ठ शोधपत्र अवार्ड, पर्यावरण विज्ञान, वानिकी और जंगली जीवन पर जनवरी 29-फरवरी 1, 2013 के दौरान आयोजित 25वें केरल विज्ञान कांग्रेस |
| श्री एस शंकर | सर्वश्रेष्ठ पोस्टर अवार्ड, समुद्र तट रेत खनिज के उपयोग और प्रसंस्करण के लिए उभरती प्रौद्योगिकियों पर 1-2 मार्च 2013 के दौरान कोच्चि, केरल में आयोजित राष्ट्रीय सम्मेलन |
| श्रीमती आर धन्या | सर्वश्रेष्ठ शोधपत्र अवार्ड, खाद्य वैज्ञानिकों और टेक्नोलॉजीज़ संघ (एएफएसटी), कोल्लम चैप्टर के सहयोग से टीकेएम प्रौद्योगिकी संस्थान, कोल्लम : 8-9 मार्च, 2013 |

# पीएच.डी. डिग्री से सम्मानित

| छात्र | थीसिस का शीर्षक | पर्यवेक्षक | विश्वविद्यालय |
|---|---|---|---|
| श्री साई श्याम एन | मॉलिक्यूलर स्टडीज ओन पेप्टाइड डीफोर्मिलेस एंड मेथिओनिन अमिनोपेप्टिडेस फ्रम मैकोबैक्टीरियम ट्यूबरक्लोसिस | डॉ. के.माधवन नंपूतिरि | केरल विश्वविद्यालय |
| सुश्री स्मिता मोहनलाल | फैटोकेमिकल इन्वेस्टीगेशन ओन ब्लैक -ग्लुम्ड ञवरा, दि मेडिसिनल राइस आस कॉम्पयेर्ड टु स्टेपल वेरायटीज एंड इवैल्यूएशन ऑफ़ देयर एंटीऑक्सीडेंट, एंटीइन्फ्लाम्मेटरी एंड एंटीकैंसर इफेक्ट्स | डॉ. ए.जयलक्ष्मी | कुसाट |
| श्री प्रतीश वी नायर | सिंथेसिस एंड फोटोफिसिकल प्रोपर्टीस ऑफ II-VI सेमिकण्डक्टर नैनोस्ट्रक्चेर्स | डॉ. के.जोर्ज थॉमस | केरल विश्वविद्यालय |
| सुश्री दिव्या के पी | डोनर-अक्सप्टर-डोनर (डी-ए-डी) टाइप स्माल मॉलिक्यूल्स एंड ओलिगोमेर्सः फोटोफिसिकल प्रोपेर्टीस, अनालैट रेसपोन्सस एंड कन्फॉर्मेशनल चेंजस | डॉ. ए.अजयघोष | केरल विश्वविद्यालय |
| सुश्री निशा पी | स्ट्रक्चर, मैग्नेटिक एंड मैग्नेटोकलोरिक स्टडीस ऑफ सम $La_{0.67}Ca_{0.33}MnO_3$ बेस्ड पेरोवस्किट्स | डॉ. मनोज रामावर्मा | केरल विश्वविद्यालय |
| श्री सजित पी के | डेवलपमेंट ऑफ क्वांटिटेटीव स्ट्रक्चर प्रोपर्टी रिलेशनशिप फॉर प्रेडिक्टिंग म्यूचल ट्रांन्सइन्फ्लुवन्स एंड लिगन्ड बॉड डिस्सोसियेशन एनेर्जीस इन Pa(II)Pt(II) एंड हाइपर वालेंट अयोडिन कॉलेक्सस | डॉ. सी.एच.सुरेश | केरल |
| श्री नेशन वर्गीस | स्टडीस ऑन ट्रांसपोर्ट एंड मैग्नेटिक प्रोपर्टीस ऑफ नैनोपार्टिकिल डोप्ड $MgB_2$ सूपरकण्डक्टर फॉर तकनोलॉजिकल अप्पिकेशन्स | डॉ. यु.श्यामाप्रसाद | कुसाट |
| श्री बालामुरुगन ए | कोजुगेटड पॉलिमर-लंथानाइड हाइब्रिड मैटीरियल्स फॉर ल्यूमिनसेंस अप्लिकेशन्स | डॉ. एम.एल.पी.रेड्डी | केरल विश्वविद्यालय |
| श्री सजित मेनोन | डिज़ाइन, सिंथेसिस एंड स्टडि ऑफ दि सेल्फ असेंब्ली एंड फोटोकेमिकल प्रोपर्टीस ऑफ सम लाइट रेसपोंसीव आम्फिफिलिक ब्लॉक कोपॉलिमेर्स | डॉ. सुरेश दास | केरल विश्वविद्यालय |
| श्री शेलवकुमार के | सिंथेसिस ऑफ फंग्शनलैस्ड 2- ओक्सिंडोल्स एंड 3- स्पैरोसाइक्लिक 2-ओक्सिनॉल्स फ्रम मोरिटा-डाइलिस-हिलमान अब्डक्ट ऑफ इसाटिन | डॉ. पी. शंमुगम | केरल विश्वविद्यालय |
| सुश्री बिंदुमॉल आई | स्टडीस ऑन एक्सोपॉलिसैक्कराइड प्रोडक्शन बाय प्रोबायोटिक लैक्टिक आसिड बैक्टीरिया | डॉ. के.माधवन नंपूतिरि | कुसाट |
| श्री सुरेश एम | ग्रैन रिफाइन्मेन्ट स्टडीस ऑन Mg एंड Ma-Al बेस्ड अलोयस | डॉ. यू.टी.एस.पिल्लै | कुसाट |

# अनुसंधान परिषद के सदस्य

## अध्यक्ष

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## एजेंसी के प्रतिनिधि

डॉ. अरविन्द दुग्गल
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लोदी रोड, नई दिल्ली - 110 003

## महानिदेशक नामांकित

डॉ. विजयमोहनन के.पिल्लै
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## सहोदर प्रयोगशाला

डॉ. पुष्पितो.के.घोष
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केंद्रीय नमक एवं समुद्री रसायन अनुसंधान
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## निदेशक

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## सचिव

डॉ. ए.सुन्दरेशन
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तिरुवनंतपुरम - 695 019

# प्रबंधन परिषद के सदस्य

## (1/1/2012 से 31/12/2013 तक की अवधि)

**अध्यक्ष**

निदेशक, एनआईआईएसटी

**सदस्य**

डॉ. विजयमोहनन के.पिल्लै, निदेशक, सीईआरआई,कारैकुडी
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डॉ. टी.पी.डी.राजन, वैज्ञानिक एनआईआईएसटी
डॉ. बी.कृष्णकुमार, वैज्ञानिक एनआईआईएसटी
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सीओएफए, एनआईआईएसटी
प्रधान, पीपीडी, एनआईआईएसटी

**सदस्य सचिव**

एओ, एनआईआईएसटी

# नई नियुक्तियाँ

## डॉ. कौस्ताभकुमार मैती, वरिष्ठ वैज्ञानिक - 23 अप्रैल 2012

कौस्ताभ कुमार मैती ने वर्ष 1993 में कोलकत्ता विश्वविद्यालय से कार्बनिक रसायन शास्त्र एमएससी और वर्ष 2000 में उसी विश्वविद्यालय से पीएच.डी. प्राप्त की । आपने भारत के एक अग्रणी आर एंड डी फार्मास्युटिकल्स कंपनी में अपना कैरियर शुरू कर दिया, ( 2000 से 2003 तक एलेम्बिक लिमिटेड और सन फार्मास्युटिकल्स इंडस्ट्रीज लिमिटेड) जहां आपने प्रक्रिया विकास और दवाओं की खोज के कार्यक्रमों में काम किए । इस औद्योगिक प्रशिक्षण के बाद, आपने पोहांग विज्ञान तथा प्रौद्योगिकी विश्वविद्यालय, दिक्षण कोरिया में (पोस्टटेक., 2003-2007) पोस्ट डॉक्टरल अनुसंधान के लिए शामिल हो गए । बाद में आपने दूसरे पोस्ट डॉक्टरल अनुसंधान जारी रखने के लिए कॉप्लेक्स कार्बोहाईड्रेट रिसर्च (सीसीआरसी) केंद्र, जॉर्जिया विश्वविद्यालय, संयुक्त राज्य अमेरिका में चले गए । इस संस्थान में शामिल होने से पहले आपने एक शोध वैज्ञानिक के रूप में (मई 2009 से मार्च 2012 तक) सिंगापुर बायोइमेजिंग कंसार्शियम(जैव चिकित्सा विज्ञान संस्थान के तहत, ए* स्टार ) में काम किया। आपके वर्तमान अनुसंधान के हित में छोटे आणविक दवाओं, प्रोटीन, न्यूक्लिक एसिड और प्लास्मिड डीएनए के लिक्षत वितरण के लिए पेप्टाइड और गैर - पेप्टाइड पाड़ आधारित दवा वितरण प्रणाली के संशेलेषण और उनके जैविक मूल्यांकन शामिल हैं । इसके अलावा, आप का ध्यान संक्रामक रोगों के लिए नैदानिक जांच के विकास पर तथा कैंसर का पता लगाने के लिए अल्ट्रासंवेदनशील और जैव संगत सतह एन्हान्स्ड रमन स्कैटरिंग (एसईआरएस) नैनो टैग पर केंद्रित हैं ।

## डॉ. बिश्वप्रिया देब, वरिष्ठ वैज्ञानिक - 25 मई 2012

संस्थान में शामिल होने से पहले आपने वर्ष 2003-2004 के दौरान रासायनिक अभियांत्रिकी तथा सामग्री विभाग, (सीईएमएस) मिनेसोटा विश्वविद्यालय, संयुक्त राज्य अमेरिका में पोस्ट डॉक्टरेट शोधकर्ता के रूप में तथा 2004-2007 के दौरान लूयिसविल्ले विश्वविद्यालय, संयुक्त राज्य अमेरिका के रासायनिक अभियांत्रिकी विभाग में रिसर्च एसोसिएट के रूप में, और वर्ष 2007-2009 के दौरान उन्नत सामग्री और अक्षय ऊर्जा (आईएएमआरई), लूयिसविल्ले विश्वविद्यालय, संयुक्त राज्य अमेरिका में अनुसंधान वैज्ञानिक (औद्यो•गक) के रूप में तथा वर्ष 2010-2012 के दौरान राष्ट्रीय सामग्री विज्ञान संस्थान, जापान( एनआईएमएस) में पोस्ट डॉक्टरेट शोधकर्ता के रूप में काम किए । आपकी अनुसंधान अभिरुचि ऊर्जा दक्ष उपकरणों के लिए कार्यात्मक नैनोपदार्थों के विकास, पतली फिल्मों, तापीयवैद्युति और नैनोस्केल परिवहन पर केंद्रित हैं ।

## डॉ. एम.वसुंधरा, वैज्ञानिक- 22 जून 2012

डॉ. (सुश्री) एम.वसुंधरा ने वर्ष 2009 में भारतीय प्रौद्योगिकी संस्थान, खड़गपुर से भौतिकी में पीएच.डी. प्राप्त की । संस्थान में वेज्ञानिक के रूप में शामिल होने से पहले आपने कोरिया उन्नत विज्ञान और प्रौद्योगिकी संस्थान, कोरिया में एक आमंत्रित शोधकर्ता के रूप में (सितम्बर 2008 से मार्च 2009 तक) तथा कोरिया उन्नत विज्ञान और प्रौद्योगिकी संस्थान, कोरिया में पोस्ट डॉक्टर के रूप में (मार्च 2009 से जून 2011 तक) तथा रिसो राष्ट्रीय सतत ऊर्जा प्रयोगशाला, डेन्मार्क में (जूलाई 2011 से जून 2012 तक) पोस्ट डॉक्टर के रूप में काम किए । आपकी अनुसंधान अभिरुचि इंटरमेटालिक्स, मैग्नटिक पतली फिल्मों, मैग्नेटिक ऑक्साईड, टनल जंक्शनों और स्थायी मैग्नट्स और उन्नत कार्यात्मक सामग्री (जैसे स्पिनट्रॉनिक, फेरोमैग्नटिक, मैग्नेटो-कैलरिक और थेरमोइलेक्ट्रिक) और तेजी से जम अनाकर सामग्री में नैनोसंरचनात्मक गठन पर केंद्रित हैं ।

## डॉ. विजयनाथ आर., चिकित्सा अधिकारी- 4 अक्तूबर 2012

एनआईआईएसटी औषधालय की स्थापना के परिणामस्वरूप डॉ. विजयनाथ ने 04.10.2012 को संस्थान के चिकित्सा अधिकारी के रूप में शामिल हो गए । आपने केरल विश्वविद्यालय से वर्ष 2009 में एमबीबीएस डिग्री प्राप्त की । संस्थान में शामिल होने से पहले आप एआरटी यूनिट, मेडिकल कॉलेज, कोट्टयम, जो एचआईवी से प्रभावित व्यक्तियों के लिए उपचार केंद्र के रूप में कार्य करता है, में चिकित्सा अधिकारी के रूप में काम कर रहे थे ।

## डॉ. शशिधर बी.एस, वैज्ञानिक इ 17 अक्तूबर 2012

डॉ. शशिधर ने वर्ष 2012 में गुलबर्गा विश्वविद्यालय, भारत से कार्बनिक रसायन विज्ञान में पीएच.डी प्राप्त की । आपको उत्कृष्ट छात्र के लिए विज्ञान में यूजीसी अनुसंधान फैलोशिप, (आरएफएसएमएस), अनुसंधान के लिए विश्वविद्यालय से मेरिट फैलोशिप और मैसूर विश्वविद्यालय से युवा वैज्ञानिक पुरस्कार(उत्कृट मौखिक प्रस्तुतकर्ता) प्राप्त है । दवा की तरह के अणुओं के संश्लेषण और जैविक-अनुप्रयोगों, डीएनए बाध्यकारी और डीएनए विदलन एजेंट के रूप में छोटे आणविक कॉजुगेटों के विकास (एसएमसी), विभिन्न जैविक परिवर्तनों के लिए हरी रसायनविज्ञान- तेजी, आर्थिक और पर्यावरण के अनुकूल तकनीक और इलेक्ट्रॉनिक अनुप्रयोगों के लिए हेटरोसाइक्लिक व्युत्पन्न एक्सोटिक पदार्थों के संश्लेषण आदि आपकी अभिरुचि के क्षेत्र हैं ।

## श्री के रिशि अरविंद, वैज्ञानिक - 17 अक्तूबर 2012

श्री के रिशि अरविंद को आईआईआईटी हैदराबाद से वर्ष 2006 में प्रौद्योगिकी में मास्टर्स डिग्री (सीएससी - बायोइनफॉरमैटिक्स) और सेंटीनियल कॉलेज से वर्ष 2010 में पोस्ट ग्रेजुएट डिप्लोमा (परियोजना प्रबंधन में ) प्राप्त है । सीएसआईआर - एनआईआईएसटी में शामिल होने से पहले, आपने फिलिप्स रिसर्च के बायोइनफॉरमैटिक्स प्रभाग में अनुसंधान अभियंता के रूप में काम किया है । आपको विभिन्न क्षमताओं में शैक्षणिक और प्रबंधन के अनुभव प्राप्त है । बायोइनफॉरमैटिक्स, उच्च निष्पादन कंप्यूटिंग, जीपीयू कंप्यूटिंग, स्वास्थ्य इनफॉरमैटिक्स, एजेंट आधारित मॉडलिंग और सिमुलेशन आपके अनुसंधान हित के क्षेत्र हैं ।

## डॉ. मुत्तु अरुमुखम, वैज्ञानिक - 25 अक्तूबर 2012

डॉ. मत्तु अरुमुखम ने भारतीय विज्ञान संस्थान बंगलौर से वर्ष 2010 में माइक्रोबायोलॉजी एवं सेल बायोलॉजी में पीएच.डी. प्राप्त की । संक्रामक रोग, औद्योगिक एंजाइमों और बायोएनर्जी आपके अनुसंधान के क्षेत्र हैं ।

## डॉ. प्रिया एस., वैज्ञानिक -29 अक्तूबर 2012

डॉ. प्रिया ने केरल विश्वविद्यालय से बायोकैमिस्ट्री में पीएचडी प्राप्त की । आपको वर्ष 2008 में बायोकैमिस्ट्री विभाग, हिब्रू यूनिवर्सिटि ऑफ यरूशलेम, इजराइल में पोस्ट डॉक्टरल फैलोशिप, और वर्ष 2012 में डीएसटी फास्ट ट्रैक युवा वैज्ञानिक पुरस्कार से सम्मानित किया गया है । वैज्ञानिक के रूप सीएसआईआर - एनआईआईएसटी में शामिल होने से पहले आपने जैव पृथक्करण प्रौद्योगिकी केंद्र (सीबीएसटी) वीआईटी विश्वविद्यालय, वेल्लोर, तमिलनाडु में वैज्ञानिक के रूप में काम किया है ।

प्राकृतिक स्रोतों से जैव सक्रिय यौगिकों के शुद्धीकरण, विभिन्न बीमारियों के खिलाफ चिकित्सकीय उपयोग के लिए उनके सेल आधारित स्क्रीनिंग, उनके विभिन्न सेल आधारित परख प्रणालियों का उपयोग करते हुए सक्रियता के आणविक तंत्र पर विस्तृत अध्ययन और आपके अनुसंधान हित के क्षेत्रों में शामिल हैं ।

## श्री. किरन कुमार एम., वैज्ञानिक - 31 अक्तूबर 2012

श्री. किरण कुमार ने वर्ष 2009 में केमिकल इंजीनियरिंग (आईआईटी खड़गपुर से) में एम.टेक प्राप्त की । एनआईआईएसटी में शामिल होने से पहले आपने सीएसआईआर- एनआईआईएसटी, तिरुवनंतपुरम के जैव- ईंधन केंद्र में परियोजना वैज्ञानिक के रूप में और वीआईटी विश्वविद्यालय, वेल्लोर के केमिकल इंजीनियरिंग प्रभाग में सहायक प्रोफेसर के रूप में काम किये हैं । आपको वर्ष 2007-2009 के दौरान मानव संसाधन विकास मंत्रालय से छात्रवृत्ति प्राप्त हुयी थी । जैव ईंधन, रासायनिक कैनेटीक्स और प्रोसेस प्लांट डिजाइन आपके अनुसंधान क्षेत्र हैं ।

## श्री पुष्किन एस., तकनीकी अधिकारी -03 अक्तूबर 2012

श्री पुष्किन सीसीएनए प्रमाण पत्र के साथ इलेक्ट्रॉनिक्स एवं कम्युनिकेशन में इंजीनियरिंग स्नातक है। आईटी नेटवर्क डिजाइनिंग और आईटी सुरक्षा आपके अभिरुचि के क्षेत्र हैं ।

## डॉ. सी विजयकुमार, वैज्ञानिक - 01 जनवरी 2013

डॉ. विजयकुमार ने सीएसआईआर-एनआईआईएसटी, तिरुवनंतपुरम में प्रो. ए अजयघोष के मार्गदर्शन में कार्यात्मक सुप्रामॉलिकुलर सामग्रियों के क्षेत्र में किए गए कार्य के आधार पर जनवरी 2008 में केरल विश्वविद्यालय से रसायन विज्ञान में पीएच.डी. की उपाधि प्राप्त की । बाद में, कार्बनिक सामग्री समूह, राष्ट्रीय पदार्थ विज्ञान संस्थान (एनआईएमएस), सुकुबा, जापान में आपने एक पोस्ट डॉक्टरेट रिसर्च फेलो (जनवरी 2008- दिसंबर 2010) के रूप में काम किया । एप्लाइड कैमिस्ट्री विभाग, ग्रेजुएट स्कूल ऑफ इंजीनियरिंग, ओसाका विश्वविद्यालय, जापान में आपने सहायक प्रोफेसर (जनवरी 2011-दिसम्बर 2012) के रूप में काम किया । वर्ष 2013 जनवरी में, आप सीएसआईआर एनआईआईएसटी, तिरुवनंतपुरम के रसायन विज्ञान तथा प्रौद्योगिकी प्रभाग में वैज्ञानिक के रूप में में शामिल हो गए । आपके वर्तमान अनुसंधान अभिरुचि में सुप्रामॉलिकुलर रसायन विज्ञान, जैविक स्मार्ट सामग्री और सेंसर, जैविक अर्धचालक सामग्री, कार्बनिक- अकार्बनिक संकर थेर्मोइलेक्ट्रिक सामग्री, फोटोवोल्टिक उपकरणों और प्रकाश उत्सर्जक डायोड शामिल हैं ।

## श्री किरन मोहन. तकनीकी अधिकारी - 01 जनवरी 2013

श्री किरन मोहन ने कालीकट विश्वविद्यालय के अधीन एनएसएस इंजीनियरिंग कॉलेज, पालक्काड से इंस्ट्रूमेंटेशन एंड कंट्रोल इंजीनियरिंग में स्नातक डिग्री (बी टेक) पूरा की। आपने आइकॉन एनालिटिकल एक्युप्मेंट प्राइवेट लिमिटेड, मुम्बई में वरिष्ठ कार्यकारी- एप्लीकेशन सपोर्ट के रूप में काम किया गया है । 2013 जनवरी में आप तकनीकी अधिकारी के रूप में सीएसआईआर एनआईआईएसटी के रासायनिक विज्ञान तथा प्रौद्योगिकी विभाग, तिरुवनंतपुरम में शामिल हो गए । विभिन्न इलेक्ट्रॉन सूक्ष्म तकनीकों, नमूना तैयार करने की तकनीकों, ईडीएस (ऊर्जा फैलानेवाली स्पेक्ट्रोस्कोपी) विश्लेषण (स्पेक्ट्रम और मानचित्रण), छवियों के ईडीएस विवेचन, ईडीएस, स्टेम (एचएएडीएफ) इमेजिंग के साथ विश्लेषणात्मक काम, छवियों का विवेचन और समस्या निवारण आपके हित के क्षेत्रों में शामिल है ।

## श्री जे.एस. किरन, तकनीकी सहायक - 26 मार्च 2013

श्री किरण कंप्यूटर इंजीनियरिंग में डिप्लोमा धारक है । आप एक सिस्को प्रमाणित नेटवर्क एसोसिएट और एक प्रमाणित 3 डी मैक्स व फ़ोटोशॉप डिजाइनर है। मार्च 2013 में आप तकनीकी सहायक के रूप में सीएसआईआर-एनआईआईएसटी के रासायनिक विज्ञान तथा प्रौद्योगिकी विभाग, में शामिल हो गए। आणविक संरचना के कंप्यूटर सहायता प्राप्त डिजाइन और रासायनिक प्रक्रियाओं के एनीमेशन आपकी अभिरुचि के क्षेत्र हैं।

# 31/03/2013 को कर्मचारियों की सूची

## निदेशक का कार्यालय

| | |
|---|---|
| डॉ सुरेश दास | निदेशक |
| श्री एस सुरेशकुमार | मुख्य वैज्ञानिक |
| श्री जी के नायर | वरिष्ठ आशुलिपिक (एसीपी) (31/3/2013 को सेवानिवृत्त) |
| श्री ए कृष्णनकुट्टी | तकनीकी ग्रेड 1 -4 |
| श्री पी बी विजयकुमार | तकनीकी ग्रेड 1 -4 |

## आर एंड डी प्रभाग

### कृषि प्रसंस्करण एवं प्राकृतिक उत्पादन प्रभाग

| | |
|---|---|
| डॉ ए सुन्दरेशन | मुख्य वैज्ञानिक तथा प्रधान प्रशासनिक सेवाएं |
| श्री एम एम श्रीकुमार | मुख्य वैज्ञानिक तथा प्रधान |
| श्रीमती ए निर्मला मेनोन | व. प्रिंसिपल वैज्ञानिक (30.06.2013 को सेवानिवृत्त) |
| श्रीमती ओमनाकुट्टि अम्मा | प्रिंसिपल वैज्ञानिक |
| डॉ दिलीपकुमार बी एस | प्रिंसिपल वैज्ञानिक |
| डॉ (श्रीमती) के पी पद्मकुमारी अम्मा | प्रिंसिपल वैज्ञानिक(31.01.2013 को सेवानिवृत्त) |
| डॉ के जी रघु | प्रिंसिपल वैज्ञानिक |
| श्री वी वी वेणुगोपाल | वरिष्ठ वैज्ञानिक |
| श्रीमती एम वी रेश्मा | वैज्ञानिक |
| डॉ रविशंकर एल | वैज्ञानिक |
| डॉ प्रिया एस | वैज्ञानिक |
| डॉ (श्रीमती) पी निशा | वैज्ञानिक |
| डॉ पी जयमूर्ती | वैज्ञानिक |
| डॉ (श्रीमती) बीना जोय | प्रिंसिपल तकनीकी अधिकारी |
| श्रीमती एल प्रसन्नाकुमारी | वरिष्ठ तकनीकी अधिकारी (31.03.2013 को सेवानिवृत्त) |
| श्री डी आर शोभन कुमार | तकनीकी अधिकारी |
| श्रीमती अन्नम्मा मात्यू | वरिष्ठ आशुलिपिक(एसीपी) (31.05.2012 को सेवानिवृत्त) |

### जैवप्रौद्योगिकी प्रभाग

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

## रसायन विज्ञान तथा प्रौद्योगिकी प्रभाग

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| डॉ ए अजयघोष | वैज्ञानिक एच |
| डॉ डी रामय्या | मुख्य वैज्ञानिक तथा प्रधान |
| डॉ टी प्रसादाराव | मुख्य वैज्ञानिक |
| डॉ (श्रीमती) मंगलम एस नायर | मुख्य वैज्ञानिक |
| डॉ (श्रीमती) ए जयलक्ष्मी | मुख्य वैज्ञानिक |
| डॉ के आर गोपिदास | मुख्य वैज्ञानिक |
| डॉ एम लक्ष्मीपति रेड्डी | मुख्य वैज्ञानिक |
| डॉ (श्रीमती) आर लक्ष्मी वर्मा | वरिष्ठ प्रिंसिपल वैज्ञानिक |
| डॉ के वी राधाकृष्णन | वरिष्ठ वैज्ञानिक |
| डॉ सी एच सुरेश | वरिष्ठ वैज्ञानिक |
| डॉ बिश्वप्रिया देब | वरिष्ठ वैज्ञानिक |
| डॉ कौस्तुभकुमार मैती | 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 किरन मोहन | तकनीकी अधिकारी |
| श्री किरन जे एस | तकनीकी सहायक |
| श्री टी एस शशिकुमार | निजी सचिव |

## पदार्थ विज्ञान तथा प्रौद्योगिकी प्रभाग

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| डॉ एम टी सेबास्टियन | मुख्य वैज्ञानिक तथा प्रधान |
| डॉ यु श्यामाप्रसाद | मुख्य वैज्ञानिक |
| डॉ पी प्रभाकर राव | मुख्य वैज्ञानिक |
| श्री के हरिकृष्ण भट् | मुख्य वैज्ञानिक |
| डॉ जोस जेइम्स | मुख्य वैज्ञानिक |
| डॉ ए आर आर मेनोन | वरिष्ठ प्रिंसिपल वैज्ञानिक |
| श्री एम सी षाजी | वरिष्ठ प्रिंसिपल वैज्ञानिक |
| डॉ यु टी एस पिल्लै | वरिष्ठ प्रिंसिपल वैज्ञानिक |
| डॉ एम रवि | वरिष्ठ प्रिंसिपल वैज्ञानिक |
| श्री स्वपनकुमार घोष | वरिष्ठ प्रिंसिपल वैज्ञानिक( 24.08.2012 को स्थानांतरित) |
| डॉ मनोज रामावर्मा | वरिष्ठ प्रिंसिपल वैज्ञानिक |
| डॉ एस अनन्तकुमार | प्रिंसिपल वैज्ञानिक |
| डॉ टीपी डी राजन | वरिष्ठ वैज्ञानिक |
| डॉ हरीश यु एस | वरिष्ठ वैज्ञानिक |

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| डॉ ई भोजे गौड | वरिष्ठ वैज्ञानिक |
| डॉ आर पी अलोशियस | वरिष्ठ वैज्ञानिक (20.11.2012 से अस्थाई स्थानांतरण पर) |
| श्री एम सुन्दराराजन | वैज्ञानिक |
| डॉ एस वी शुक्ला | वैज्ञानिक |
| डॉ ए श्रीनिवासन | वैज्ञानिक |
| डॉ के पी सुरेन्द्रन | वैज्ञानिक |
| डॉ सजु पिल्लै | वैज्ञानिक |
| डॉ (सुश्री) एम वसुंधरा | वैज्ञानिक |
| श्री एस वेलुसामी | प्रिंसिपल तकनीकी अधिकारी |
| श्री एम ब्रह्माकुमार | प्रिंसिपल तकनीकी अधिकारी |
| डॉ वी एस प्रसाद | प्रिंसिपल तकनीकी अधिकारी |
| श्री के के रविकुमार | वरिष्ठ तकनीकी अधिकारी(3) |
| श्रीमती लूसी पॉल | वरिष्ठ तकनीकी अधिकारी(3) |
| श्री पी पेरुमाल | वरिष्ठ तकनीकी अधिकारी(2) |
| श्री पी गुरुसामी | वरिष्ठ तकनीकी अधिकारी(2) |
| 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 |
| श्री वी आन्टणी | तकनीशन ग्रेड 2-3 |
| श्री वी श्रीकण्डन | तकनीशन ग्रेड 1-4 |

## प्रक्रिया इंजिनीयरिंग तथा पर्यावरण प्रौद्योगिकी प्रभाग

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| श्री पी राघवन | मुख्य वैज्ञानिक तथा प्रधान ( 31.05.2012 को सेवानिवृत्त) |
| डॉ (श्रीमती) रोशन शशिकुमार | मुख्य वैज्ञानिक तथा प्रधान |
| श्री अजित हरिदास | मुख्य वैज्ञानिक |
| डॉ (श्रीमती) एस सावित्री | वरिष्ठ प्रिंसिपल वैज्ञानिक |
| डॉ (श्रीमती) एलिज़बत जेकब | वरिष्ठ प्रिंसिपल वैज्ञानिक |
| श्री जे.अंसारी | वरिष्ठ प्रिंसिपल वैज्ञानिक |
| डॉ वी बी मणिलाल | प्रिंसिपल वैज्ञानिक |
| डॉ (श्रीमती) रुग्मिणी सुकुमार | प्रिंसिपल वैज्ञानिक |
| डॉ एम अंबू | प्रिंसिपल वैज्ञानिक |
| डॉ बी कृष्णकुमार | वैज्ञानिक |
| श्री अब्दुल हलीम बी | वैज्ञानिक |
| श्री के रिशि अरविंद | वैज्ञानिक |
| श्रीमती विजयाप्रसाद | वरिष्ठ तकनीकी अधिकारी -2 |
| श्री वी के षाजिकुमार | वरिष्ठ तकनीकी अधिकारी |
| डॉ एस रामस्वामी | तकनीकी अधिकारी |
| श्री टी पी पौलोस | तकनीशियन ग्रेड 2-4 |
| श्रीमती सहरूबा पी एम | कनिष्ठ तकनीकी सहायक |

# एस एंड टी सेवा प्रभाग

## सिविल इंजीनियरिंग एवं एस्टेट प्रबंधन प्रभाग

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| श्री पी जे वर्गीस | वरिष्ठ अधीक्षण इंजीनियर (30.04.2012 को स्थानांतरित) |
| श्री आर राजीव | अधीक्षक इंजिनीयर |
| श्री के वी उण्णिकृष्णन | अधीक्षक इंजीनियर ( 31.12.2012 को सेवानिवृत्त) |
| श्री के प्रसाद | सहायक कार्यपालक इंजीनियर( इलेक्ट्रिकल) |
| श्री जी चन्द्रबाबु | सहायक कार्यपालक इंजिनीयर (सिविल) |
| श्री बी कार्तिक | कनिष्ठ इंजिनीयर(सिविल) |
| श्री पी अरुमुखम | कनिष्ठ इंजीनियर(सिविल) |
| श्री बशीर टी एच | वरिष्ठ तकनीशियन |
| श्री एन सुधिलाल | तकनीशियन ग्रेड 2-5 |
| श्री एस हरिदासन पिल्लै | तकनीशियन ग्रेड 2-4 |
| श्री पी एम राघवन | तकनीशियन ग्रेड 2-4 |
| श्री पी वी तम्पी | तकनीशियन ग्रेड 2-4 |
| श्री एन जे जेकब | तकनीशियन ग्रेड 2-4( 28.02.2013 को सेवानिवृत्त) |
| श्री एम.जयदीप | तकनीशियन ग्रेड 2-2 |
| श्री के एस प्रमोद | तकनीशियन ग्रेड 2-1 |
| श्री के सुरेश कण्णन | तकनीशियन ग्रेड 2-1 |
| श्री यु.धरणीपति | तकनीशियन ग्रेड 2-1 |
| श्री बी.विक्रमन | तकनीशियन ग्रेड 1-4 |
| श्री सी पी नारायणन | तकनीशियन ग्रेड 1-4 |
| श्री पी सोमन | तकनीशियन ग्रेड 1-4 |
| श्री आर सुकुमारन | तकनीशियन ग्रेड 1-4 |
| श्री टी वी सतीश | ग्रेड सी गैर तकनीकी(एमएसीपी) |

## नॉलिज रिसोर्स सेंटर

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| श्रीमती पी निशी | वरिष्ठ प्रिंसिपल वैज्ञानिक तथा प्रधान |
| श्रीमती संतोश बाबु | प्रिंसिपल वैज्ञानिक तथा प्रधान (31.08.2012 को सेवानिवृत्त) |
| श्री वी मणी | वैज्ञानिक |
| श्री रिबिन जोन्स एस बी | वैज्ञानिक |
| श्रीमती एस मिनि | प्रिंसिपल तकनीकी अधिकारी |
| श्री एम रामसामि पिल्लै | प्रिंसिपल तकनीकी अधिकारी |
| श्री एस पुश्किन | तकनीकी अधिकारी |
| श्री जी सुधाकरन | तकनीशियन ग्रेड 2-4 |
| श्री जी नागश्रीनिवासु | वरिष्ठ तकनीशिन(2) |
| सुश्री टी एस लता | सहायक(सा) ग्रेड II (एमएसीपी) |
| श्री पुष्पाकुमार के आर नायर | ग्रेड सी गैर तकनीकी |

# योजना तथा व्यवसाय विकास प्रभाग

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| डॉ वी जी मोहनन नायर | मुख्य वैज्ञानिक |
| डॉ सी चन्द्रशेखरा भट्ट | वरिष्ठ प्रिंसिपल वैज्ञानिक |
| श्री डी भीमेश्वर | प्रिंसिपल वैज्ञानिक |
| श्री चन्द्राकान्त सी के | वरिष्ठ वैज्ञानिक |
| श्री आर एस प्रवीण राज | वैज्ञानिक |
| डॉ एम शंकरानारायणन | प्रिंसिपल तकनीकी अधिकारी |
| श्रीमती वी जे सरोजाकुमारी | वरिष्ठ आशुलिपिक(एमएसीपी) |
| श्री के सी चाक्को | ग्रेड सी गैर तकनीकी |

## प्रशासन

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| श्री एन एस राजु | प्रशासन अधिकारी |
| श्रीमती एस शोभना | प्रशासन अधिकारी |
| श्री के एफ जोसफ | अनुभाग अधिकारी(सा) |
| श्रीमती के एस लतीदेवी | हिन्दी अधिकारी |
| श्री टी जे बाबु | सुरक्षा अधिकारी |
| डॉ विजयनाथ आर | चिकित्सा अधिकारी |
| श्री एम के शिवदासन | सहायक(सा) ग्रेड। |
| श्रीमती सिसिली पौलोस | सहायक(सा) ग्रेड। |
| श्री वी मोहनन नायर | सहायक(सा) ग्रेड। |
| श्रीमती ज्योति आर.तम्पी | सहायक(सा) ग्रेड।। |
| श्री जी.रामभद्रन | सहायक(सा) ग्रेड।। |
| श्रीमती मेर्सी जोसफ | सहायक(सा) ग्रेड।। |
| श्री आर के रमेशकुमार | सहायक(सा) ग्रेड।। |
| श्रीमती सूसन मैथ्यू | सहायक(सा) ग्रेड।। ( 31.10.2012 को सेवानिवृत्त) |
| श्रीमती पार्वती राजीवन | सहायक ग्रेड। |
| श्री डी.जयप्रसाद | सहायक(सा) ग्रेड।।(एमएसीपी) |
| श्रीमती के सरस्वति | सहायक(सा) ग्रेड।।(एमएसीपी) |
| श्रीमती पद्मिनी पी एस | वरिष्ठ आशुलिपिक(एमएसीपी) |
| श्रीमती एलिज़बेत थॉमस | वरिष्ठ आशुलिपिक (एमएसीपी) |
| श्रीमती श्रीलता नायर | वरिष्ठ आशुलिपिक(एमएसीपी) |
| श्री बी वेणुगोपाल | तकनीशियन ग्रेड 2-4 |
| श्री पी सुरेन्द्रन | तकनीशियन ग्रेड 2-4(30.06.2012 को सेवानिवृत्त) |
| श्री पी.एन.शिवनकुट्टि नायर | तकनीशियन ग्रेड 2-4 |
| श्री प्रवीण कण्णाल | तकनीशियन ग्रेड 2-2 |
| श्री बी.राधाकृष्णन | तकनीशियन ग्रेड 2-1 |
| श्री एम.पी.वर्की | तकनीशियन ग्रेड 1-4 |
| श्रीमती एम.गीता | तकनीशियन ग्रेड 1-3 |
| श्री शशिधरन | बेयरर(एसीपी) |
| श्री के मधु | ड्राइवर |

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| श्री ए श्रीकुमारन | सफाईवाला(एसीपी) |
| श्रीमती एस लीलादेवी अम्मा | ग्रुप सी गैर तकनीकी |
| श्री के उण्णिकृष्णन | ग्रुप सी गैर तकनीकी |
| श्री बी सतीशकुमार | ग्रुप सी गैर तकनीकी |

## वित्त एवं लेखा विभाग

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| श्री टी वी शंकरन | वित्त एवं लेखा नियंत्रक |
| श्रीमती पी वी विजि | अनुभाग अधिकारी(वित्त एवं लेखा) |
| श्री कृष्णकुमार एम | अनुभाग अधिकारी(वित्त एवं लेखा) |
| श्री संजीव सदानन्दन | सहायक (सा)ग्रेड। |
| श्री के जी पिल्लै | सहायक(वित्त एवं लेखा) ग्रेड। |
| श्रीमती रमणी देवराज | सहायक(वित्त एवं लेखा) ग्रेड। |
| श्रीमती जी.गीता | सहायक(वित्त एवं लेखा) ग्रेड। |
| श्रीमती कोमला सोमन | सहायक(वित्त एवं लेखा) ग्रेड।। |
| श्री एस राजु | वरिष्ठ आशुलिपिक(एसीपी) |
| श्री पी परमेश्वरन पिल्लै | ग्रुप सी गैर तकनीकी |
| श्रीमती आर रमादेवी | रेकॉर्ड कीपर |

## भण्डार एवं क्रय

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| श्री एम आर देवासीस | भण्डार एवं क्रय अधिकारी |
| श्री संजय सुमन | अनुभाग अधिकारी |
| श्री के सतीशन नायर | सहायक(भण्डार एवं क्रय) ग्रेड।( 31.03.2013 को सेवानिवृत्त) |
| श्री सी एम कृष्णदास | सहायक(भण्डार एवं क्रय) ग्रेड। |
| श्री एम अनिलकुमार | सहायक(भण्डार एवं क्रय) ग्रेड।। |
| श्रीमती एल लता | तकनीशियन ग्रेड 2-4 |
| श्री बी अजयकुमार | तकनीशियन ग्रेड 2-3 |
| श्री टी आर सुरेश कुमार | वरिष्ठ तकनीशिन-2 |
| श्री टीके गोपि | ग्रुप सी गैर तकनीकी |
| श्री टी के घोष | ग्रुप सी गैर तकनीकी |
| श्री जी भक्तवल्सलम | ग्रुप सी गैर तकनीकी |

## राष्ट्रीय प्रौद्योगिकी दिवस समारोह

सीएसआईआर- एनआईआईएसटी में 11 मई, 2012 को राष्ट्रीय प्रौद्योगिकी दिवस मनाया गया । श्री नारायण मूर्ति, निदेशक के वरिष्ठ सलाहकार, वीएसएससी, तिरुवनंतपुरम समारोह में मुख्य अतिथि थे । श्री. नारायणन मूर्ति ने इसरो की प्रतिष्ठित परियोजनाओं -जीएसएलवी और पीएसएलवी के भीतर "जोखिम प्रबंधन" पर राष्ट्रीय प्रौद्योगिकी दिवस व्याख्यान दिया। उन्होंने


श्री. नारायण मूर्ति, निदेशक के वरिष्ठ सलाहकार, वीएसएससी, च्जोखिम प्रबंधनछ पर राष्ट्रीय प्रौद्योगिकी दिवस व्याख्यान देते हुए

अपने व्याख्यान में एक संगठन में किसी भी अप्रत्याशित घटना में अपनाई जाने वाली मानक संचालन प्रक्रियाओं पर प्रकाश डाला । सीएसआईआर - एनआईआईएसटी के छात्रों और अनुसंधान समूहों ने व्याख्यान में भाग लिया ।

## संस्थान में सीएसआईआर स्थापना दिवस मनाया गया

आईएनएई विशिष्ट प्रोफेसर और सीएसआईआर - आईआईसीटी के पूर्व निदेशक डॉ. के.वी. राघवन सीएसआईआर- एनआईआईएसटी में स्थापना दिवस समारोह के मुख्य अतिथि थे । अपने स्थापना दिवस व्याख्यान में उन्होंने पिछले 70 वर्षों के सीएसआईआर के योगदान का जिक्र किया । समाज और भारतीय उद्योग के लिए सीएसआईआर के योगदान पर प्रकाश डालते हुए उन्होंने श्रोतागणों को याद दिलाया है कि सीएसआईआर ने लगभग 50,000 कंपनियों के साथ भागीदारी की हैं और इसके 4500 से अधिक पेटेंट हैं । विभिन्न पंचवर्षीय योजनाओं के लक्ष्य प्राप्त करने में सीएसआईआर द्वारा निभाई गई भूमिका की ओर भी उन्होंने ध्यान दिलाया । 12वीं पंचवर्षीय योजना का प्रमुख उद्देश्य जोकि नवाचारों को बढ़ावा देना है, तभी हासिल किया जा सकता है जब सीएसआईआर अपनी ध्यान प्रक्रिया उन्मुख अनुसंधान से उत्पादों की ओर बदलेगी । उन्होंने कहा कि हमारे देश से कम संख्या में पेटेंट फाइलिंग एक चिंता का विषय है । उन्होंने एनआईआईएसटी के वैज्ञानिकों से आग्रह किया कि आला क्षेत्रों, जहां प्रयोगशाला अंतर्विषयी अनुसंधान में नेतृत्व कर सकती है, की पहचान करें । उन्होंने अपने भाषण में अधिक बौद्धिक संपदा उत्पादों के सृजन की आवश्यकता पर भी ज़ोर दिया । 26 सितंबर 2012 को खुले दिन के रूप में मनाया गया और शैक्षिक संस्थानों से छात्रों के दौरे के लिए भी व्यवस्था की गई थी ।


डॉ. के.वी. राघवन, आईएनएई विशिष्ट प्रोफेसर और सीएसआईआर - आईआईसीटी के पूर्व निदेशक सीएसआईआर स्थापना दिवस व्याख्यान देते हुए

## एनआईआईएसटी स्थापना दिवस मनाया गया

एनआईआईएसटी के स्थापना - दिवस समारोह में सीएसआईआर के महानिदेशक प्रो. समीर के. ब्रह्मचारी मुख्य अतिथि थे । सीएसआईआर - एनआईआईएसटी परिवार को संबोधित करते हुए प्रो.ब्रह्मचारी ने कहा कि सीएसआईआर - एनआईआईएसटी सहित सीएसआईआर की कई प्रयोगशालाओं ने वर्षों से अनुप्रयुक्त और बुनियादी

अनुसंधान पर एक प्रमुख भूमिका निभाते हुए उत्कृष्टता के केन्द्रों की स्थिति हासिल की है । यह समय की मांग है कि समुद्र तट के निकट स्थित सीएसआईआर प्रयोगशालाओं द्वारा भोजन, ऊर्जा और उत्पादों के लिए कच्चे माल के एक संभावित स्रोत के रूप में शैवाल जैसे समुद्री संसाधनों के उपयोग पर अपना अनुसंधान केंद्रित करके प्रौद्योगिकी विकसित करें। प्रो.ब्रह्मचारी ने सीएसआईआर विज़न- 2022 दस्तावेज के हिंदी और मलयालम संस्करण विमोचित किये। उन्होंने एनआईआईएसटी की अत्याधुनिक फोटोनिक्स और फोटोसाइन्स प्रयोगशाला का उद्घाटन भी किया।

अपने स्थापना दिवस व्याख्यान में उन्होंने अंतरराष्ट्रीय प्रकाशनों और सामाजिक माल के वितरण के मामले में अपनी सराहनीय उपलब्धियों के लिए प्रयोगशाला की बधाई की । उन्होंने बताया कि सीएसआईआर-एनआईआईएसटी के आउटरीच कार्यक्रम ने ओएसडीडी मंच के माध्यम से हमारे देश सहित विकासशील देशों को प्रभावित करनेवाले स्वास्थ्य खतरों को निपटाने के लिए राज्य के सबसे अच्छे दिमाग की अपार क्षमता का उपयोग किया है । उन्होंने एनआईआईएसटी में महिला वैज्ञानिकों के बड़े अनुपात की सराहना की ।

प्रो समीर के. ब्रह्मचारी, महानिदेशक, सीएसआईआर एनआईआईएसटी में अत्याधुनिक फोटोनिक्स और फोटोसाइंस प्रयोगशाला का उद्घाटन करते हुए

प्रोफेसर समीर के ब्रह्मचारी, महानिदेशक, सीएसआईआर डॉ. सुरेश दास, निदेशक, एनआईआईएसटी को सीएसआईआर विजन -2022 दस्तावेजों का हिंदी और मलयालम संस्करण सौंपाते हुए

## ओपन सोर्स ड्रग डिस्कवरी कार्यक्रम

ओएसडीडी वैश्विक भागीदारी के साथ सीएसआईआर नेतृत्व वाली टीम भारत कंसोर्शियम है । सबसे उत्कृष्ट दिमागों को एक वैश्विक मंच प्रदान करते हुए उनके सहयोग और सामूहिक प्रयासों से मलेरिया, क्षय रोग, लशमनियासिस जैसे उपेक्षित उष्णकटिबंधीय रोगों के लिए नूतन चिकित्सा की खोज के साथ जुड़ी जटिल समस्याओं को हल करके विकासशील देशों के लिए सस्ती स्वास्थ्य सुविधा उपलब्ध कराना इसका उद्देश्य है। यह परियोजना एक पोर्टल पर आधारित है, जिसके द्वारा वैज्ञानिक, डॉक्टर, टेक्नोक्रेट, सॉफ्टवेयर पेशेवर और छात्रों को ज्ञान का साझा करने के लिए एक खुला मंच प्रदान कर सकता है ।

प्रो. समीर के. ब्रह्मचारी के कथन के अनुसार ओपन सोर्स ड्रग डिस्कवरी कार्यक्रम (ओएसडीडी) के तहत क्षयरोग के इलाज के लिए संश्लेषित एक दवा अणु का परीक्षण वर्ष2012 में ही होने की उम्मीद थी । एमएससी के छात्रों, जो ओएसडीडी आउटरीच कार्यक्रम के हिस्सा हैं, को बधाई देते हुए 4 अक्तूबर 2012 को एनआईआईएसटी में आयोजित एक समारोह में बोलते हुए उन्होंने कहा कि वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद् (सीएसआआर) अगले पांच वर्षों में ओएसडीडी के तहत संश्लेषित अणुओं के क्लिनिकल परीक्षण संचालन करने की अपनी योजना के साथ आगे बढ़ेगी ।


प्रो.समीर के.ब्रह्मचारी, महानिदेशक, सीएसआईआर ओएसडीडी कार्यक्रम पर बोलते हुए

सीएसआईआर - एनआईआईएसटी ने केरल के रसायन विज्ञान शिक्षकों की अकादमी के साथ आउटरीच

कार्यक्रम के लिए सहयोग किया है । एनआईआईएसटी के वैज्ञानिकों द्वारा छात्रों को दवा अनुसंधान और परिष्कृत विश्लेषणात्मक उपकरणों के उपयोग में नवीनतम तकनीकों पर प्रशिक्षित दिलाया है । उनके द्वारा टीबी विरोधी दवाओं के रूप में इस्तेमाल किये जाने की क्षमता रखनेवाले कई अणुओं का संश्लेषण किया गया है । डॉ. सुरेश दास, निदेशक, एनआईआईएसटी, डॉ.जाकिर थॉमस ,परियोजना निदेशक- ओएसडीडी, और डॉ. के.वी राधाकृष्णन- समन्वयक, छात्र आउटरीच कार्यक्रम ने समारोह के दौरान श्रोताओं को संबोधित किया ।

## डॉ. कस्तूरी रंगन, सदस्य, योजना आयोग. भारत सरकार के संस्थान का दौरा

डॉ. कस्तूरी रंगन, सदस्य, एस एंड टी, योजना आयोग ने 18.08.2012 को संस्थान का दौरा किया। इस अवसर पर संस्थान के वरिष्ठ वैज्ञानिकों और पदाधिकारियों के साथ चर्चा/ बैठक आयोजित की गयी। संस्थान निदेशक डॉ. सुरेश दास ने वैज्ञानिकों की उपलब्धियों पर प्रकाश डालते हुए संस्थान की विभिन्न गतिविधियों पर एक संक्षिप्त प्रस्तुति दी । डॉ. कस्तूरी रंगन ने भारत सरकार द्वारा विज्ञान तथा प्रौद्योगिकी के लिए दिये महत्व और विज्ञान और प्रौद्योगिकी के बजट की वृद्धि के बारे में विस्तार से बताया। विज्ञान तथा प्रौद्योगिकी और सामाजिक विकास में सबसे आगे रहने के लिए उन्होंने नवीन और प्रतिस्पर्धी होने की जरूरत पर जोर दिया ।

डॉ. कस्तूरी रेगन, वैज्ञानिकॉ/ वरिष्ठ अधिकारियों के साथ चर्चा करते हुए

## जैव - ईंधन केन्द्र का उद्घाटन

जैव प्रौद्योगिकी प्रभाग ने जैव ईंधन के लिए एक केंद्र की स्थापना की है । प्रायोगिक संयंत्र भारत में अपनी तरह का पहला सार्वजनिक क्षेत्र की पहल है और बायोमास से बायोएथेनॉल के उत्पादन के लिए सीएसआईआर एनआईआईएसटी परिसर में यह सुविधा स्थापित की गयी है । परिवहन के लिए एक वैकल्पिक ईंधन के रूप में बायोएथेनॉल के उत्पादन के लिए प्रौद्योगिकी विकास की यह सुविधा, प्रौद्योगिकी सूचना, पूर्वानुमान और विश्लेषण (टाइफैक), विज्ञान तथा प्रौद्योगिकी विभाग एवं वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद् (सीएसआईआर) द्वारा संयुक्त रूप से वित्त पोषित अनुसंधान परियोजना के रूप में प्रारंभ की गयी है। डॉ. टी. रामसामी, सचिव, विज्ञान तथा प्रौद्योगिकी विभाग (डीएसटी), नई दिल्ली द्वारा 23 अप्रैल, 2012 को प्रायोगिक संयंत्र का उद्घाटन किया गया। सीएसआईआर एनआईआईएसटी के निदेशक, डॉ. सुरेश दास ने उद्घाटन समारोह की अध्यक्षता की। संयंत्र को कृषि अवशेषों तथा वानिकी उत्पादों सहित लिग्नोसेलूलोजिक बायोमास से इथेनॉल उत्पादन के लिए 80 कि.ग्रा./बैच क्षमता है और बायोमास का इथेनॉल के रूप में परिवर्तन में 70 प्रतिशत की क्षमता है। उत्पादन की प्रक्रिया तीन बुनियादी चरणों के माध्यम से होती है - पूर्व उपचार, मुक्त शक्कर का उत्पादन करने के लिए एंजाइमी हाइड्रोलिसिस, और इथेनॉल के लिए शर्करा का किण्वन ।

जैव ईंधन केन्द्र ने बायोमास आधारित ब्यूटेनॉल के उत्पादन तथा शैवाल जैव ईंधन पर भी गतिविधियों शुरू कर दी है । एनआईआईएसटी-सीएफबी ने अंतर्राष्ट्रीय ऊर्जा एजेंसी (आईईए), फ्रांस के लिए आईईए द्वारा देश-वार जैव ईंधन नीति के विकास के लिए एक अध्ययन जारी किया । केंद्र ने बायोमास आधारित ईंधन और ऊर्जा पर तथा जीवन चक्र पर और तकनीकी आर्थिक विश्लेषण पर उन्नत अध्ययन के लिए अंतरराष्ट्रीय विश्वविद्यालयों और संस्थानों के साथ सहयोग की शुरुआत की है । केन्द्र द्वारा जैव ईंधन और जैव ऊर्जा के क्षेत्र में ज्ञान और कुशल मानव शक्ति के विकास के लिए प्रशिक्षण की सेवा भी दी जाएगी ।

## " राष्ट्रीय नॉलेज नेटवर्क" पर तकनीकी कार्यशाला

09 -10 मई 2012 के दौरान संस्थान में "राष्ट्रीय ज्ञान नेटवर्क (NKN)" पर दो दिवसीय कार्यशाला का आयोजन किया गया । राष्ट्रीय नॉलिज नेटवर्क, जो देश के सभी नॉलिज आधारित संस्थानों के लिए एकीकृत

हाई स्पीड नेटवर्क समर्थन प्रदान करने के लिए एक अत्याधुनिक मल्टी जिगाबिट-पैन इंडिया नेटवर्क है, के बारे में प्रतिभागियों को शिक्षित करने के लिए राष्ट्रीय सूचना विज्ञान केन्द्र (एनआईसी) द्वारा यह तकनीकी कार्यशाला आयोजित की गयी थी । संस्थानों के आंतरित नेटवर्क के माध्यम से एनकेएन के एकीकरण के लिए कार्यप्रणाली को सोदाहरण स्पष्ट करना और तकनीकी सत्र की एक श्रृंखला के माध्यम से अन्य नेटवर्क से संबंधित विषयों पर चर्चा करके एक अधिक प्रभावी और एन्हांस्ड ढंग से एनकेएन की सेवाओं का उपयोग करने में संस्थाओं को सक्षम बनाना कार्यशाला के आयोजन का उद्देश्य था ।


श्री. पी.एच. कुरियन आईएएस, प्रधान सचिव, सूचना प्रौद्योगिकी विभाग, केरल और तथा पूर्व महानियंत्रक के पेटेंट्स, भारत, कार्यशाला में उद्घाटन भाषण दे रहे है

श्री पी.एच. कुरियन आईएएस, प्रधान सचिव, सूचना प्रौद्योगिकी विभाग, केरल और तथा पूर्व महानियंत्रक, पेटेंट्स, भारत, ने कार्यशाला का उद्घाटन किया । नई दिल्ली से एक वीडियो कॉन्फ्रेंन्स नेटवर्क पर उद्घाटन समारोह को संबोधित करते हुये भारत सरकार के प्रमुख वैज्ञानिक सलाहकार और एनकेएन की उच्च स्तरीय समिति के अध्यक्ष श्री आर चिदंबरम ने कहा कि देश के भीतर और विदेशों में वैज्ञानिकों के बीच के सहयोग को बढ़ावा देने के लिए तथा ज्ञान के आदान- प्रदान के लिए एक मंच प्रदान करने के लिए एनकेएन का डिजाइन किया गया था । प्रो. एस.वी राघवन, तकनीकी सलाहकार समिति के अध्यक्ष, एनकेएन, डॉ. बी.के. गैरोला, महानिदेशक, राष्ट्रीय सूचना विज्ञान केन्द्र (एनआईसी), डॉ. सुरेश दास, निदेशक, सीएसआईआर-एनआईआईएसटी और डॉ. के.एस रमन, राज्य सूचना विज्ञान अधिकारी, एनआईसी, उद्घाटन समारोह में वक्ता थें। उद्घाटन दिवस के दौरान दो तकनीकी सत्र और अगले दिन पर और दो तकनीकी सत्र आयोजित किए गए ।

## क्युस्टल ओर्बिट (क्युपीएटी) का उपयोग करके पेटेंट खोज और मैपिंग पर प्रशिक्षण कार्यक्रम

संस्थान के वैज्ञानिकों, शोधकर्ताओं और छात्रों के लाभार्थ यह कार्यक्रम 11 मई 2012 को आयोजित किया गया । सिद्दहास्ट आईपी नवाचार, नई दिल्ली के प्रबंध निदेशक श्री रोशन अग्रवाल प्रशिक्षण कार्यक्रम में आमंत्रित वक्ता थे । बौद्धिक संपदा (आईपीआर) के क्षेत्र में अपने विशाल अनुभव और ज्ञान के साथ श्री रोशन अग्रवाल ने रासायनिक और जैव विज्ञान खोजों पर विशेष जोर देते हुए क्युस्टल क्युप्ट डेटाबेस और ऑर्बिट प्लैटफार्म पर प्रशिक्षण दिया

श्री रोशन अग्रवाल, प्रबंध निदेशक, सिद्दहास्ट आईपी नवाचार, नई दिल्ली पेटेंट्स और उनके महत्व पर व्याख्यान देते हुए

## अनुसंधान योजना और व्यावसायीकरण के लिए पेटइन्फोर्मेटिक्स पर कार्यशाला

दिनांक 23-24 अगस्त 2012 के दौरान पेटइन्फोर्मेटिक्स,जो एक नयी उभरती वैज्ञानिक शाखा है, जिसमें संबंध और प्रवृत्तियों की खोज के लिए पेटेंट डेटा के सेट का विश्लेषण शामिल है, पर कार्यशाला आयोजित की गयी । सीएसआईआर - यूआरडीआईपी से डॉ. आर.आर. हिरवानी, सुश्री शिवकामी धुलाप और श्री निषाद देशपांडे जैसे प्रख्यात वैज्ञानिक इस कार्यशाला के आमंत्रित वक्ता थें। सीएसआईआर - एनआईआईएसटी से वैज्ञानिकों, अनुसंधान फेलो और छात्रों ने कार्यशाला में भाग लिया।

## स्वास्थ्य जागरूकता व्याख्यान और नि:शुल्क चिकित्सा जांच का आयोजन

एनआईआईएसटी स्टाफ मनोरंजन क्लब ने 26 सितंबर 2012 को केरल मेडिकल साइंसेस संस्थान (केआईएमएस) अस्पताल, तिरुवनन्तपुरम के सहयोग में एक स्वास्थ्य जागरूकता व्याख्यान और नि: शुल्क चिकित्सा जांच का आयोजन किया। केआईएमएस अस्पताल से डॉ प्रवीण श्रीकुमार ने "हृदय रोगों के कारण, रोकथाम, लक्षण और हृदय रोग के उपचार" पर एक बहुत जानकारीपूर्ण व्याख्यान दिया। केरल में हृदय रोग के प्रसार 10-12 % और मधुमेह 20% है । उन्होंने यह भी उल्लेख किया है कि केरल में होने वाली मौतों के 40-50% हृदय रोगों के कारण होते हैं । इसके बाद एक जीवंत इंटरैक्टिव सत्र का आयोजन भी किया गया । दोपहर में नि:शुल्क चिकित्सा जांच आयोजित की गयी । 154 व्यक्तियों के रक्त शुगर, रक्तचाप और बॉडी- मास इंडेक्स (बीएमआई) की जांच की गई ।

किम्स अस्पताल से डॉ. प्रवीण श्रीकुमार हृदय रोगों के कारण, रोकथाम, लक्षण और उपचार घ्पर जानकारीपूर्ण भाषण देते हुए

## अनुसंधान पत्रिकाओं में कैसे प्रकाशन पा सकते हैं पर कार्यशाला

30 नवंबर 2012 को मेसेर्स एल्सेविएर विज्ञान के साथ सहयोग में विद्वत्तापूर्ण संचार प्रक्रिया के विभिन्न पहलुओं पर शोधकर्ताओं को प्रशिक्षण और जानकारी देने के लिए एक पब्लिशिंग कनेक्ट कार्यशाला आयोजित की गयी। एनआईआईएसटी के वैज्ञानिकों और छात्रों के अलावा तिरुवनंतपुरम के विभिन्न अनुसंधान संगठनों से संकायों और छात्रों ने कार्यशाला में भाग लिया । डॉ. सुरेश दास, निदेशक, एनआईआईएसटी, ने कार्यशाला का उद्घाटन किया । श्री डेविड स्लीमान, विश्लेषणात्मक रसायन विज्ञान और सेंसर पत्रिकाओं के प्रकाशक ने विद्वत्तापूर्ण प्रकाशन के बारे में बात की और सुश्री प्रियंका नियोगि, बिक्री प्रबंधक, एल्सेविएर ने ओरसिड और स्कोपस पर सत्र चलाया ।

## हिन्दी दिवस/हिन्दी सप्ताह का आयोजन

सीएसआईआर- एनआईआईएसटी में दिनांक 14 सितंबर 2012 को हिंदी दिवस के रूप में तथा बाद के एक सप्ताह को हिंदी सप्ताह के रूप में समुचित ढंग से मनाया गया । हिंदी दिवस का औपचारिक उद्घाटन 14 सितंबर सुबह 9.30 बजे आयोजन समिति के अध्यक्ष डॉ. अशोक पाण्डेय के स्वागत भाषण के साथ प्रारंभ हुआ।


हिंदी दिवस संदेश व उद्घाटन भाषण देते हुए निदेशक डॉ. सुरेश दास


समापन समारोह में अध्यक्षीय भाषण देते हुए डॉ. ए. अजयघोष

संस्थान के निदेशक डॉ. सुरेश दास ने प्रतिभागियों को हिंदी दिवस संदेश दिया और बाद में दीप प्रज्वलित

करके समारोह का औपचारिक उद्घाटन किया। उन्होंने अपने भाषण में बताया कि हिंदी हमारे देश की सबसे बड़ी संपर्क भाषा है। यह देश के अधिकांश लोगों द्वारा पारस्परिक संप्रषण में प्रयुक्त की जाती है। श्री संजय सुमन, अनुभाग अधिकारी (भंडार व क्रय) तथा सदस्य, आयोजन समिति ने "राजभाषा हिंदी- सरल एवं उपयोगी" शीर्षक व्याख्यान प्रस्तुत किया। पूरे सप्ताह के दौरान परियोजना स्टाफ, अनुसंधान छात्र आदि सहित संस्थान के संपूर्ण स्टाफ सदस्यों तथा उनके स्कूली छात्रों के लिए हिंदी निबंध लेखन, हिंदी टिप्पण व आलेखन, तकनीकी रिपोर्ट लेखन, हिंदी गीत प्रतियोगिता, हिंदी अंताक्षरी, हिंदी प्रश्नोत्तरी, हिंदी अनुवाद जैसे अनेक प्रतियोगिताएं आयोजित की गईं। समापन समारोह व पुरस्कार वितरण दिनांक 21.9.2012 शाम को 4.30 बजे आयोजित किया गया। यूनिवर्सिटी कॉलेज, तिरुवनंतपुरम के पूर्व प्राध्यापक एवं, हिन्दी विभाग के प्रमुख, तथा केरल हिन्दी प्रचार सभा तिरुवनन्तपुरम के स्नातकोत्तर एवं रिसर्च सेंटर के प्रधानाचार्य डॉ. पी.जे. शिवकुमार समारोह में मुख्य अतिथि थे।


श्री ए.हेमचन्द्रन, आईपीएस, अपर महा निदेशक, पुलिस मुख्यालय समापन भाषण देते हुए

## सतर्कता जागरूकता सप्ताह (29 अक्तूबर से 4 नवंबर 2012 तक) का आयोजन

संस्थान में तारीख 29 अक्तूबर से 4 नवंबर 2012 तक सतर्कता जागरूकता सप्ताह आयोजित किया गया । सतर्कता जागरूकता सप्ताह का प्रारंभ हिंदी और अंग्रेजी दोनों भाषाओं में सतर्कता जागरूकता प्रतिज्ञा दिलाने के साथ हुआ । पूरे सप्ताह में स्टाफ सदस्यों एवं अनुसंधान छात्रों के लिए निबंध लेखन, वक्तृता, कार्टून चित्रण तथा नारा लेखन पर प्रतियोगितायें चलाई गयीं। 2 नवम्बर 2012 को समापन समारोह तथा पुरस्कार वितरण संपन्न हुआ। डॉ. ए.अजयघोष, निदेशक-प्रभारी ने समारोह की अध्यक्षता की। श्री ए.हेमचन्द्रन, आईपीएस, अपर महा निदेशक - पुलिस मुख्यालय समापन समारोह में मुख्य अतिथि थे। उन्होंने समापन भाषण दिया और विभिन्न प्रतियोगिताओं के विजेताओं को पुरस्कार प्रदान किए गए।

## एनआईआईएसटी "नीर परियोजना" का उद्घाटन किया गया

ओणम समारोह के दौरान अगस्त 24, 2012 को संस्थान में पूरी तरह से स्वचालित पीने के पानी का संयंत्र स्थापित किया गया। संयंत्र से पीने का शुद्ध पानी उपलब्ध होता है, जिसे "निस्ट नीर" नाम दिया गया । संयंत्र में रिवर्स परासरण और यूवी उपचार प्रौद्योगिकी का इस्तेमाल होता है। पीने के पानी की गुणवत्ता विश्व स्वास्थ्य संगठन के मानकों का पालन करता है। संयंत्र को 50% की दक्षता के साथ प्रति घंटा 500 लीटर पानी की क्षमता है। इस सुविधा से अब पीने के पानी की आपूर्ति के लिए संस्थान बाहरी एजेंसी से छुटकारा द्वारा सरकारी खजाने पर काफी बचत करता है।

पैक्ड पेयजल संयंत्र का उद्घाटन करते हुए डॉ. सुरेश दास, निदेशक, एनआईआईएसटी

## एनआईआईएसटी डिस्पेंसरी का उद्घाटन

संस्थान परिसर में औषधालय खोलने के स्टाफ सदस्यों और पेंशनरों के लंबे समय का दुलारा सपना 21 दिसंबर 2012 को पूरा हो गया। संस्थान की अनुसंधान परिषद् के अध्यक्ष डॉ. दिबंकर बनर्जी ने 21 दिसंबर

2012 को एनआईआईएसटी डिस्पेंसरी का औपचारिक उद्घाटन किया। चिकित्सा अधिकारी की भर्ती औषधालय के उद्घाटन से पहले ही की गयी थी। औषधालय की सुविधाएं संस्थान के रिसेर्च स्कोलेर्स, स्टाफ सदस्य तथा पेंशनभोगियों और उनके परिवारों के लिए उपलब्ध होंगी।

डॉ. दिबंकर बनर्जी, अध्यक्ष, प्रबंधन परिषद् एनआईआईएसटी डिस्पेंसरी का औपचारिक उद्घाटन करते हुए

## एनआईआईएसटी में ओणम महोत्सव

पिछले वर्षों जैसे, बड़े उत्साह के साथ, संस्थान में केरल के सबसे लोकप्रिय त्योहार, ओणम मनाया गया। ओणम, प्राचीन काल में केरल के शासन किये महान राजा, राजा महाबली की घर वापसी को चिह्नित करता है । संस्थान में इस दौरान कई गतिविधियॉ/ प्रतियोगिताएं आयोजित की गयीं जैसे अत्तपूक्कलम, ओणपाट्टुकल, वंचिपाट्टुकल, टग-ऑफ-वार, आदि । कलाकारों द्वारा बाघों के रूप में ड्रस- अप करके निष्पादित पुलिकली समारोह का सबसे आकर्षक आइटम था । स्टाफ सदस्यों को कैंटीन में स्वादिष्ट दावत भी उपलब्ध कराया गया ।


ओणम महोत्सव के अवसर परसंस्थान में आयोजित विभिन्न गतिविधियों की एक झलक