

Annual Report 2007-08



National Institute for Interdisciplinary Science & Technology
Thiruvananthapuram



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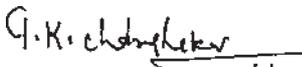
FOREWORD



It is a pleasure for me to present the Annual Reeport of the Institute for the period 2007-08. This is a very momentous and productive year for the Institute in several aspects;

- a) The Institute was transformed from Regional Research Laboratory (RRL) to National Institute for Interdisciplinary Science & Technology (NIIST) ;
- b) A major chilly processing plant was dedicated to Nation on 21-3-08 by Hon'ble Minister for Commerce Shri Kamal Nath based on the technology developed in the laboratory in Byadgi Karnataka.;
- c) A technology package on production of synthetic rutile from illmenite was handed over to Cochin Minerals & Rutiles Ltd. By DG, CSIR as a part of technology transfer;
- d) The Institute has received the second Shanti Swarup Bhatnagar Prize in Chemical Sciences for the year 2007;
- e) The first CSIR young scientist award was received in the Institute in the area of chemical sciences.

This year we have published 210 SCI research papers with an average impact factor of 2.57 which is significantly higher than CSIR Average. An ECF of 8.07 lakhs per scientist and an average of 2.67 research papers per scientist are achieved for the year. On the infrastructure front, a High Resolution 500 MHz NMR facility has been created to cater the needs of our Chemical Sciences and Agroprocessing Divisions. Overall this year has been particularly productive which is apparent from the R&D highlights presented in this report. I congratulate all the staff members who have made this possible and happy that they will strive hard to sustain this growth in the coming years.



Prof. T. K. Chandrashekar

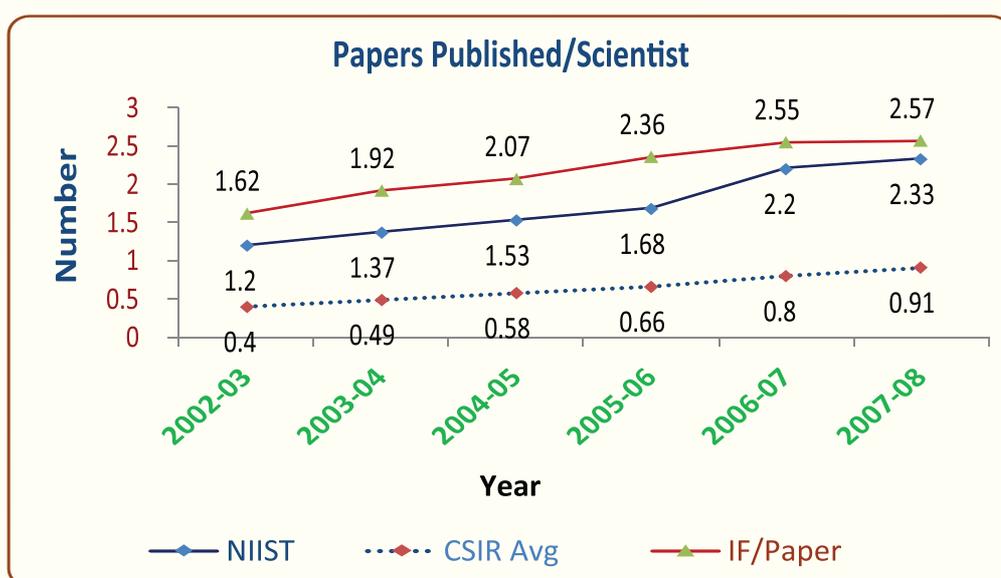




HIGHLIGHTS OF NIIST ANNUAL REPORT 2007-08

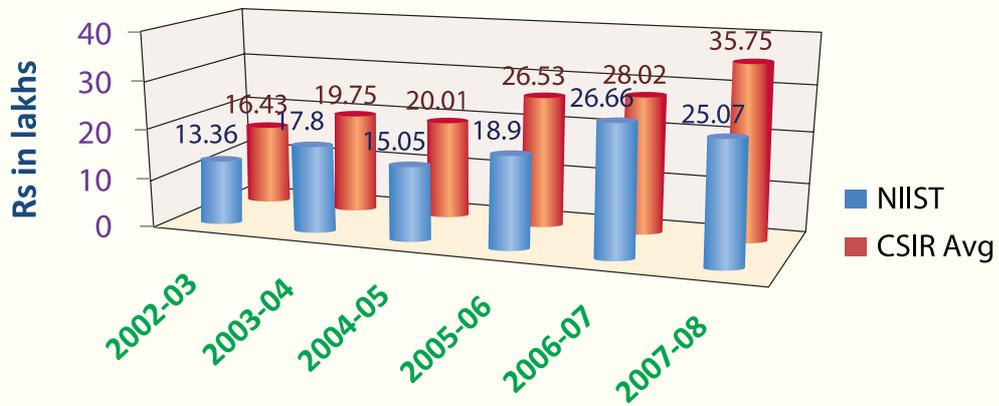
The first year of the Eleventh Five Year Plan was one of most productive years for the Institute. Initiatives taken for the technological up-gradation of the R&D facilities, creation of state-of-art infrastructure, quality systems, reorganization of divisions, and introduction of innovative and trained youngsters during the last few years started yielding fruits. In terms of quality publications and SCI papers per scientist, the Institute now ranks at position two among the CSIR labs in its performance. The analysis for the period 2002-2008 showed that it performed well with lower budgetary support per scientist, in terms of number of high impact factor publications (890 numbers with average IF more than 2 per paper), patents filed (79 US), generation of ECF (more than Rs 48 crores), etc.

The Institute obtained approvals for six network projects and one project each under supra-institutional, inter agency and societal categories from the Planning Commission for implementation during the XI Five Year Plan at a total cost of Rs. 24.63 crores. Collaborations continued with national and international research organizations, academic institutions and industries. A major project on development of novel infrared absorbing molecules and complexes for photodynamic therapy of cancer and related diseases in collaboration with CCMB & RGCN with financial support of DST under the national initiative on metal based drugs was also initiated during this year.

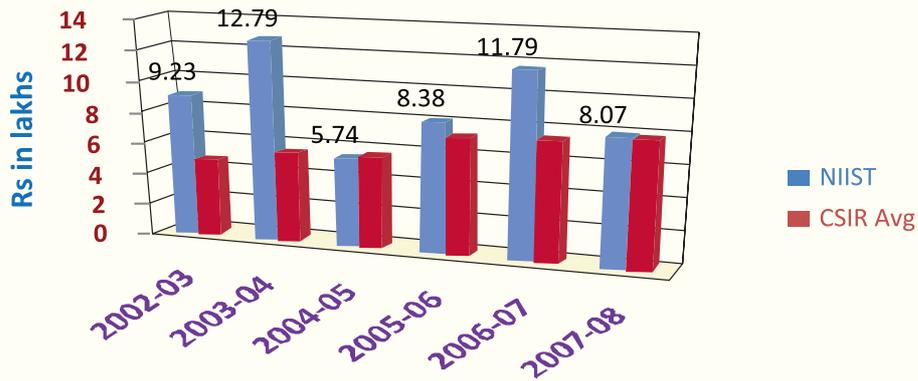




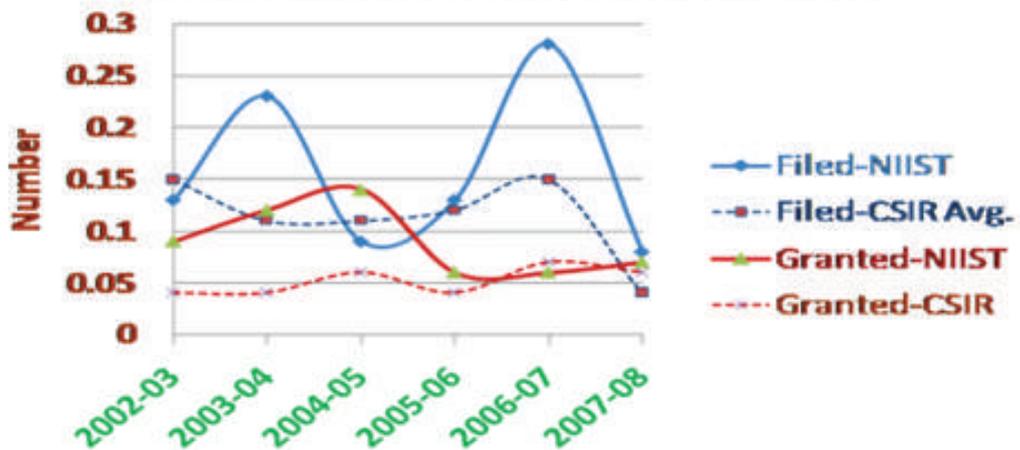
Budget Support per Scientist



ECF per Scientist



Patents Filed & Granted per Scientist





Highlights

R&D output and its commercialization

One of the major technological achievements was the handing over of the technology for the commercialization of a new process for the production of synthetic rutile from ilmenite to Cochin Minerals and Rutile Limited (CMRL) by Prof. S.K. Brahmachari, Director General, CSIR at a function organized at NIIST on January 16, 2008 in the presence of the Director and Scientists involved in the development of technology. This is one of the biggest technology transfers in the history of CSIR taking into view the capacity of production, level of investment, environment impact and quantum of royalty payable.



DG handling over technology document to CMRL

As a part of the institutional efforts to commercialize the know-how developed in house, the laboratory took up the task of setting up a 20 TPD fresh chilli processing facility at Byadgi for M/S STCL, Karnataka. This facility was set up at a cost of Rs 2.5 crores and is the first such unit to come up in the country for processing fresh chilli. Minister of State for Trade and Commerce, Govt. of India, Shri Jayaram Ramesh dedicated the processing plant to the nation on March 21, 2008. The Byadgi variety of chilli is known for its high colour due to the presence of carotenoids which are light sensitive. The technology ensures the drying operation in 20 minutes at controlled conditions to ensure higher carotenoid retention along with pre-washing which removes surface pesticide and dirt adhering to the material. The product fetches higher price giving better return to the farmers.

Two commercial plants of capacity 50 tons per day red palmolein were established through project engineering companies based on the technology developed by laboratory. In these plants, refining process is carried out under controlled conditions so that more than 75% of the micro nutrients



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are retained in the end product unlike in the normal refining process where all the micro nutrients present in palm oil is lost. The contribution is significant to the society since Red palmolein is rich in β -carotene, tocopherols and toco trienols. This can be used as a nutritional oil to address vitamin A deficiency problem. This programme was supported by Technology Mission on Oilseeds and Pulses (TMOP) and each plant provides direct employment to about 30 people.

An agreement for technology transfer and licensing of knowhow for setting up of an integrated spice processing facility in the state of Sikkim was signed with Horticulture and Cash Crops Development Department, Government of Sikkim. Similar technology transfer agreements were also signed with entrepreneurs in Arunachal Pradesh and Mizoram.

A new software was developed to overcome the limitation of the simulation software developed earlier by the Institute, *Virtual Casting*. The new software called *Virtual Feed*, creates a simulation-based initial design of feeders by integrating the complementary strengths of the rigorous heat transfer analysis of *Virtual Casting* and practically derived design rules. A novel pattern recognition algorithm divides the casting into clusters each cluster being a "feeding section" requiring a separate feeder. From the volume and modulus of a feeding section, the size of the feeder is calculated. For every feeding section, a genetic algorithm finds a class of feeder dimensions such that the yield is maximized. The design can be iteratively refined using further simulations.

A commercial process design has been done to produce 10 TPD of reactive microsilica from a 59 Tons per day (TPD) rice husk processing plant. The process know how was transferred to the sponsor, M/s BMPTC, New Delhi in March 2008. Tests showed that the material produced was an excellent pozzolan for the concrete particularly for its chloride ion resistance. The cost analysis showed that the process was economically viable.

A zero-discharge process was developed for parboiled rice mills pilot plant was set up by Kalady Rice Mill Consortium Ltd., at Pavizham Rice Mill in Kalady. Twelve successive batches of paddy were evaluated and the rice quality was unaffected in blind tests. A full scale unit is planned based on the pilot tests.

A prototype of all ceramic membrane setup for water filtration was successfully tested at BHEL and the pore size reduction from 1500 nm to <200 nm was achieved by the technique developed in NIIST.



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Al-SiC functionally graded prototype brake rotor discs containing 20% SiC particle were developed by vertical centrifugal casting and successfully road tested by an automobile industry. Structural integrity of the disc was very good with closer braking efficiency compared to conventional cast iron disc.

A new class of soft materials was designed which emit light of different colors. These gels are ideal scaffolds for the design of supramolecular light- harvesting assemblies and are potential two-photon-absorbing materials, which could open the window to a novel class of electronically active soft organic materials with tunable optical properties

MIP micro beads utilizing Dummy Template concept (Chlorendic acid) suitable for detoxification of endosulfan contaminated natural waters were prepared. The methanol washed MIP beads removed endosulphan present in contaminated natural waters down to levels much below the maximum permissible level stipulated by WHO ie. 20 ppb. This concept will be a forerunner for detoxification of other deadly toxins like persistent organic and inorganic pollutants(POP's & PIP's), actual chemical warfare agents(CWA's) and radionuclide.

Novel environmentally secure inorganic pigments by doping praseodymium into CeO_2 matrix of TiCeO_4 were synthesized having colours ranging from white to brick red. The brown red ceramic pigments were found to be interesting alternative to existing toxic pigments for various surface coating applications.

The laboratory's reverse flow natural convection driers have found extensive applications in the rural areas for drying agricultural products. The driers are called RRLT-NC Driers and five models already are being used by farmers, cottage scale units, self employed persons etc for the drying of variety of agricultural and other materials. Presently the laboratory has developed a drier for domestic laundry drying and a modified low cost version for drying rubber sheets. A drier for accelerated drying of coconuts to make ball copra at a scale of 300 numbers of whole coconuts per batch is undergoing repeat trials.

Publications & Patents

During the year the Institute published over 230 research papers in various national and international periodicals and contributed several papers and poster presentations in different seminars/



Highlights

symposia and conferences. The average impact factor increased to 2.57. A few of the publications also appeared as cover page in reputed journals. The success of Institute's innovative approaches was well reflected in filing of 7 foreign and 6 Indian patents and grant of 6 foreign and 11 Indian patents during the reporting year.

Honors and Awards

Several NIIST scientists were awarded by different bodies for their meritorious work and achievements. Prof. T.K. Chandrashekar, Director was awarded CRSI Silver Medal, Dr. A. Ajayaghosh was the recipient of Shanti Swarup Bhatnagar Prize in Chemical Science, Ramanna Fellowship and MRSI Medal 2007, Dr. Ashok Pandey received the Honorary Doctorate Degree from Univ. of Blaise, Pascal, Dr Suresh Das received the MRSI Medal 2007, Dr. K. George Thomas has been elected as Fellow of the Indian Academy of Sciences, Bangalore, Dr. M. Jayakannan received the CSIR Young Scientist Award (Chemical Sci.), Dr. J. Mary Gladis got the Prof. H.J. Arnikar Best Thesis Award" by IANCAS, BARC. Many paper/poster presentations by the staff and students in national and international conferences/seminars also received "Best Paper Awards".

Human Resource Development

Training and exposure to the use of management approaches, advanced tools and latest techniques for the staff are considered very essential for sustained growth. During the year, many staff members as well as students were deputed for various training programs/seminars/symposia/conferences. More than 100 research students pursued their work for doctoral degree and 26 received their Ph.D. degrees from different universities. The Institute also extended short-term training facilities to student and staff of academia and industry.

Events/Seminars/Symposia

The Institute celebrated National technology Day, CSIR Foundation Day, NIIST Foundation Day and National Science Day in which eminent personalities enlightened the staff. Vigilance awareness week, Hindi Diwas/week, Republic day, Independence day, Students day "Radiance07", Staff club day were also celebrated.

Many seminars and conferences arranged during the period gave an opportunity to the scientific staff and students to get an exposure to the recent developments in related subjects. Some important conferences held are listed below:



Highlights

International conference on "Advanced materials and composites (ICAMC-2007)"

International Conference on "New horizons in biotechnology"

DST-JSPS joint conference on "Recent trends in molecular materials research"

One Day Symposium on "Frontiers in chemistry-2008"

Seminar on "Solid waste management and dioxin control"



Inaugural function of International Conference on Advanced Materials and Composites

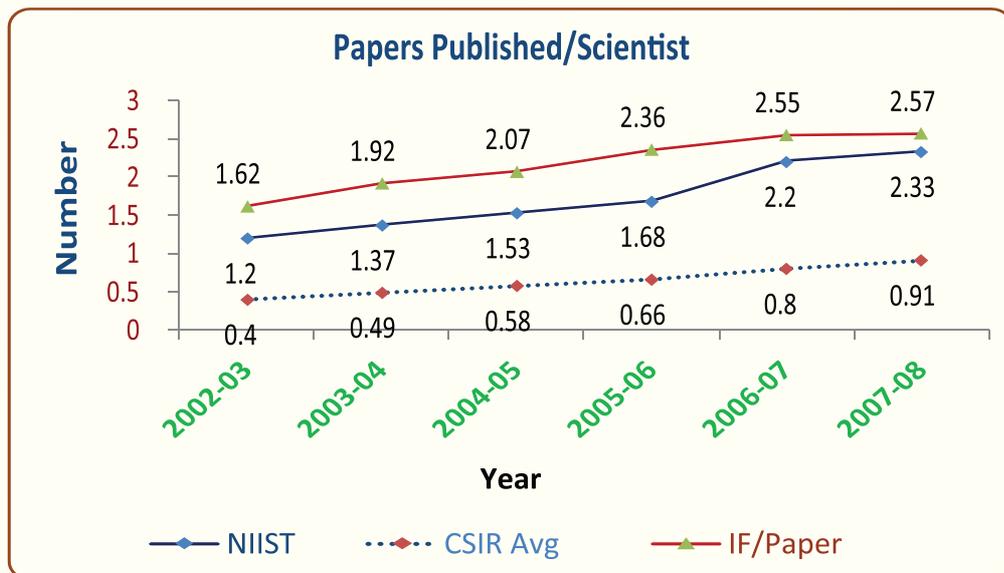


एन आई आई एस टी - वार्षिक रिपोर्ट 2007-08 के मुख्य अंश

ग्यारहवीं पंचवर्षीय योजना का प्रथम वर्ष था। अनुसंधान एवं विकास सुविधाओं का प्रौद्योगिकीय उन्नयन, अवसंरचना का सृजन, गुणता पद्धति, प्रभागों की पुनः संरचना आदि केलिए किए गए पहल तथा पिछले कुछ वर्षों से संस्थान में नवाचारी तथा प्रशिक्षित नवयुवकों के प्रवेश आदि का अच्छा परिणाम प्रदान करने लगा है। प्रकाशनों की उत्कृष्टता तथा प्रति वैज्ञानिक एस सी आई अनुसंधान पत्र के मामले में सी एस आई आर की प्रयोगशालाओं के बीच निष्पादन में संस्थान को द्वितीय स्थान प्राप्त है।

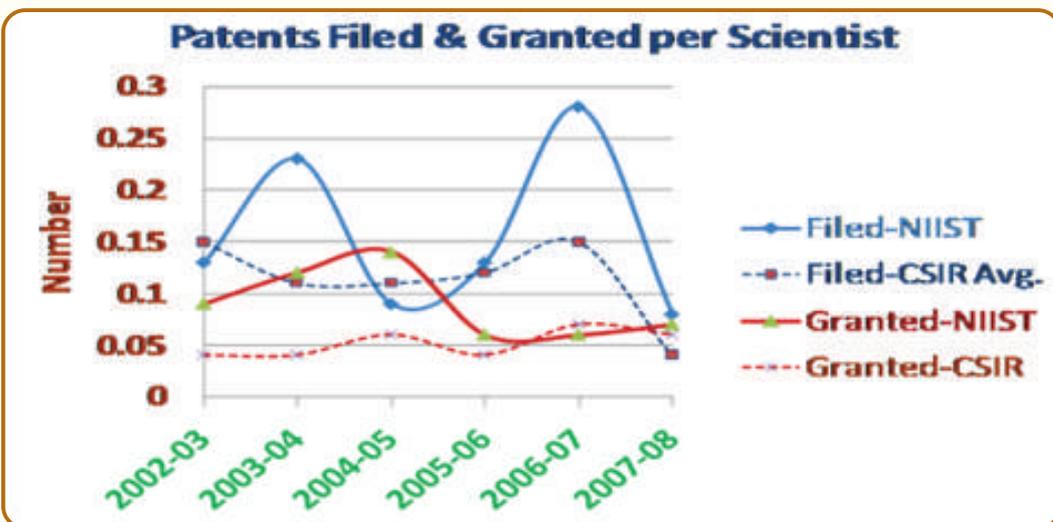
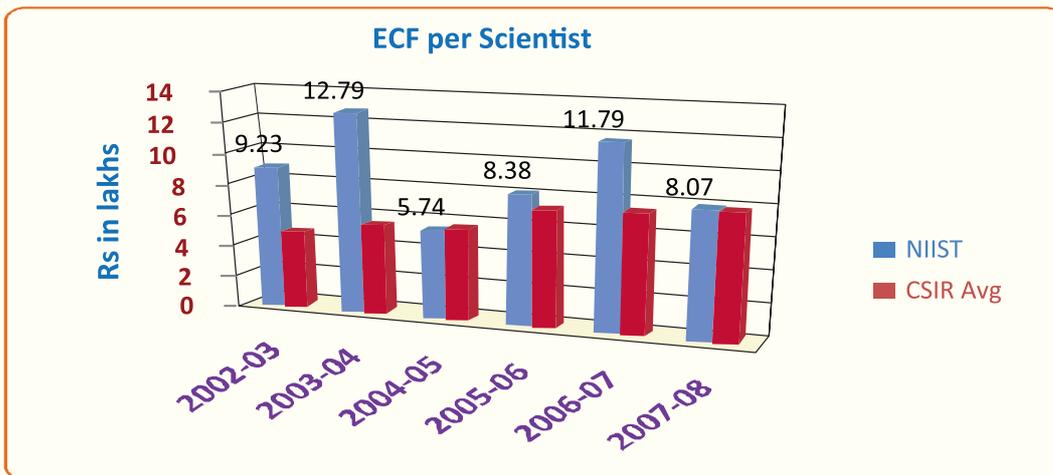
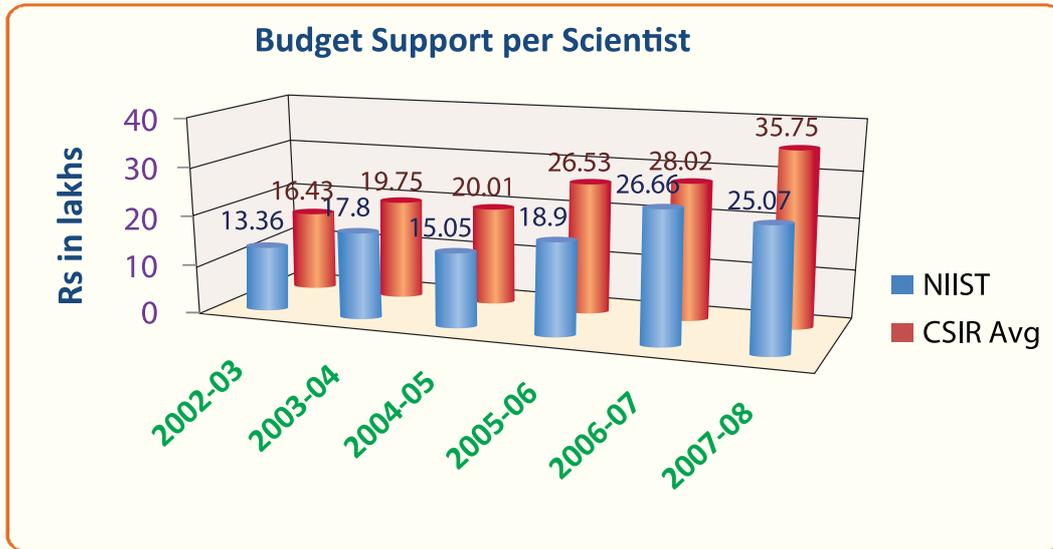
वर्ष 2002-2008 की अवधि के बजटीय विश्लेषण ने यह दर्शाया है कि प्रति वैज्ञानिक के निम्न बजटीय समर्थन में भी संस्थान ने उच्च इंपैक्ट फैक्टर प्रकाशनों की संख्या (प्रति अनुसंधान पत्र को 2 से ज़्यादा औसत इंपैक्ट फैक्टर के साथ 890 प्रकाशनों) फाईल किए गए पेटेन्ट (79 यू. एस) ई.सी.एफ का उत्पादन (48 करोड रुपए से ज़्यादा) आदि के संदर्भ में उत्कृष्ट निष्पादन प्रकट किया है।

24.63 करोड रुपए की कुल लागत पर ग्यारहवीं पंचवर्षीय योजना के दौरान कार्यान्वयन के लिए योजना आयोग से संस्थान को छः नेटवर्क परियोजना तथा सूप्रा-संस्थागत, अंतर एजन्सी तथा सामाजिक श्रेणियों में, प्रत्येक श्रेणी के अधीन एक-एक परियोजना केलिए अनुमोदन प्राप्त हुए है। राष्ट्रीय तथा अंतरराष्ट्रीय अनुसंधान संगठन, शैक्षणिक संस्थान, तथा उद्योगों के साथ सहकारिता जारी रखा है। इस वर्ष के दौरान, संस्थान में, धातु आधारित औषधों पर राष्ट्रीय पहल के अधीन तथा डी.एस.टी.के वित्तीय समर्थन में सी सी एम बी तथा आर जी सी बी की सहकारिता में कैंसर तथा संबद्ध बीमारियों में प्रकाश गतिशील रोगोपचार के लिए नूतन इन्फ्रारेड अवशोषण अणुओं तथा सम्मिश्रों के विकास पर एक प्रमुख परियोजना प्रारंभ की है।





मुख्य अंश





अनुसंधान एवं विकास परिणाम तथा उनका वाणिज्जीकरण

इल्मिनाइट से कृत्रिम रूटाइल के उत्पादन के लिए विकसित नई प्रक्रिया का वाणिज्जीकरण केलिए हस्तांतरण की गयी प्रौद्योगिकीय उपलब्धियों में सबसे प्रमुख है। प्रो. एस. के ब्रह्मचारी, महानिदेशक, सी एस आई आर ने निस्ट निरुवनन्तपुरम में जनवरी 16, 2008 को आयोजित समारोह में निदेशक तथा उक्त प्रौद्योगिकी के विकास में सम्मिलित वैज्ञानिकों की उपस्थिति में प्रौद्योगिकी का वाणिज्जीकरण केलिए उसे कोच्चिन मिनरल्स आन्ड रूटाइल लिमिटेड (सी एम आर एल) को हस्तांतरित किया। उत्पादन की क्षमता, निवेश, पर्यावरणीय इंपैक्ट, तथा भुगतानी रॉयल्टी की मात्रा आदि की दृष्टि से यह निस्ट के ही नहीं बल्कि सी एस आई आर के इतिहास में किए गए सबसे प्रमुख प्रौद्योगिकी हस्तांतरण है।



संस्थान में विकसित तकनीकी जानकारी का वाणिज्जीकरण केलिए किए गए संस्थागत प्रयास के रूप में संस्थान ने मेसेर्स एस टी. सी. एल, कर्नाटक केलिए बैडगी में 20 टी पी डी ताजा मिर्च प्रसंस्करण सुविधा की स्थापना का कार्य ले लिया। इसकी स्थापना 2.5 करोड रुपए की कुल लागत पर की गयी और यह ताजा मिर्च प्रसंस्करण केलिए देश में प्रारंभ किए ऐसे प्रथम यूनिट है। श्री जयराम रमेश, राज्य मंत्री, व्यापार एवं वाणिज्य, भारत सरकार ने दिनांक 21 मार्च 2008 को इस प्रसंस्करण संयंत्र राष्ट्र को समर्पित किया। प्रकाश सुग्राही करोटिनाइट युक्त मिर्च की बैडगी किस्म उनके उत्कृष्ट रंग केलिए सुप्रसिद्ध है। यह प्रौद्योगिकी, नियंत्रित अवस्थाओं में 20 मिनट में शुष्कन प्रक्रिया सुनिश्चित करने के साथ मिर्च के उपरितल में चिपका हुआ मैल तथा कीटनाशी को दूर करने केलिए पूर्व धुलाई सहित उच्च करोटिनाइट अवधारण भी सुनिश्चित कराती है। उत्पाद उच्च मूल्य में बेचे जाते है और किसानों को बेहतर फायदा की प्राप्ति भी होती है। प्रयोगशाला द्वारा विकसित प्रौद्योगिकी के आधार पर परियोजना अभियांत्रिकी कंपनियों के माध्यम से प्रतिदिन 50 टंग लाल पॉमोलिन के उत्पादन केलिए क्षमता युक्त दो वाणिज्य संयंत्र की स्थापना की गयी। इन संयंत्रों में शुद्धीकरण प्रक्रिया नियंत्रित अवस्थाओं में की जाती है जिससे साधारण शुद्धीकरण प्रक्रिया, जहाँ पामोलिन में विद्यमान सभी माइक्रो पुष्टिकारकों नष्ट हो जाते है, की तुलना में अंतिम उत्पाद में 75 प्रतिशत माइक्रो पुष्टिकारकों की अवधारण होती है।



मुख्य अंश

यह समाज केलिए एक महत्वपूर्ण योगदान है, क्योंकि लाल पामोलिन बीटा करोटिन, टोकोफॉराल तथा टोको ट्रिऑल से समृद्ध है। विटामिन 'क' के अभाव से उत्पन्न समस्याओं का समाधान केलिये इसे एक पौषणिक तेल के रूप में इस्तेमाल किया जा सकता है। यह कार्यक्रम टीएमओपी द्वारा समर्थित है और प्रत्येक संयंत्र प्रत्यक्ष रूप से 30 लोगों को रोजगार का अवसर प्रदान करता है। सिक्किम राज्य में एकीकृत स्पाइसस संसाधन सुविधा की स्थापना केलिए प्रौद्योगिकी हस्तांतरण तथा तकनीकी जानकारी का लाईसेंसिंग केलिए बागवानी तथा नकदी फसल विकास विभाग, सिक्किम सरकार के साथ करार हस्ताक्षर किया है। अरुणाचल प्रदेश तथा मिज़ोरम में उद्यमियों के साथ ऐसी समान प्रकृति के प्रौद्योगिकी हस्तांतरण केलिए करार हस्ताक्षर किए गए हैं।

संस्थान द्वारा पहले से विकसित सिमुलेशन सॉफ्टवेयर 'वेर्चुल कार्स्टिंग' की कमियों से बच जाने केलिए 'वेर्चुल फीड' नामक एक नया सॉफ्टवेयर विकसित किया गया। यह नया साफ्टवेयर वर्चुल कार्स्टिंग के शक्तिशाली ताप अंतरण विश्लेषण के प्रतिपूरक बल के एकीकरण तथा व्यावहारिक तौर पर निकाल लिए डिज़ाइन नियमों द्वारा फीडरों के सिमुलेशन आधारित प्रारंभिक डिज़ाइन का सृजन करता है। एक नूतन पैटेर्न प्रत्याभिज्ञान अल्गोरिथम कार्स्टिंग को समूहों में विभजित करते है, प्रत्येक समूह का एक फीडिंग खण्ड के रूप में प्रत्येक फीडर की आवश्यकता है। फीडिंग खण्ड के मोड्यूलन तथा मात्रा से, फीडर के आकार की गणना की जाती है। हर एक फीडिंग खण्ड केलिये एक जेनेटिक अल्गोरिथम फीडर आकार की श्रेणी का पता लगाता है, जिससे कि अधिकतम उपलब्धि प्राप्त होती है। आगे और सिमुलेशन का इस्तेमाल करके विकल्प रूप से डिज़ाइन परिष्कृत किया जा सकता है।

प्रतिदिन 59 टण चावल भूसी संसाधन केलिए क्षमता युक्त संयंत्र से 10 टी.पी.डी अभिक्रियाशील माइक्रो सिलिका का उत्पादन केलिए एक वाणिज्य प्रक्रिया की रूपरेखा तैयार किया गया। मार्च 2008 में मेसेस बी एम पी टी सी, नई दिल्ली, जो इसके प्रायोजक थे, को प्रक्रिया जानकारी हस्तांतरित की गयी। परीक्षण ने यह दर्शाया है कि उत्पाद किए पदार्थ कोंक्रीट, विशेषतया: उनके क्लोराइड-लोहा प्रतिरोध के लिए उत्कृष्ट पॉत्सलाना है। लागत विश्लेषण ने यह सूचित किया है कि यह प्रक्रिया आर्थिक दृष्टि से भी व्यवहार्य है। सेला चावल मिलों के लिए एक जीरो डिस्चार्ज प्रक्रिया विकसित की गयी। कालडी चावल मिल संघ ने पविष्म चावल मिल, कालडी में प्रारंभिक संयंत्र की स्थापना की। बारह क्रमिक बैचों के धान का मूल्यांकन किया गया और अंधाधुन्ध परीक्षण में भी चावल की गुणता अप्रभावित रही। प्रारंभिक परीक्षणों के आधार पर संपूर्ण स्केल यूनिट की स्थापना केलिए योजना तैयार की गयी है। बी एच इ एल में पानी का फिल्टरेशन केलिए सिरैमिक झिल्ली युक्त प्रोटोटाइप का सफलतापूर्वक परीक्षण किया गया है और रंध आकार का 1500 नैनो मीटर से <200 नैनोमीटर तक लघूकरण निस्ट द्वारा विकसित प्रौद्योगिकी से प्राप्त हुआ। अनुलम्ब अपकेंद्री कार्स्टिंग द्वारा 20% एस आई सी (Sic) कण युक्त एएल-एसआईसी (Al-Sic) प्रकार्यात्मक ग्रेड के एक आदर्श रोक यंत्रवत (Rotor) डिस्क का विकास किया गया और एक ओटोमोबाइल उद्योग द्वारा इसका सफलता पूर्वक सड़क परीक्षण संपन्न हुआ। परंपरागत कास्ट ऑयन डिस्क की तुलना में इसमें नज़दीक ब्रेकिंग क्षमता है तथा डिस्क की संचरनात्मक समाकलन भी उत्कृष्ट है। एक नयी श्रेणी के मुलायम पदार्थों का डिज़ाइन किया गया जो विभिन्न रंगों के प्रकाश का उत्सर्जन करता है। ये जेल अतिआणविक प्रकाश एकत्रित संयोजन के डिज़ाइन के लिए आदर्श ढांचा है और शक्तिशाली दो फोटोणी अवशोषण पदार्थ है, जिससे समस्वरक प्रकाशिक गुणधर्म युक्त नूतन श्रेणी के इलक्ट्रॉनिकी सक्रिय मुलायम कार्बनिक पदार्थों केलिए रास्ता खेला जा सकता है। एन्डोसल्फान से संदूषित प्राकृतिक पानी के विष दूरीकरण केलिए नकली सांचा संकल्पना का उपयोग करके एक



उपयुक्त एम.आई.पी. सूक्ष्मबीड्स तैयार किया गया। मेथनॉल से धुले एम.आई.पी बीड्स ने संदूषित प्राकृतिक पानी में वर्तमान एन्डोसल्फान का पृथक्करण किया जो विश्व स्वास्थ्य संघठन द्वारा निर्धारित अधिकतम अनुमत स्तर यानि 20 पीपीबी से भी निम्न स्तर है। यह संकल्पना अन्य खतरनाक विष जैसे सतत कार्बनिक तथा अकार्बनिक प्रदुषक,(पी ओ पी तथा पीआईपी) वास्तविक रासायनिक युद्ध एजन्ट तथा रेडियो न्यूक्लौड आदि के विष दूरीकरण में अग्रणी होगा।

TiCe 04 के Ce 02 मैट्रिक्स में प्रासियोडाइमिनम डोपिंग द्वारा सफेद रंग से ईट-सा लाल रंग तक के विभिन्न रंगों के नूतन पर्यावरणीय सुरक्षित अकार्बनिक वर्णकों का संश्लेषण हुआ है। विभिन्न पृष्ठीय विलेपन अनुप्रयोगों के लिए वर्तमान में प्रयुक्त विषैले रंजकों के स्थान में भूरे लाल सिरैमिक वर्णक एक अच्छा विकल्प है।

कृषीय उत्पादों को सुखाने के लिए ग्रामीण क्षेत्र में प्रयोगशाला द्वारा विकसित विपरीत प्रवाही प्राकृतिक संवहन ड्रायरों का व्यापक अनुप्रयोग होता है। ये ड्रायर आर आर एल टी एन सी ड्रायरों के नाम से प्रसिद्ध है, और इसके पाँच नमूने किसान, कुटीर यूनिट तथा स्वनियोजित व्यक्तियों द्वारा विभिन्न कृषीय तथा अन्य उत्पादों को सुखाने के लिए इस्तेमाल किया जाता है। वर्तमान में प्रयोगशाला ने घरेलु धोबीखाने में शुष्कन के लिए तथा रबड़ के शीटों के शुष्कन के लिए निम्न लागत वाले और एक परिवर्तित रूप विकसित किया है। प्रति बैच में 300 संपूर्ण नारियल को बॉल खोपड़ा में परिवर्तन करने युक्त गतिवर्धित ड्रायर के विकास के संबंध में प्रयोगशाला में पुनरावृत्त परीक्षण हो रहा है।

प्रकाशन एवं पेटेंट

वर्ष के दौरान विभिन्न राष्ट्रीय तथा अंतरराष्ट्रीय आवधिकों में 230 से ज्यादा अनुसंधान कागजात का प्रकाशन हुआ तथा विभिन्न संगोष्ठी, परिसंवाद तथा सम्मेलन में अनेक अनुसंधान कागजात तथा पोस्टर प्रस्तुतीकरण किए गए। औसत इंपैक्ट गुणत्र खंड 2.57 तक बढ़ गया। विख्यात जर्नलों के आवरण पृष्ठों में संस्थान के कुछ अनुसंधान पत्रों का नाम प्रकाशित किया गया। रिपोर्ट अवधि के दौरान 7 विदेशी तथा 6 भारतीय पेटेंट फाइल किए गए तथा 6 विदेशी तथा 11 भारतीय पेटेंट के लिए स्वीकृति प्राप्त की। ये संस्थान के नवाचारी उपगमन की सफलता का द्योतक है।

सम्मान एवं पुरस्कार

अपने उत्कृष्ट कार्य एवं उपलब्धियों के लिए निस्ट के वैज्ञानिकों को विभिन्न निकायों से पुरस्कार प्राप्त हुए हैं। प्रो. टी. के. चन्द्रशेकर, निदेशक सी आर एस आई रजत पदक से सम्मानित किया गया। डॉ ए अजयघोष, रसायन विज्ञान में शान्तिस्वरूप भटनागर पुरस्कार, रामण्णा फेलोशिप तथा एम. आर. एम आई पदक 2007 से सम्मानित किया गया। डॉ. अशोकपाण्डेय को ब्लेस विश्वविद्यालय, पास्कल से सम्मानार्थ डाक्टरेट उपाधि प्रदान की गयी। डॉ सुरेशदास एम.आर.एस.आई पदक 2007 से सम्मानित किया गया। डॉ के जोर्ज तोमस भारतीय विज्ञान अकादमी, बंगलूर के फेलो घोषित किया गया। डॉ जे मेरी ग्लाडिस को आईएएनसीएएस, बी ए आर सी द्वारा प्रोफसर एच. जे अर्निकर उत्कृष्ट शोधपत्र पुरस्कार प्राप्त हुआ। स्टाफ तथा अनुसंधान छात्र द्वारा विभिन्न राष्ट्रीय तथा अंतरराष्ट्रीय सम्मेलन एवं संगोष्ठियों में प्रस्तुत अनुसंधान पत्र तथा पोस्टर प्रस्तुतीकरण के लिए 'उत्कृष्ट अनुसंधान पत्र' पुरस्कार प्राप्त हुए हैं।



मुख्य अंश

मानव संसाधन विकास

प्रबंधन उपगम्यता के उपयोग में प्रशिक्षण तथा खुलाव, अग्रवर्ती साधन तथा नवीनतम तकनीक आदि दीर्घकालीन विकास के लिए अत्यंत आवश्यक माना जाता है। वर्ष के दौरान अनेक स्टाफ सदस्य तथा छात्र विभिन्न प्रशिक्षण कार्यक्रम/सेमिनार/परिसंवाद/सम्मेलन में भाग लेने के लिए प्रतिनियुक्त किये गये। 100 से ज्यादा अनुसंधान छात्र डाक्टरल डिग्री के लिए कार्य किए और विभिन्न विश्वविद्यालयों से 26 छात्रों को पी एच डी की उपाधि प्रदान की गयी। अकादमी तथा उद्योगों के छात्र तथा स्टाफ के लिए संस्थान द्वारा अल्पकालीन प्रशिक्षण सुविधा दी गयी।

घटनाएं/संगोष्ठियाँ/परिसंवादें

संस्थान में राष्ट्रीय प्रौद्योगिकी दिवस, सी एस आई आर स्थापना दिवस, एन आई आई एस टी स्थापना दिवस, राष्ट्रीय विज्ञान दिवस आदि का आयोजन किया गया। इन समारोहों के दौरान प्रतिष्ठित व्यक्तियों द्वारा स्टाफ प्रबुद्ध किया गया।

सतर्कता जागरूकता सप्ताह, हिंदी दिवस, स्वतंत्रता दिवस, छात्रों का दिवस “रेडियन्स 07”, स्टाफ क्लब दिवस आदि भी आयोजित किए गए। वैज्ञानिक तथा अनुसंधान छात्रों को वर्ष के दौरान आयोजित अनेक संगोष्ठी तथा सम्मेलन में भाग लेने का तथा संबंधित क्षेत्र के नूतन विकास घटना चक्रों से परिचय होने का अवसर मिला। आयोजित कुछ प्रमुख सम्मेलन ये हैं:-

प्रगत पदार्थ एवं संयुक्तों पर अंतरराष्ट्रीय सम्मेलन

जैवप्रौद्योगिकी में नया क्षितिज पर अंतरराष्ट्रीय सम्मेलन

रसायन विज्ञान में सीमान्त क्षेत्र 2008 पर एक दिवसीय परिचर्चा

ठोस रद्दी प्रबंधन तथा डार्ई आक्सीन नियंत्रण पर संगोष्ठी।



अग्रवर्ती पदार्थ एवं संयुक्तों पर आयोजित अंतरराष्ट्रीय सम्मेलन का उद्घाटन सत्र



AGRO-PROCESSING & NATURAL PRODUCTS

Focused on three thrust areas of research viz., Lipid Science & Technology, Spices & Flavour Technology and Natural Products, the main activities of Agro-Processing and Natural Products Division is oriented towards process development, process chemistry, technology transfer and commercialization activities through project engineering Company (PEC). In order to remain in the forefront areas of research, modern areas of biological sciences such as functional food products, nutraceuticals and bioactive molecules in the management of health have been identified, with futuristic vision.

HIGHLIGHTS OF THE ACTIVITIES DURING THE YEAR 2007-2008



Mr. Jayaram Ramesh, Union Minister for commerce inaugurated Byadagi Chilli processing plant on 21-03-2008.

Byadagi Chilli processing plant

First such venture in India, processing fresh Chillies making high colour value product free of aflatoxins.

Employment for 20 rural unskilled women

Remunerative prices for farmers

Export potential of USD 2.5 million in 4 months in a year

- ♦ 50 tons per day Red Palm Olein and Zero Trans Shortening plants for M/S Balaji Oils, Tamilnadu and M/S Mantora Oils, Uttar Pradesh through project engineering companies- Commercialized
- ♦ 20 tons per day Byadagi Chilli processing plant for M/S STCL, Karnataka through a project engineering company
- ♦ 2.5 ton FFB/hr palm oil mill in Orissa for M/S Laxmi Balaji Oils—Ready for Commissioning
- ♦ Technology transfer for “integrated spices processing” to Horticulture department, Sikkim
- ♦ Technology transfer for “integrated spices processing” to NGO in Arunachal Pradesh and Mizoram
- ♦ Transfer of technology for palm oil mill, 10 ton expandable to 20 ton FFB/hr to Andhra Pradesh Co-operative Oil Seeds Federation
- ♦ Supra Institutional Project on “Evidence based herbal/nutraceutical products for preventive health and disease management”.
- ♦ Department participated in Golden Triangle Project on “Standardization and validation of active biological principles in selected plants and their formulations used in Ayurveda”, following modern scientific protocols.



Agro-processing & Natural Products

Commercialization of red palm olein and zero trans shortening technology package

Technology package for carotene rich red palm olein from palm oil and zero trans shortening by blending palm stearin and rice bran oil was developed and commercialized earlier. The process involves neutralization of palm oil, deodorization under controlled temperature and high vacuum to retain the carotene and tocopherols, winterization of palm oil using a crystallizer to separate the solid palm stearin from liquid palm olein. The red palm olein thus obtained retains more than 75% of carotene and tocopherols present in the raw material, crude palm oil. The solid palm stearin obtained in the process is blended with rice bran oil which is rich in micro nutrients such as oryzanol, tocopherols and sterols. The blended oil is further processed using a margarine crystallizer to get shortening of desired physico-chemical properties.

This technology was commercialized for M/S Balaji Oil Mills, Tamilnadu and M/S Mantora Oil Mills, Uttar Pradesh, during this year. This process was funded by TMOP and critical equipments required for winterization and zero trans shortening were supplied, erected and the plant was commissioned through Project Engineering Companies.

Establishment of 2.5 ton FFB/hr Palm oil mill in Orissa

Technology mission on oil seeds and pulses (TMOP) under its technology promotion programme, funded for a palm oil mill which is to be established in Orissa. The palm oil mill is 2.5 ton expandable to 5.0 ton FFB/hr capacity. During last year, purchase order was placed for the supply of plant and machinery. Subsequently, the project engineering company had provided the general arrangement and plant layout drawings based on which the beneficiary M/S Lakshmi Balaji Oils executed the plant building work. The Project Engineering Company had supplied all the equipments and erection of the total plant is completed. The plant is ready for commissioning.

Virgin coconut oil with improved yield

Virgin coconut oil is extracted from the fresh coconut. The process involves extraction of coconut milk from the meat, centrifugation of the milk and the enzymatic treatment of the centrifuged cream, etc. In the present process, screw press was used to extract the milk from the fresh coconut and the



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milk was centrifuged to separate the cream. The cream contains oil, insoluble proteins, and traces of sugar. The skimmed milk contains soluble proteins and sugar. The cream was treated with an enzyme which hydrolyses the protein and releases the oil. In the earlier studies, milk was treated with multiple enzymes, wherein the yield was less. In the present study the oil was extracted from the cream using a single enzyme where the oil yield was more than 80% and the oil quality was good. This method can be scaled up to develop a process for technology transfer.

Ether linked Triacylglycerols in Rice Bran Oil

Triacylglycerols (TG) that constitute 90-95% of edible oils are triesters of fatty acids and glycerols. Studies on Rice Bran Oil (RBO) revealed that some of the TG were with ether linkages, i.e. instead of fatty acids, fatty aldehydes were esterified to glycerols. Studies conducted to identify and quantify ether linked TG comprised separation of TG, hydrolysis of TG by pancreatic lipase and separation of the reaction products, characterization of the reaction products using GCMS, FTIR, NMR etc. Results showed that the monoacylglycerols obtained by lipase hydrolysis contained the ether linkage. The aldehydes obtained by the saponification of the monoacylglycerols further confirmed the presence of ether linked TG in RBO and is not reported in any other edible oils. Biological effects such as antitumour, radiation protection, wound healing properties are attributed to glyceryl ethers. RBO with the glyceryl ethers content (0.7% in crude and 0.3% in refined) may increase the health benefits in addition to the micronutrients already known.

Lipase catalyzed interesterification of palm stearin and rice bran oil blends for preparation of zero trans shortening with bioactive phytochemicals

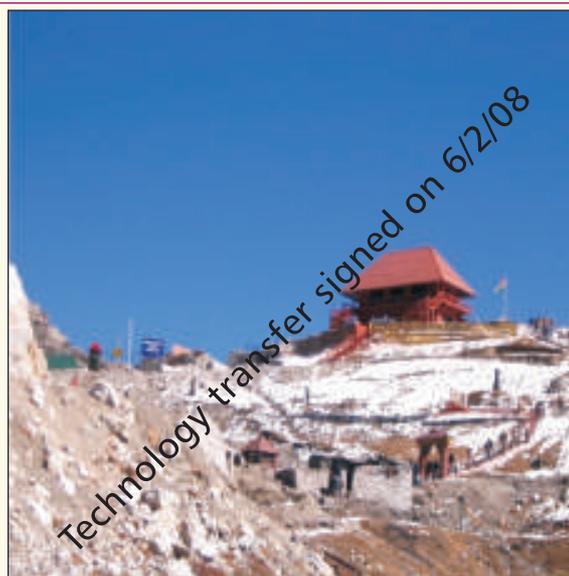
Palm Stearin (PS) and Rice Bran Oil (RBO) blends of varying proportions were subjected to enzymatic interesterification (EIE) using a 1,3 specific immobilized lipase. The interesterified blends were evaluated for their physicochemical characteristics and bioactive phytochemical contents using differential scanning calorimeter (DSC), X-ray diffraction (XRD), gas chromatography (GC) and high performance liquid chromatography (HPLC). The blends of PS and RBO in different proportions (40:60, 50:50, 60:40 and 70:30) had saturated fatty acid content and unsaturated fatty acid content in the range of 37.6 to 52.0% and 48.0-62.4% respectively. The blends 40:60, 50:50 and 60:40 showed



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a considerable reduction in their highest melt peak temperature (TP) and solid fat content (SFC) on EIE. The interesterified blends retained bioactive phytochemicals like tocopherols (839-1172ppm), sterols (4318- 9647ppm), oryzanols (3000-6800ppm) and carotene (121-180ppm). XRD studies demonstrated that the interesterified blends contained β and β' polymorphic forms.

- ★ NIIST signed a technology transfer agreement for setting up an integrated Spice processing unit for processing Fresh Ginger, Turmeric and Large Cardamom in the State.
- ★ Laboratory to assist the State Horticulture Department to set up the processing unit.
- ★ Similar Technology Transfer agreements signed with entrepreneurs in Arunachal Pradesh and Mizoram



20TPD Chilli Processing Facility Commissioned at Byadgi

As part of the institutional efforts to commercialize the know how developed in house, the laboratory took up the task of setting up a 20 TPD fresh chilli processing facility at Byadgi. The foundation stone for the plant was laid by Mr. Pandala, Chairman State trading Corporation and the plant was made functional by Jan 2007.

The Byadgi Chilli, which is known for its high colour is currently processed in the traditional manner which result in loss of carotenoids during the sun drying operation. The new facility created processes fresh chilli hygienically and employs a fluid bed drier for bringing down the moisture to acceptable levels. The resulting end product will have a 10 % increase in colour value when compared to the conventionally processed raw material.

The raw material is washed, size reduced, dried in the fluid bed drier and then de seeded. The contact time in the drier is less than 15 minutes and the entire operation is automatic. All the machineries are interlocked and the manpower requirements are marginal. High pressure steam is used as the



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heating medium and the plant is engineered to ensure high thermal efficiency.

The facility is set up at a cost of approximately Rs.2.5 crores and this is the first such unit to come up in the country for processing Fresh Chilli. The unit will provide direct employment to 30 people and indirectly benefit a large number of farmers ensuring fair price for the produce.

Marker based standardization of selected plant used in Ayurveda: Golden Triangle Partnership Project (GTP).

GTP, initiated jointly by Dept. of AYUSH, CSIR and ICMR with financial support from AYUSH for standardization and validation of selected plants used in Ayurveda with objectives as a) identification of chemical markers and standardization of methods for their quantification, (b) methods for identification and quantification of the markers in the Ayurveda formulations and (c) validation of the formulations for their biopotency through pharmacological and clinical trials. NIIST had been assigned 9 plants and their formulations for the marker based standardization. Besides, physico-chemical characterization of "Bhasmas" was also undertaken as part of this project. During the last year (AR 2006-07) detailed investigations were conducted on 7 plants and methods were developed and validated for identification as well as quantification of markers.

During the period under report, methods were developed for the identification and quantification of chemical markers in the remaining 2 plants namely *Semicarpus anacardium* and *Valeriana wallichii* and validated. Methods for identification and quantification of chemical markers in 6 formulations were also developed and validated during the period.

Semicarpus anacardium

Seed of this plant is used for treating a variety of disorders including digestive and hepatic disorders, cancer, inflammation in Ayurveda and siddha. Tetrahydro amentoflavone (THA), a biflavone, was isolated in pure form from the seeds of *S. anacardium* characterized and confirmed by FTIR, NMR and MS. Using the isolated THA as standard, two separate methods based on HPTLC and HPLC were developed and validated in terms of calibration, limit of detection (LOD), limit of quantification (LOQ), robustness, recovery, precision etc. The method





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thus developed was sensitive to detect THA at 1 ppm level. Finger printing of methanol extracts of the seed and 3 formulations of *S. anacardium* as well as estimation of THA in formulations were carried out using these methods.

Valeriana wallichii

Rhizome of the plant and its formulations are better known for their therapeutic efficacy for anxiety, insomnia, epilepsy and other neuro disorders. Method for identification and quantification of valerenic acid in the rhizome as the marker compound was standardized by HPTLC and HPLC, using standard valerenic acid. The rhizome samples from AYUSH showed valerenic acid content of 100 to 300 ppm on dry basis.



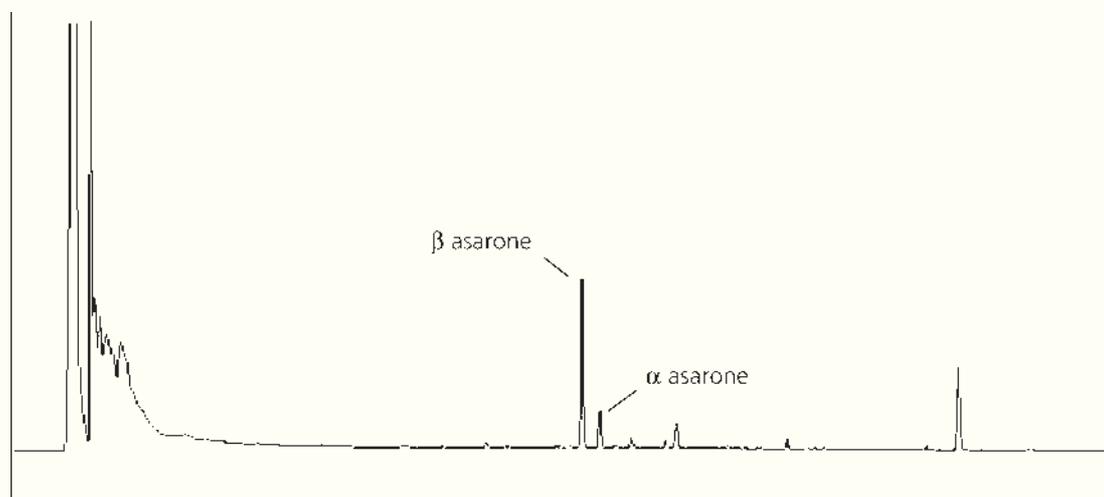
Identification and quantification of marker compounds in formulations

9 formulations namely Dislipidemia (GTP 050), Medhya-6 (GTP: 0111), TG 01(GTP 0107), TG 02 (GTP 0108), TG 03 (GTP 109), TG 04 (GTP 0110), Shinganadaguggulu (GTP 012), Goshuradiguggulu (GTP 0121), and Nirgundi Thailam (GTP0123) were received under the project from AYUSH for conducting the studies. The formulations contained 4 to 8 plants. Methods were developed for identification and quantification of marker compounds using HPTLC and HPLC including their finger prints. The marker compounds identified and quantified in the formulations are the following:

| Formulation | : | Marker compounds |
|--------------------|----------|--------------------------------------|
| GTP : 050 | : | Gingingerol, Zosarone B-asarone |
| GTP : 0111 | : | I-asarone, B-asarone, valerenic acid |
| GTP : 0107-0110 | : | Valerenic acid |
| GTP : 0121-0122 | : | E-guggul sterone and z-guggulsterone |
| GTP: 0123 | : | Sesamin and sesamol |



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HPLC profile of methanol extract of formulation for dislipidemia (GTP 050) (asarones) at 304 nm

Chemical profiling of active fractions of sea buckthorn seeds

Sea buckthorn seeds were evaluated for their antioxidant activities using *in-vitro* model systems. Ethyl acetate and water fractions of seed kernel methanol extracts having maximum activity were further fractionated and profiled for their chemical composition. Phenolics contributed to the major class of compounds in ethyl acetate fraction and flavonoids were found to be concentrated in this fraction. The detailed profiling of flavanoids were done using HPLC-DAD-ESI-APCI and the following glycosides were identified and quantified: quercetin-3-O-sophroside-7-O-rhamnoside, quercetin-3-O-rutinoside and quercetin-3-O-rutinoside, isorhamnetin-3-O-sophroside-7-O-rhamnoside, isorhamnetin-3-O-glucoside-7-O-rhamnoside, isorhamnetin-3-O-glucoside-7-O-rhamnoside and isorhamnetin-3-O-glucoside as glycosides of isorhamnetin and kampherol-3-O-sophroside-7-O-rhamnoside. Free forms of quercetin, isorhamnetin and kaempherol were also identified and quantified.



Evidence based herbal/nutraceutical products for preventive health and disease management:

This *Supra Institutional Project*, SIP 004 was approved with a total budget outlay of Rs. 820



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lakhs with main objectives as

- ♦ Establishment of a correlation between oxidation stress and genesis diseases like inflammation, cardiovascular diseases (CVD) and diabetes based on cell line studies.
- ♦ Development of formulations using active fractions/active principles from the plants selected for this studies.
- ♦ Validation of the formulations by *in-vitro* and *in-vivo* methods.
- ♦ Creation of a state of the art cell culture facility.

Creation of state of the art cell culture facility

A clean room (class1000) facility for the preservation and culture of cell lines and supporting instrumentation systems like confocal bio-imaging, flow cytometry etc are under establishment. The civil and electrical works were commenced and the facility is expected to be operational in September 2008. The cell culture facility supported with most advanced instrumentation with total investment of Rs.500 lakhs will be the first of its kind in the region for screening natural products for their activity.

Experimental Design

Out of the 12 plants selected, studies are initiated on six plants for activity guided fractionation. A new process at pilot scale to recover the active principle from the fresh plant material with high purity (> 95%) was optimized for SIP 008 and also with 20-25% higher recovery as compared to the conventional method. A marker compound in pure form was isolated from SIP010, characterized and confirmed its identity and purity by spectral data. The compound was found to possess very high xanthine oxidase inhibition activity and hence could be a potent anti-inflammatory agent. Two fractions of SIP012 were evaluated for their anticancer and antidiabetic properties in model cell lines. One of the fractions showed strong anti-proliferative activity against Hela S₃ and the other fraction exhibited high anti-diabetic activity in 3T₃ differentiated adiposities. Further studies are envisaged to establish their efficacy in other model systems.



BIOTECHNOLOGY DIVISION

Areas of Research & Highlights

The R&D activities of the Division centre around the theme of Bio-based processes and products development and has three major areas, which include 1. Bio-based processes and products development, 2. Energy, and 3. Health and genomics..

A partnership link has been initiated with the TIFAC, New Delhi (and CII) to propagate the need for industries to adopt bio-based processes as futuristic course for their products. The bioethanol program, classified currently under a new area of Energy, got a boost with the initiation of two new projects. The activities in the area of biodiversity were strengthened with the sanction of a new project on metagenomics by the Department of Biotechnology (DBT), New Delhi. New activities were initiated on enzymes inhibitors and substrate specific amino peptidases under the eleventh five year plan networked project.

- ♦ An industrial consultancy project from US on the production of amino acids, especially glutamic acid, arginine and citrulline: State-of-art scenario was successfully completed.
- ♦ A laboratory model column bioreactor designed for the production of food grade alpha amylase showed substantial increase in the enzyme production by the fungal culture in solid-state fermentation in comparison to flasks.
- ♦ *Aspergillus crystallinus* was shown to contain at least five different beta glucosidase (BGL) iso-forms and one of these was found to be glucose tolerant (GT-BGL). It was demonstrated that the BGL iso-forms in *A crystallinus* were differentially expressed in response to the C-source used for the cultivation.
- ♦ A fusant obtained by protoplast fusion of *Lactobacillus delbrueckii* and an amylase producing non-fastidious *Bacillus amyloliquefaciens* showed high yields of L(+) lactic acid (40 g/L; ~96% conversion of starch to lactic acid) from 83 g/L cassava bagasse (starch content 50%, w/w).

1. BIO-BASED PROCESSES AND PRODUCTS DEVELOPMENT

Development and application of industrial enzymes

Alpha amylase: Food grade alpha amylase production by *Aspergillus oryzae* was carried out in packed bed tray and column fermenters. Maximum enzyme yield (specific activity-146.34) was similar to that of control flasks (specific activity: 141.48). Substrate bed thickness strongly influenced the production



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and 2 cm or higher bed thickness resulted poor growth and enzyme production. Fermentation in column bioreactor (22.5 cm × 4 cm) at different aeration rates from 1.5 vvm to 4.5 vvm with a fixed bed height of 17.5 cm for 72h showed the production at all aeration rates, but the maximal enzyme yield (specific activity-220.3) was obtained at 3.5 vvm. No growth was observed in the column fermenter for which aeration was not provided. Enzyme production was 48% higher by column bioreactor than by conical flasks and on contradictory growth were lower in column bioreactors.

Alpha amylase of *Bacillus amyloliquefaciens* produced by submerged fermentation was purified to near-homogeneity by ion exchange chromatography. Through the process 38.6-folds increase in purity with a specific activity of 72 was obtained. From SDS-PAGE, the apparent molecular weight of the purified enzyme determined as 58 kDa and was confirmed by activity staining. The purified enzyme exhibited maximal substrate specificity for amylase. The K_m and V_{max} of the enzyme was determined using both amylose and soluble starch as substrate. Scanning electron micrograph of raw rice starch hydrolysed with the partially purified enzyme showed its effectiveness (Figure 1).

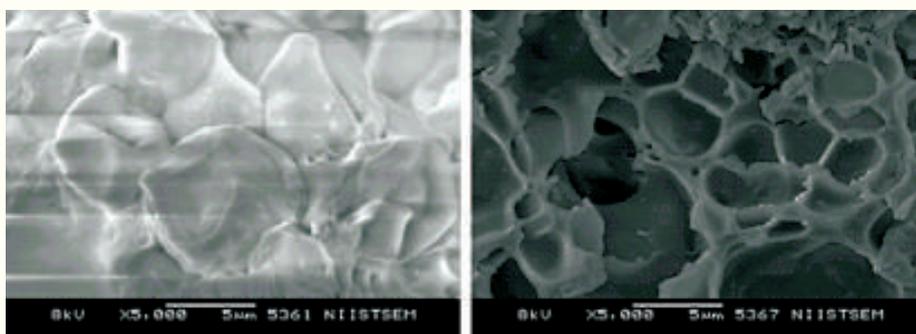


Fig. 1 Scanning electron micrograph of (a) raw rice starch (b) raw rice starch hydrolysed with purified enzyme (50 U) for 3h

Biocatalysts- a novel approach for the production of pharmaceuticals

Under the Indo-Argentina bilateral cooperation project, the stability studies of lipase enzyme were performed at different temperatures and in hydrophilic and hydrophobic solvents. The process development studies for the lipase production were carried out in submerged and solid-state fermentation conditions. Based on initial screening using a factorial design with 10 factors at two levels, three factors were found to be significant. A central composite design with three factors at 5



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levels was used to develop a quadratic model and validation of model is under progress. The screening under submerged fermentation revealed nine factors to be important. Further screening of factors using statistical design is under progress.

Substrate specific amino peptidases: Several *Streptomyces* strains were evaluated for extra cellular L- leucine aminopeptidase production. *Streptomyces gedanensis* was found to be a good producer of extra-cellular leucine aminopeptidase (LAP) in submerged fermentation using soy flour as substrate. The parameters influenced significantly were initial pH, incubation temperature, concentration of Tween80 and NaCl. The maximum LAP titer under the optimum conditions was 22.52 ± 0.14 IU/ml. pH optimum for the maximum LAP activity was in the range of 8.5 – 9.0 and the temperature optima between 50°C and 55°C. Metal ion salts, $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$, $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$, $\text{FeCl}_2 \cdot 2\text{H}_2\text{O}$, and $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$ in 5mM concentration enhanced the relative activity of enzyme. LAP produced by *S. gedanensis* was thermostable for about 60 min in presence of Co^{2+} at 60°C.

Development of thermostable and low pH tolerant phytase from *Aspergillus niger* using

site-directed mutagenesis: In continuation to a completed project on the production of phytase in solid-state fermentation, DBT has supported this project to develop pH and temperature tolerance in the fungal enzyme. The phytase sequences from NCBI database were downloaded and multiple sequences were aligned. The degenerate and specific primers for amplification from *Aspergillus niger*

NHBT-2007

Organised International Conference on New Horizons in Biotechnology (NHBT-2007) and the Fourth Annual Convention of the Biotech Research Society, India (BRSI) at Trivandrum during November 26-30, 2007.

Prof. Javed Iqbal, Director, Institute of Life Sciences, Hyderabad, who inaugurated the event, observed that biotechnology will provide an important background for drug discovery and emphasized that synergistic efforts are needed between the various fields for the development of research.

The function was felicitated by Prof. Claude-Gilles Dussap, Director, Polytech'Clermont Ferrabd, University Blaise-Pascal, France. The scientific programme of the conference focussed on thrust areas of industrial, environmental, food & agricultural and medical biotechnology with 101 invited lectures in 22 sessions and 437 posters in four sessions besides five mini-symposia focussing on Nanotechnology, Mycobacterium Research, Molecular Ecology, Advances in Food Safety and Biofuels. A total of 607 delegates, including 107 from the overseas countries attended the conference.



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were designed. The genomic DNA isolation protocol from fungal DNA was standardized and PCR amplification using degenerate primers was carried out.



Address by Prof G. C. Dussap (Blaise Pascal Univ, France) at the inauguration of NHBT-2007. On dais (L to R): Prof A. Pandey (BRSI President), Prof C. Larroche (Blaise Pascal Univ, France), Prof. T.K. Chandrasekhar (Director, NIIST), Dr J. Iqbal (Chief Guest), Dr M. R. Pillai (RGCB) and Prof L.V. Rao (BRSI Secretary)

Neutral protease production: *Aspergillus oryzae* NRRL 2217 was used for solid-state fermentation for neutral protease production using statistical design experiments employing the Box-Benken quadratic model. The model showed that the fermentation time and temperature had a significant interaction. Scale-up studies using the trays showed that the enzyme yields as obtained in the lab studies in the flasks could be well achieved.

Production, characterization and application of alpha and beta galactosidase: Psychrophilic yeast strains were isolated from low temperature milk portion for beta galactosidase. Different media were screened for the production of enzymes and cultural and nutritional parameters were optimized for the over-expression of enzymes from the selected medium.

Lignin degrading enzymes production and application: Utilization of brown coir waste pith for the production of lignin degrading enzymes and development of value added products from the fermented



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waste pith was evaluated. The cultures of *P. sajorcaju*, *P. sqarrulosus*, *P. florida* and *Ganoderma* sp. were screened and *P. sajorcaju* was selected for solid-state fermentation with coir pith.

Production of nitrilase, reductase and hydantoinase: Soil samples were screened for isolating wild-type microbial cultures for the production of specific enzymes under an industrial consultancy project.

Production of biopolymers

Polyhydroxybutyrate production using renewable feed-stocks as substrate by *Bacillus sphaericus*:

The aim of this work was to study the production of polyhydroxybutyrate (PHB) using renewable feed-stocks residues as the carbon source. Seven substrates, viz., wheat bran, potato starch, sesame oil cake, groundnut oil cake, cassava powder, jackfruit seed powder and corn flour were hydrolyzed using commercial enzymes and the hydrolyzates assessed for selecting the best substrate for PHB production. Jackfruit seed powder gave the maximum production of PHB under submerged fermentation using *Bacillus sphaericus* (19%) at the initial pH of 7.5.

Production of L(+) lactic acid: L(+) lactic acid was synthesised as the monomer of polylactide by *Lactobacillus delbrueckii* NCIM 2025. Genome shuffling method was adopted to increase its productivity and also to develop the tolerance to pH, etc. Protoplast fusion of *L. delbrueckii* and an amylase producing non-fastidious *Bacillus amyloliquefaciens* ATCC 23842 was carried out. After the third cycle of protoplast fusion, lactic acid production by few fusants was monitored and the best fusant was selected for further studies. Selected fusant could utilize the liquefied cassava bagasse starch directly with minimum nutrient supplementation for L(+) lactic acid production. Optimization of the important process parameters for lactic acid production was conducted using Plackett-Burman design and Response Surface Methodology. During validation, 40 g/L of lactic acid was obtained (~96% conversion of starch to lactic acid) by using fusant inoculum (3%, v/v) from 83 g/L cassava bagasse (starch content 50%, w/w) supplemented with yeast extract and peptone (0.2% each) and the buffering agent (2% CaCO₃).

2. ENERGY

Bioethanol from lignocellulosic biomass: A new project on bioethanol production using lignocellulosic biomass as feedstock was initiated under the NMITLI scheme of CSIR. Different natural feed-stocks, such as rice straw, sugar cane bagasse and water hyacinth biomass were used as substrates for bioethanol



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production. Rice straw and sugar cane bagasse were selected as potent feed-stocks based on saccharification efficiency and availability. Production studies for cellulases from *T. reesei* RUT C30 and BGL from *A. niger* BTCF5 by SSF was continued, which showed that *A. niger* beta glucosidases could be differentially induced in response to carbon sources in the medium. Cellulase production by the fungus was optimized using statistical design of experiments and a four-fold improvement in the production was achieved. The partially purified BGL showed a K_i of $\sim 200\text{mM}$ which qualified it as a glucose tolerant enzyme.

Isolation and cloning of glucose tolerant beta-glucosidase from fungal isolate BTCF58 and the CBHI control elements from *T. reesei*, and the studies on the properties of the enzyme: This is a new project funded by the DST, New Delhi under the Young Scientists Fast Track scheme. Crude BGL preparation from BTCF58 was shown that the K_i for glucose inhibition of the GT-BGL was 400mM confirming that the enzyme was moderately glucose tolerant. Gel electrophoresis followed by activity staining revealed the presence of at least five different BGL and at least one of which was glucose tolerant. Degenerate primers were designed for amplification of the GT-BGL protein from *A. crystallinus*. BGL sequences of filamentous fungi belonging to classes I, III and V of glycosyl hydrolases were downloaded from public domain, aligned and conserved blocks were used for design of 14 sets of degenerate primers.



Figure 3: Differential induction of BGLs in *A. crystallinus*.
Lane 1: WB (SmF), Lane 2: RS (SmF), Lane 3: Cellulose (SmF)
Lane 4: Glucose (SmF), Lane 8: WB(SSF), Lane 9: RS(SSF)

Glucose tolerance of the different BGL iso-forms test by incubating similarly processed gels with the substrate (4-MUG) in presence of glucose indicated that the low molecular weight iso-form was glucose



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tolerant since only the band corresponding to this iso-form showed activity in presence of elevated glucose concentrations (Figure 4)

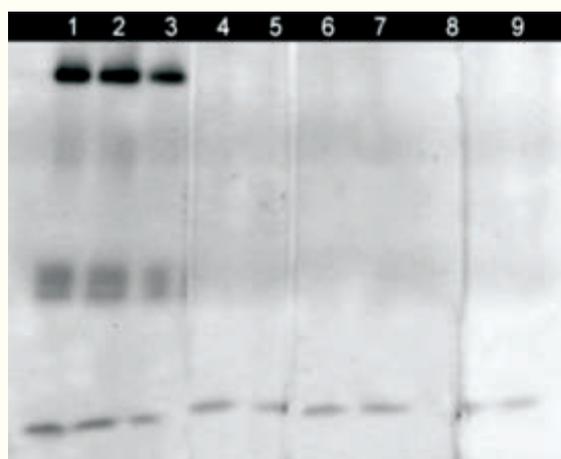


Figure 4: Glucose tolerance of BGL isoforms in *A. crystallinus*
Lanes 1,2,3: Control (No Glucose), Lanes 4, 5 : 0.5M Glucose,
Lanes 6, 7: 1M Glucose, Lanes 8, 9: 1.5 M Glucose

3. HEALTH AND GENOMICS

Mycobacterium research

Molecular cloning, over expression and biochemical characterization of beta lactamase of *M. tuberculosis*: Three genes (Rv2068c, Rv 0406 c and Rv3677c) from the genome data bank of *M. tuberculosis* H37 Rv, showing hypothetical beta lactamase activity were cloned in pET28a vector and over expressed in C41 (DE3) *E. coli*. The His tagged recombinant proteins were confirmed by immunoblotting and were shown to have beta lactamase activity by the hydrolysis of nitrocefin and other beta lactams. Catalytic parameters for all the recombinant proteins were derived followed by the enzyme inhibition studies. Antibiotic susceptibility studies were performed using the recombinant strains showed an increased resistance. The study revealed the possibility of more than one gene in *M. tuberculosis* producing proteins having beta lactamase or beta lactamase like activity giving wide spectrum of resistance against beta lactams. Systematic study of *M. tuberculosis* beta lactamases and that of related species and their correlation with beta lactam and inhibitor susceptibility profile are useful in developing new antibiotic regime for treatment of tuberculosis with MDR strains.



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Mannolipids and mannose metabolism in *M. tuberculosis*: The survival of *Mycobacterium* within the macrophages is possible due to the physiological interaction between mannan core (MC) in the mannolipids of mycobacterial cell wall and mannose binding receptor (MBR) on macrophage cell wall. Four genes namely *manA*, *manB*, *pmmA* and *pmmB* involved in the synthesis of mannolipids in *M. tuberculosis* were amplified, cloned and over-expressed in *E. coli* through pET28a expression vector as Histidine tagged. Purification and detailed biochemical characterization of over expressed recombinant proteins were in progress.

Molecular studies on peptide deformylase and methionine aminopeptidases of *M. tuberculosis*

H37Rv: The peptide deformylase (PDF) from *Mycobacterium tuberculosis* H37Rv was overexpressed in *E. coli* as recombinant His tagged protein and purified by passing through the Ni²⁺ affinity column. The purified PDF was found active against the chemotactic peptide substrate N-formyl-Met-Ala and that Km value was calculated to be 4 mM. The optimum temperature for activity of PDF was found to be 30 °C and pH of 7.5. Metal chelators like EDTA and 1, 10 Phenanthroline completely abolished the PDF enzyme activity at a concentration of 10mM. The recombinant PDF was shown to be completely inhibited by the known peptide deformylase inhibitor actinonin and a method for screening of natural inhibitors against mycobacterial PDF is being standardized. Some site-directed mutants of peptide deformylase, having some of their conserved sequences changed, were created to study the structure-function relationship of this protein.

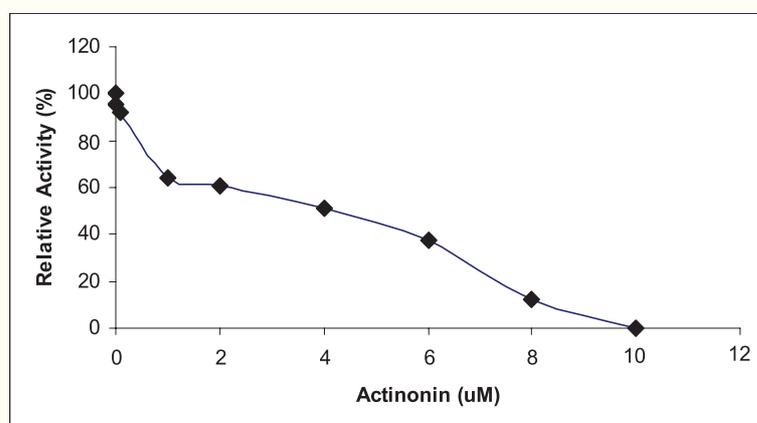
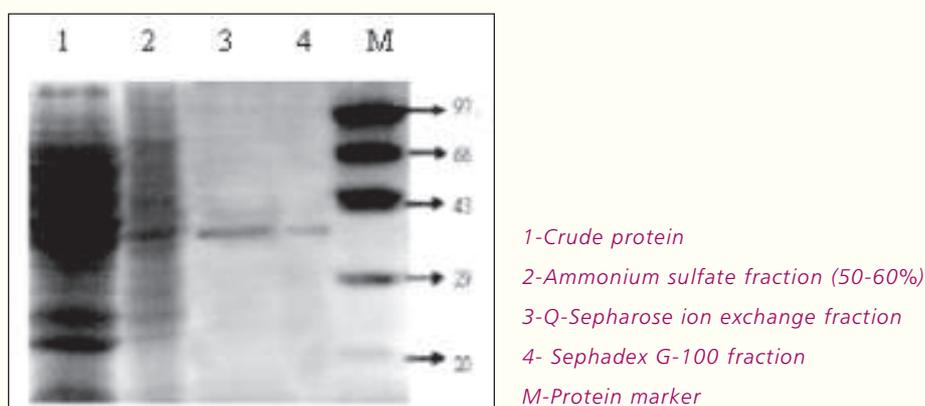


Figure 5. Inhibition of peptide deformylase of *M. tuberculosis* by Actinonin



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The methionine aminopeptidases (MetAP) of *M. smegmatis* mc²155 was purified from the organism directly by routine purification steps involving ammonium sulfate precipitation and sequential chromatographic steps. The purified Methionine aminopeptidase was found active against L-Methionine *p* nitroanilide, a chromogenic substrate specific for Methionine aminopeptidases. The MetAP was found to be activated by Mg²⁺ from the apoenzyme state and not by Co²⁺ which is the reported cofactor for most of the methionine aminopeptidases. *M. smegmatis* MetAP was found to be inhibited by known aminopeptidases inhibitors like, bestatin, amastatin and actinonin. Some of the cations, such as Fe²⁺ and Cu²⁺ inhibited the MetAP from *M. smegmatis*.



Metagenomics

Construction and screening of environmental DNA libraries for novel beta-lactamase inhibitors and lipases: Beta-lactamase inhibitors: DNA extraction from soil samples was done using a combination of lysozyme/CTAB, SDS and PVP method and DNA isolation protocol was standardized. The isolated metagenomic DNA's were tested for restriction digestion by using *Hin* dIII enzyme. The average size of metagenomic DNA isolated was 30 Kb. The isolated DNA was end repaired, size selected and ligated with pCCFos vector and packaged. The *E. coli* cells were infected with packaged library and plated on Chloramphenicol containing Luria agar plates. Approximately, 2000 colonies were screened by plating with beta-lactamase producing strain. Further screening of library and confirmation of clones is in progress.

Lipase producers were enriched in the soil sample for construction of metagenomic library and DNA isolation was carried out. DNA yield was higher with the enrichment cultures. Quality of DNA was



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tested by performing absorbance ratio analysis and restriction digestion. Absorbance ratio was found to be lower ($260/280=1.3-1.5$) for soil DNA indicating contamination with proteins and/or humic components. Restriction analysis was not successful implicating a probable interference with humic components. Purification using gel purification kits as well as by classic methods of repeated phenol chloroform extractions were attempted with some improvement in absorbance ratios ($260/280=1.5-1.6$). Tests are being carried out for restriction digestion compatibility

Probiotics

Metabolic activities and genetic manipulation leading to nutraceutical products from lactic acid bacteria for novel applications: Lactic acid bacteria (LAB) were isolated from fermented vegetables, sour dough, milk products, sheep, human excreta and yogurt. The isolated cultures were evaluated for certain probiotic characteristics like bile salt resistance, salt tolerance, survival in low pH, hydrophobicity of the cell surface, emulsifying activity, resistance to phenol concentration, antimicrobial activity and susceptibility pattern against antibiotics etc. The selected cultures were further screened for their ability to produce nutraceuticals such as folic acid and exo-polysaccharide (EPS). Two potent isolates, CB2 (from cabbage) and SD2 (from sour dough) were found to produce both extra cellular and intracellular folate. Metabolic engineering has been initiated for increased production of folate. Among the isolates two potent isolates, MC1 from yogurt and W3 from whey were found to be EPS producers, of which the best is by MC1 with a maximum production of 8.79 ± 0.05 g/l. and the yield increased up to (24.17 g/l) by performing statistical studies.

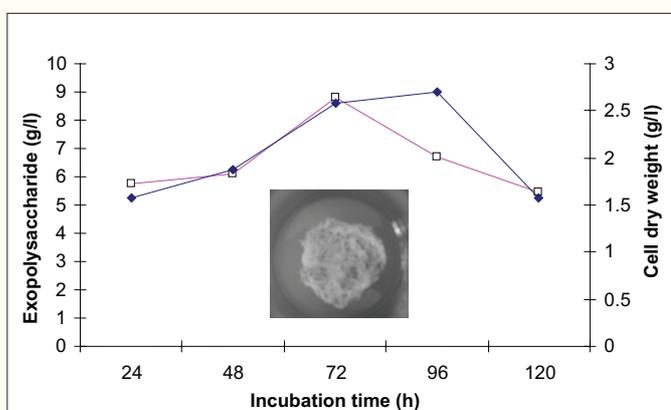
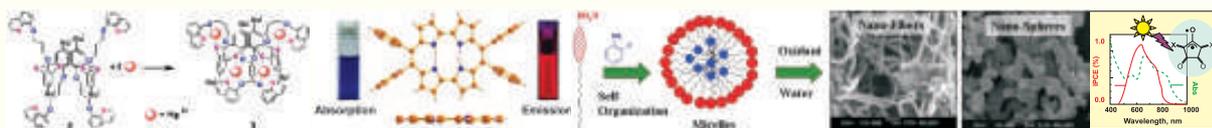


Figure 7. EPS production at various time intervals (\square) and the growth profile of MC1(\blacklozenge).



Biotechnology Division

Development of efficient probiotic to combat Vitamin B12, folic acid and iron deficiency: This is a net work research programme involving three institutions such as North Maharashtra University, Jalgoan, Osmania University, Hyderabad and NIIST Trivandrum. The over all work for NIIST involves the isolation and collection of lactic acid bacteria from various sources, screening them based on their qualities underlying probiotic characteristics and the selected ones will be further analyzed for the efficacy to produce folic acid and derivatives. HPLC and microbiological assay were adopted to detect the folate levels. Extracellular and intracellular folate levels were detected for the selected isolates. Further process optimization studies for the folate production are in progress.



CHEMICAL SCIENCE & TECHNOLOGY

Vision & Areas of research

'To be internationally recognized for excellence in discovering new knowledge about functional materials and natural products/bioactive molecules, and to develop such materials/molecules for industrial applications using innovative, cost competitive and environmentally acceptable processing technologies.'

- Photosciences and Photonics
- Organic Chemistry
- Inorganic & Polymer Materials

Highlights

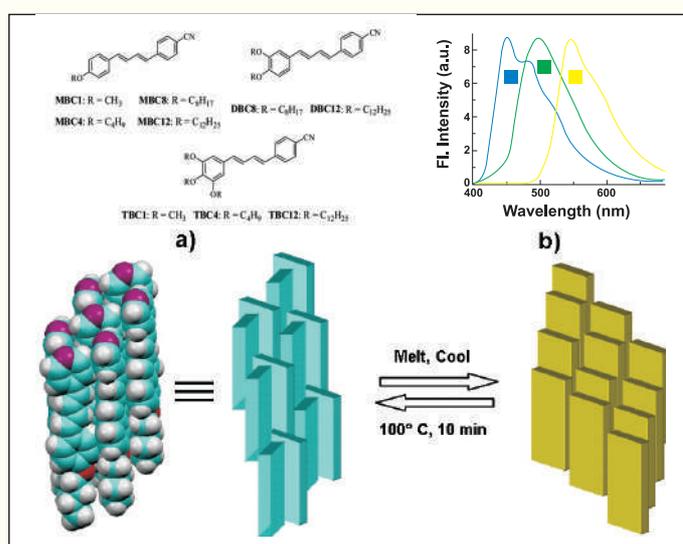
- For the second consecutive year a member of the Division namely Dr. A. Ajayaghosh has been awarded the prestigious Shanti Swaroop Bhatnagar Prize for Chemistry.
- Dr. K. George Thomas has been elected as Fellow of the Indian Academy of Sciences, Bangalore.
- CSIR Young scientist award-2007 by Dr. M Jayakannan,
- MRSI medal-2007 by Dr. A. Ajayaghosh
- MRSI medal-2008 by Dr. Suresh Das.
- Cover Pages publications in leading journals such as Angewandte Chemie, J. Phys. Chem. J. Polym. Sci. and Macromolecules.
- Collaboration with Corning SAS-France a leading manufacturer of a wide range of products including plastic photochromic lenses, fixed-tint sunglass lenses, and camera and LCD projector lenses.
- Co-ordinating a major CSIR funded network project on "Organic Materials for Energy Efficient Devices". NCL, Pune and CLRI, Chennai participating in this network project.
- Participating in two other network projects being coordinated by other laboratories in the CSIR family.
- Initiated a major project on development of novel infrared absorbing molecules and complexes for photodynamic therapy of cancer and related diseases in collaboration with CCMB & RGCB with financial support of DST under the national initiative on metal based drugs.



1. PHOTOSCIENCES AND PHOTONICS

Molecular Packing Vs Solid State Fluorescence

Non-covalent molecular interactions such as aggregation play a major role in controlling molecular organization in materials and an in depth knowledge of these interactions is fundamental for predicting their structure-property relationships. The role of molecular packing in determining



Change in fluorescence with difference in molecular packing in solid state.

solid state fluorescence and other photophysical properties of organic molecules is an area that is still not well understood and it is of significant importance in the design of organic light emitting diodes (OLEDs). Although a number of chromophores exhibiting strong emission in solution have been designed and synthesized, their solid state fluorescence is quenched due to exciton coupling caused by molecular aggregation. This work deals with the interesting observation of thermally reversible transformation between two polymorphic states of alkoxy-

cyano-substituted diphenyl butadiene compounds as well as alkoxy phenyl-pyridyl compounds possessing visually distinguishable fluorescence. The differences could be attributed to a transformation in the molecular packing of the material which could be characterized by studying the molecular packing by single crystal X-ray analysis (*J. Phys. Chem.* 2008, 112, 2137 and *J. Phys. Chem.* 2008, 112, 8429).

Chirality Switching in Sugar Based Photoactive SmC Liquid Crystals*

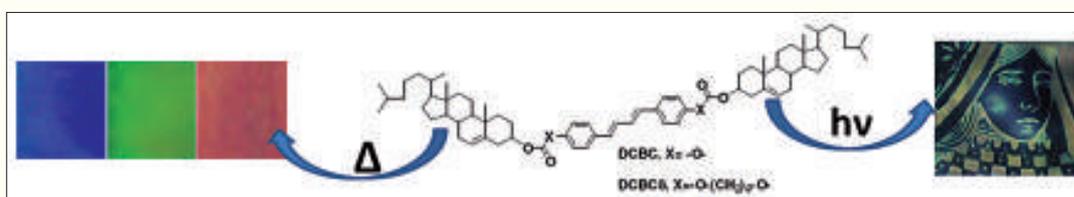
Liquid crystals (LCs) belong to a class of materials, which have been extensively exploited for the past several decades for a variety of technological applications. Among the various liquid crystal phases, chiral nematic and chiral smectic C (SmC*) attract considerable attention. It is well known in the literature that in spite of the presence of chiral centers, amphiphilic sugars in generally do not exhibit macroscopic chirality due to strong hydrogen bonding between sugar head groups. The present study demonstrated the existence of chiral smectic C (SmC*) phases in a series of symmetrical bolaamphiphiles possessing a diphenylbutadiene core and glucopyranoside head groups linked together



by oligomethylene spacers exhibited the smectic C* phase. The absorption and fluorescence spectra of these materials suggest that the unusual observation of macroscopic chirality in these bolaamphiphiles containing free hydroxyl groups could be attributed to self aggregating behavior of the diphenyl butadiene core. (*Adv. Funct. Mater.* 2008, 18, 1632).

Photoresponsive N Liquid Crystals with Circularly Polarised Photoluminescence*

Chiral nematic (N*) LCs are especially attractive among liquid crystals, since in these systems the molecules self-organize into helically ordered structures which lead to selective reflection of light, depending upon the pitch of the helix. The helical pitch of N* LCs is dependent upon various factors such as temperature, electrical, or magnetic field and on the nature and concentration of impurities, which makes it possible to tune their color by a variety of external stimuli. In the present work, photo- and thermo responsive trimesogens consisting of a diphenylbutadiene core linked to cholesterol moieties on either side via flexible alkyl chains were developed for display device fabrication. The pitch of the cholesteric phase of these materials could be continuously varied thermally and photochemically, making it possible to tune the color of the film over the entire visible region. The color images thus generated could be stabilized by converting them to N* glasses. These materials were also highly photoluminescent, exhibiting circularly polarized characteristics in the glassy liquid crystalline state even by linearly polarized excitation. (*Adv. Funct. Mater.* 2008)



Photomodulated full color display device

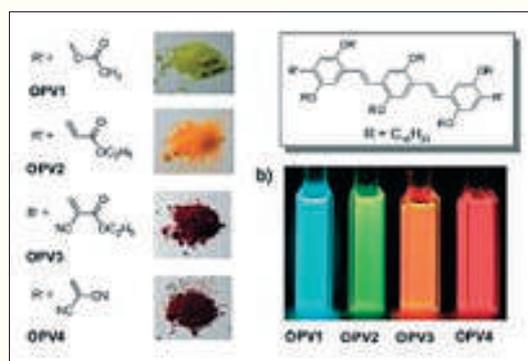
Design of pi-Gels with Tunable Emission

A new class of soft materials was designed which emit light of different colors as shown in the figure. The dipolar ester moieties played a crucial role in providing a tunable electronic character to the

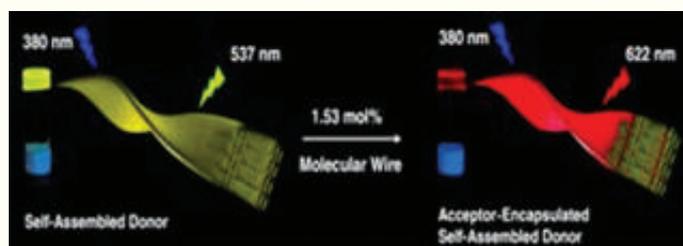


Chemical Science & Technology

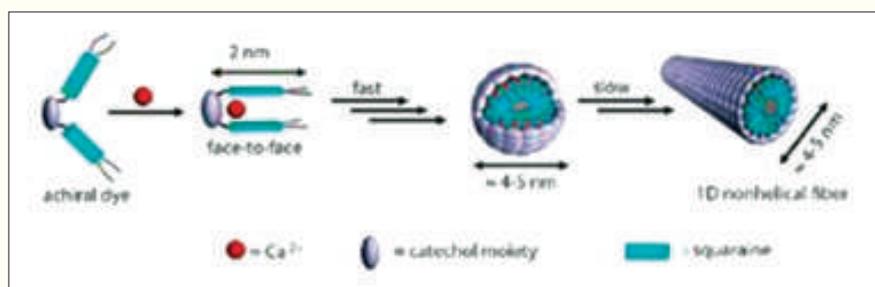
molecules shown in the structure, which form gels in organic solvents. These gels are ideal scaffolds for the design of supramolecular light-harvesting assemblies and are potential two-photon-absorbing materials, which could open the window to a novel class of electronically active soft organic materials with tunable optical properties (*Adv. Mater.* 2007, 19, 411)



Subsequently, it was demonstrated that the encapsulation of less than 2 mol% of a molecular wire, PYPV within the pi-gels facilitate fast exciton funnelling and efficient energy transfer which results in a supramolecular light harvesting antenna. Although a variety of organic dyes and chromophores have been reported as acceptors, this is the first use of a molecular wire for trapping excitation energy in an organo gel medium. Energy transfer is feasible only in the case of the gel and occurs exclusively from the donor (OPV) self-assembled structure to the molecular wires as a result of fast and efficient exciton migration. These results are expected to open up further research interests in the design of artificial light-harvesting assemblies (*Angew. Chem., Int. Ed.* 2007, 46, 6260)

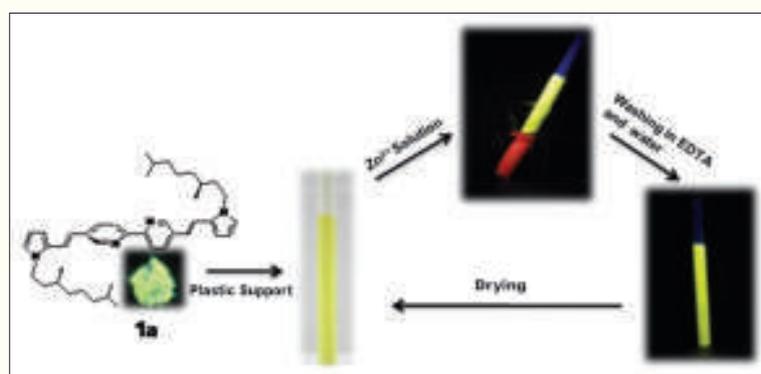


Cation controlled the self-assembly of a tripodal squaraine dye to spherical and helical architectures. It was demonstrated that subtle variation in the structure of the dye had a significant impact on the hierarchical self-assembly, initially to 0D spherical and finally to 1D extended micellar structures, accompanied by a hyperchromic effect. (*Chem. Commun.* 2008, 969).



Molecular Probes for the Detection of Zinc Ions under Aqueous Conditions

Detection and imaging of Zn^{2+} in biological as well as analytical samples are of paramount interest due to the role of this cation in physiological functions. In this work, the high solid-state

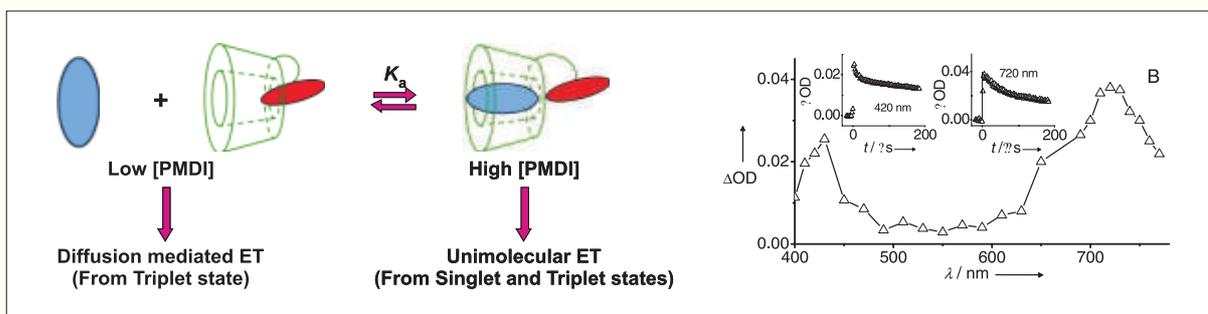


fluorescence of a chiral ligand **1a** for the fabrication of a reusable dipstick which is sensitive to Zn^{2+} ions was explored. A fluorescence “dipstick” was fabricated by coating **1a** in a solid support which upon dipping in an aqueous Zn^{2+} solution resulted in a change of fluorescence and color from initial greenish-yellow to bright

red. The details of the synthesis, optical properties of **1a** and its use in the fabrication of the reusable dip-stick fluorescence device for the detection of Zn^{2+} ions were recently published (*Chem. Commun.*, 2008, 2903 - 05)

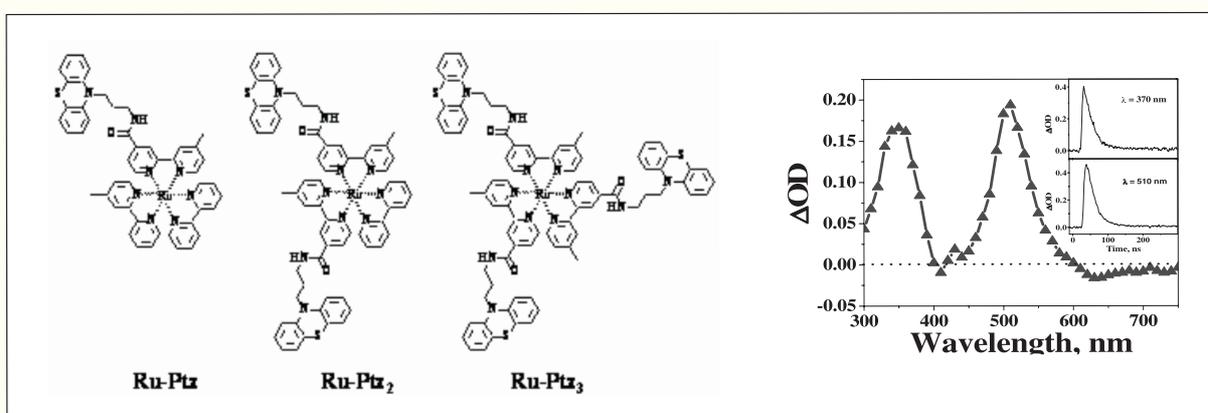
Photoinduced electron transfer in β -CD based supramolecular dyads

Photoinduced electron transfer (PET) between a β -CD-appended donor and a β -CD included acceptor was studied in aqueous solution using fluorescence quenching and laser flash photolysis techniques. At very low concentrations of acceptor, the equilibrium was in favour of free molecules, and under these conditions fluorescence quenching was negligible and diffusion mediated electron transfer involving the triplet excited state of the donor predominated. At high concentrations of the acceptor the equilibrium was largely in favour of the supramolecular dyad and intra-ensemble PET processes predominate. The experimentally determined PET rates agree very well with those calculated using Marcus equation. It was observed that a fraction of the ion pairs survived for more than 200 ms (*Chemistry - A European Journal* 2007,13, pp. 5173-85).



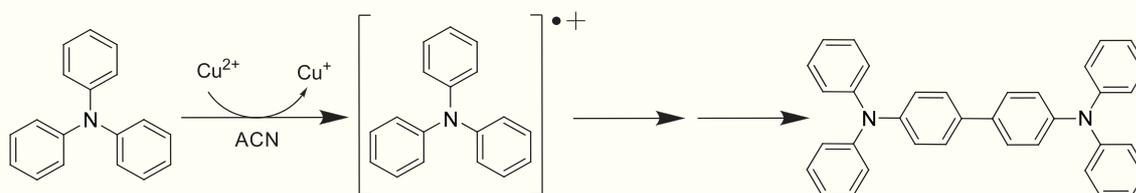
Long-lived photoinduced charge separation in new donor-acceptor systems

Synthesis and photophysical properties of three phenothiazine substituted tris-bipyridylruthenium dyads were studied. Very facile electron transfer takes place in these systems with the rates $k_{\text{et}} > 10^8 \text{ s}^{-1}$. Compared to previously reported systems the back electron transfer rates in these systems were about 100 times slower. Observation of the charge separated states in the nanosecond time scales was thus enabled (*Photochem. Photobiol. Sci.* 2008, 7, 826–33).



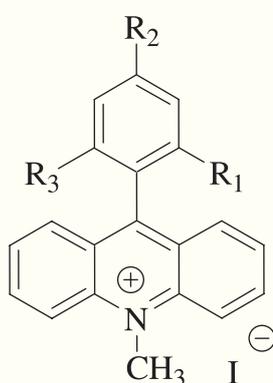
Cu(II) Mediated Generation of Triarylamine Radical Cations and their dimerization

It was earlier shown that Triphenylamine derivatives undergo electron transfer to Cu^{2+} in acetonitrile to give amine radical cations, which undergo dimerization reactions to yield tetraphenylbenzidines. Synthetic utility of this reaction was demonstrated using several triphenylamine derivatives and yields in excess of 80% were obtained in most cases. Involvement of the amine radical cations in these reactions was confirmed by esr and absorption spectroscopic studies (*Organic Letters* 2008, 9, pp. 2709-12).



Design of novel acridinium derivatives and study of their interactions with ssDNA

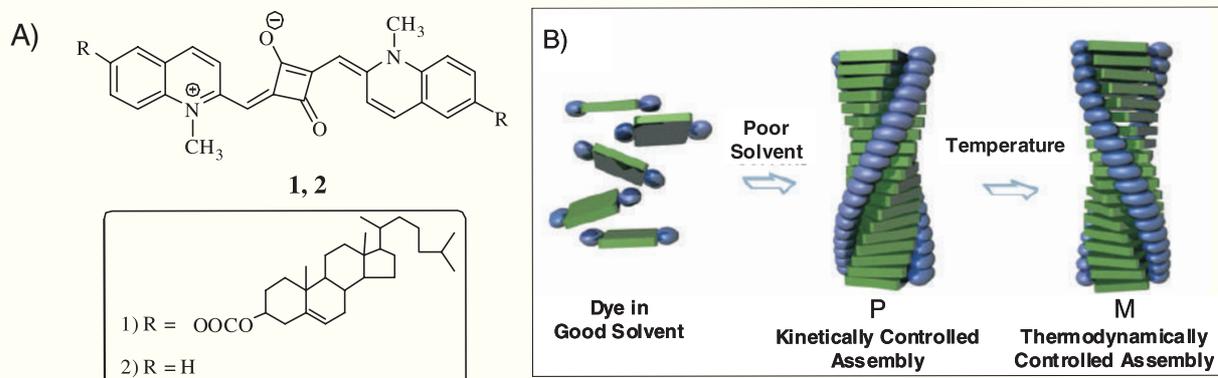
The single strand DNA (ssDNA) forms an important intermediate in processes such as DNA replication, recombination and repair. In this context, a few novel acridinium derivatives were synthesized which showed high water solubility and ability to distinguish between ssDNA and dsDNA through changes in the fluorescence intensity. These systems can be used as probes for the quantification of ssDNA in buffer (*J. Phys. Chem. B* 2007, 111, 6549-56).



- 1) $R_1 = \text{CH}_3, R_2 = R_3 = \text{H}$
- 2) $R_1 = R_2 = \text{CH}_3, R_3 = \text{H}$
- 3) $R_1 = R_3 = \text{CH}_3, R_2 = \text{H}$

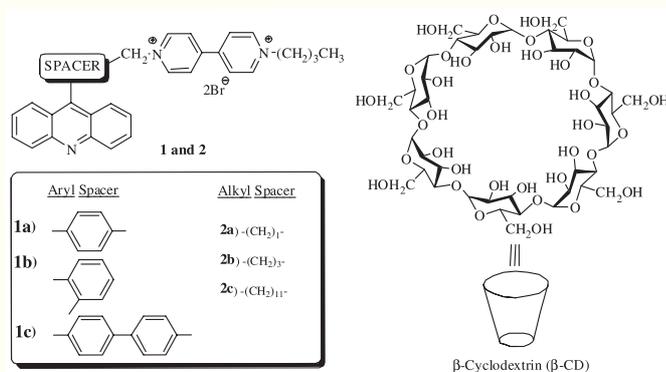
Supramolecular assemblies that undergo chirality inversion

Novel cholesterol-appended squaraine dye which forms two H-type supramolecular assemblies with opposite chirality was designed. Interestingly, the chirality inversion in these assemblies can be brought about by changing either the concentration, temperature or the solvent composition (*Chem. Eur. J.* 2007, 13, 5944-51).



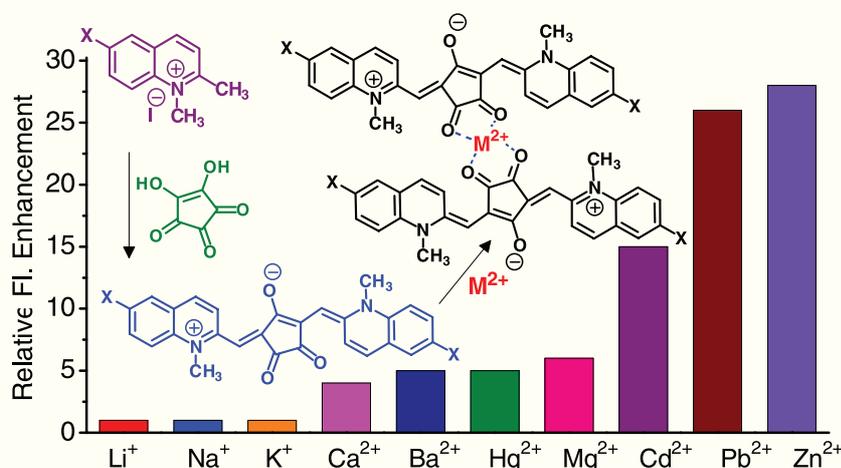
β -Cyclodextrin induced unusual planarization in electron-donor acceptor dyads

Encapsulation of the dyads having aliphatic spacer group in β -cyclodextrin (β -CD) led to the conformational unfolding of sandwich type of structure, whereas the dyads with rigid aryl spacer group underwent unusual planarization as compared to the un-encapsulated dyads resulting in the enhanced electron transfer reaction between the donor and acceptor moieties (*J. Phys. Chem. B* 2007, 111, 11940-47).



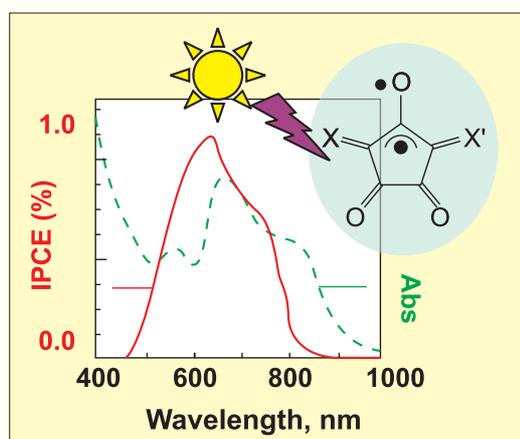
Infrared absorbing croconaine dyes: synthesis and metal ion binding properties

With the objective of developing near infrared (NIR) absorbing dyes, a few novel quinaldine based croconaine dyes were synthesized. These dyes exhibited absorption 750-850 nm and underwent selective interactions with the divalent metal ions. These infrared absorbing dyes can be favorably utilized for the development of potential sensors for the detection of metal ions and can be exploited as sensitizers for photodynamic therapeutic applications (*J. Org. Chem.* 2008, 73, 274-79).



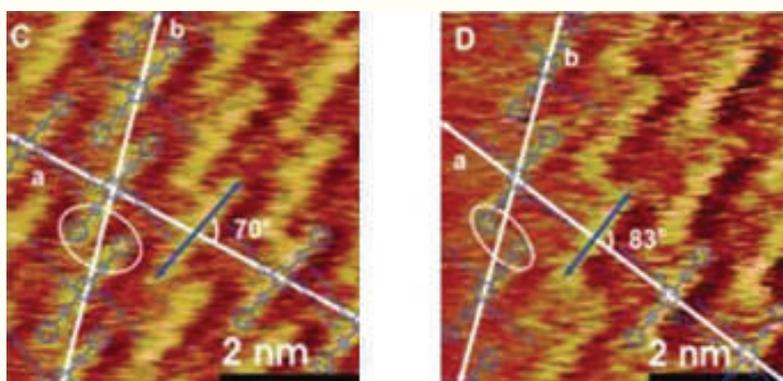
Harvesting infrared photons with croconate dyes

Excited state properties of the croconate dyes were investigated with an aim to utilize them as light harvesting assemblies in the infrared (IR) region ($\lambda_{\text{max}} \sim 865 \text{ nm}$). The excitons formed upon excitation of the dye aggregates underwent charge separation at the TiO₂ and SnO₂ interface. (*Chem. Mater.* 2008, 20, 265-72).



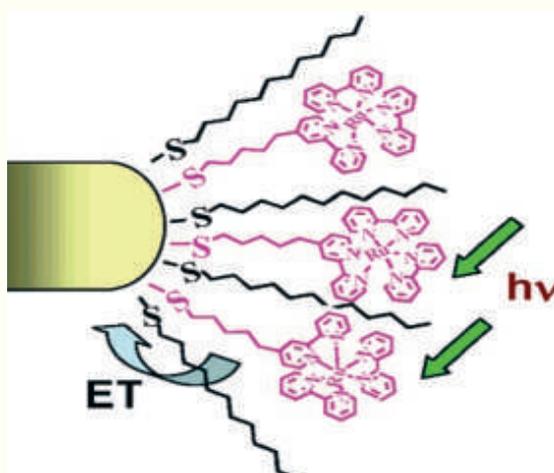
Self-Organization of Phenyleneethynylene into Wire-Like Molecular Materials on Surfaces

A model phenyleneethynylene, which does not possess any functional groups, self-organizes into wire-like structures on 2D surfaces. High-resolution STM imaging revealed that the molecules are arranged in a skewed 1D fashion. Analysis of various domains indicated the existence of two types of molecular packing arising from different modes of alkyl CH... π interaction, which was further supported by theoretical calculations. (*J. Phys. Chem. C*, 2007, 111, 14933-36.)



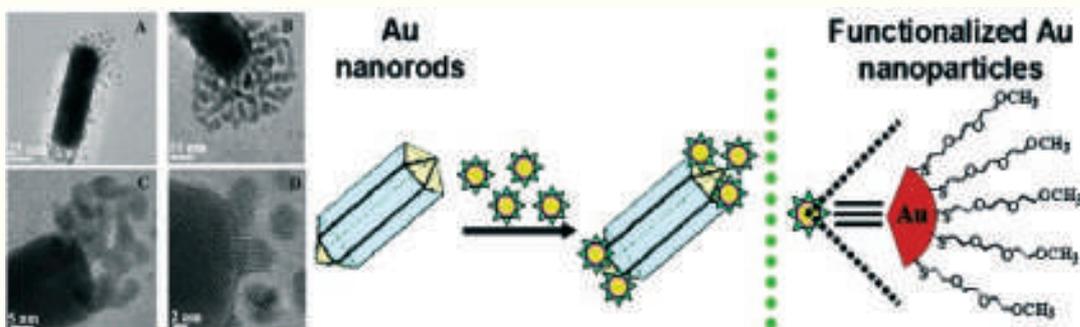
Ruthenium(II) Trisbipyridine Functionalized Gold Nanorods. Morphological Changes and Excited-State Interactions

The tris-bipyridylruthenium chromophores were linked to gold nanorods and their photophysical and excited state properties were investigated. Emission decay analysis indicated an efficient energy transfer from the chromophore to gold nanorod (*J. Phys. Chem. B.*, 2007, 111, 6839-44).

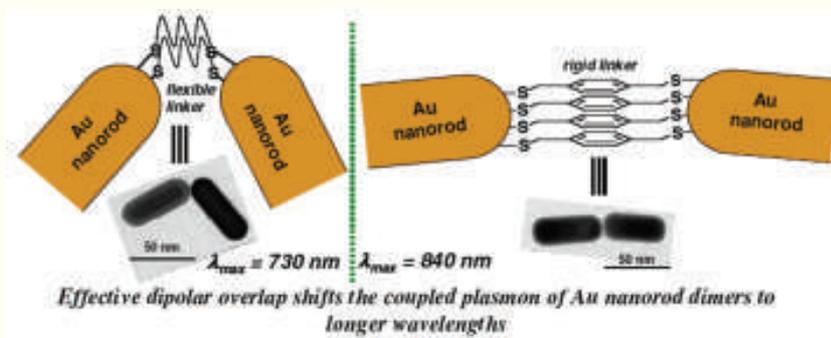


Preferential End Functionalization of Au Nanorods through Electrostatic Interactions

A novel methodology for the preferential end functionalization of Au nanorods with nanoparticles was reported by exploiting the electrostatic attractive interactions. The enhanced potential at the edges of Au nanorods preferentially attracted the positively charged Au nanoparticles, leading to their selective binding. Site-specific binding resulted in a spontaneous bathochromic shift in the longitudinal Plasmon band of Au nanorods which was dependent on the size of the nanoparticles (*J. Am. Chem. Soc.* 2007, 129, 6712-13).



Plasmon Coupling in Dimers of Au Nanorods



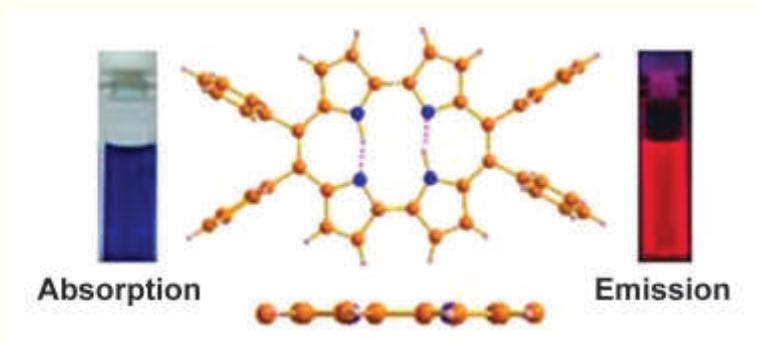
The coupled Plasmon absorption of Au nanorod dimers was investigated as a function of orientation between the long axes of the nanorod by linking them with rigid and flexible molecules. As the angle between the Au nanorods increases, the coupled Plasmon band shifts to longer wavelength confirming the role of effective dipolar overlap (*Adv. Mater. In press*).

Materials for sensors and therapeutic applications

Syntheses, spectral and structural characterization of various Calixpyrrole, calixphyrin and porphyrin isomer derivatives are reported. The pyrrole units in the ferrocenyl based calix[2]pyrrole showed 1,2-alternative conformation, which resembled the parent calix[4]pyrrole units. The positive shift in the electrochemical studies upon the addition of various anions suggests the moderate binding. The structural analysis of 1:1 calix[2]phyrin showed the self-assembled dimer, while the 2:2 isomer exhibited in 1D array. On the other hand, porphycene, a structural isomer of porphyrin unit, is synthesized through the acid-catalyzed oxidative coupling reaction, which is the alternative synthetic methodology for the McMurray coupling reaction, and is the only known synthetic route till date. For the first time, the synthesis of *meso*-tetraarylporphycene as shown here was demonstrated. The photophysical properties showed, ten fold absorption (blue) in the Q-band region and two fold emission (red), higher

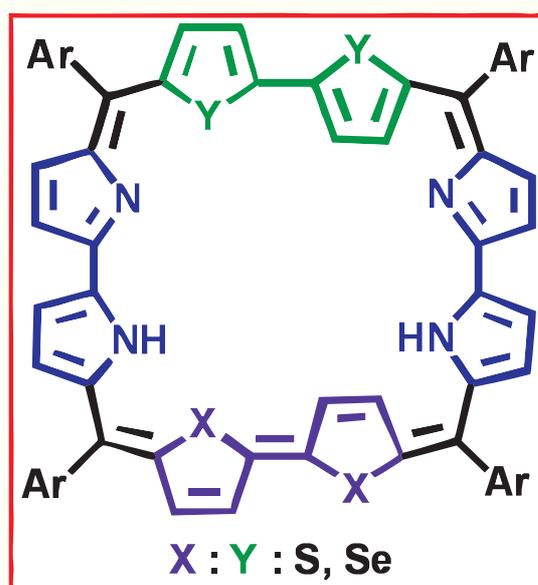


than the respective parent porphyrin unit, which clearly suggests that this is a potential candidate for Photodynamic therapeutic (PDT) applications. (Org. Lett. 2007, 9, 4769-72.)



New Generation Organic Non-Linear Optical Materials

A new set of non-linear optical materials which show very high third order non-linear optical response have been synthesized and characterized. These materials are based on Porphyrins and Expanded porphyrins (Figure) which have conjugated π -electrons. In addition to excellent non-linear optical response (*J. Phys. Chem. B* 2008, 112, 6900-05), they also exhibit a variety of structural diversity. An attempt was made to relate the structure with function (*Acc. Chem. Res.* 2008, 41, 265-79).

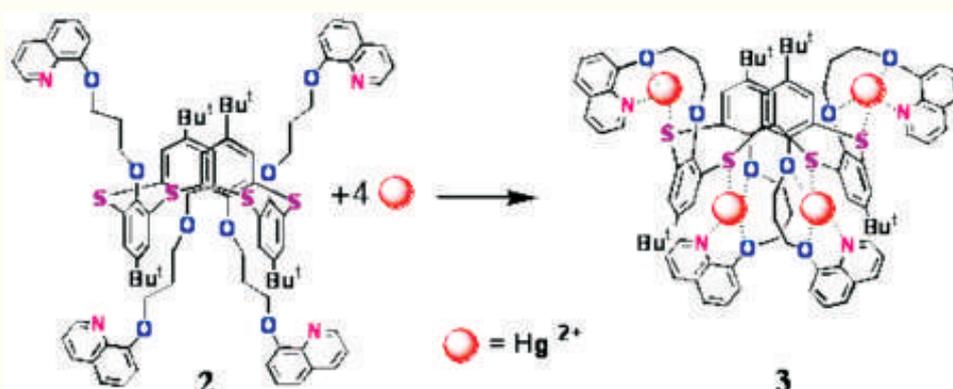




2. ORGANIC CHEMISTRY

A New Hg²⁺- Selective Fluorescent Sensor Based on 1,3-Alternate Thiocalix[4]arene Anchored with Four 8-Quinolinoloxo Groups

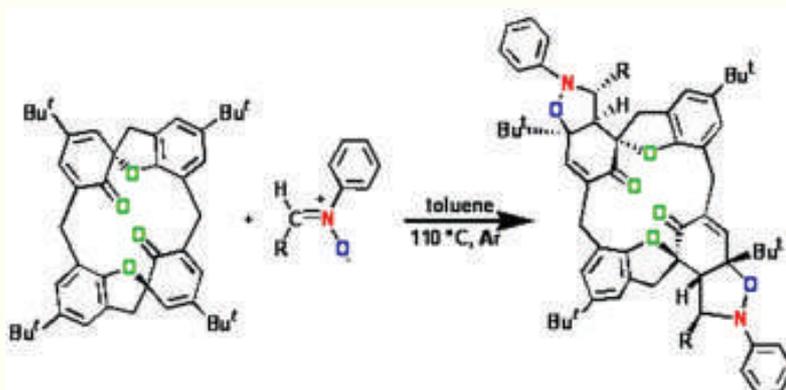
A new thiocalix[4]arene derivative **2** bearing four quinolinoloxo groups through propyl chains in 1,3-alternate conformation was synthesized and its metal ion binding and sensing properties were investigated. The receptor exhibited pronounced Hg²⁺ selective ON-OFF type fluoroionophoric properties among the representative transition- and heavy metal ions. The unusual formation of a tetramercury complex **3** involving four Hg²⁺ ions encapsulated in a single platform was demonstrated by UV-vis, fluorescence, ¹H NMR and MALDI-TOF mass spectral studies (*Inorg. Chem.* 2007,46,6277-88)



The unusual formation of a tetramercury complex and mercury selectivity of a newly synthesized 1,3-alternate thiocalix[4]arene derivative bearing four 8-quinolinoloxo groups through flexible

Novel 1,3-Dipolar Cycloaddition reactions of calix[4]bis(spirodienones): Synthesis of Isoxazolidine derived macrocycles derived macrocycles

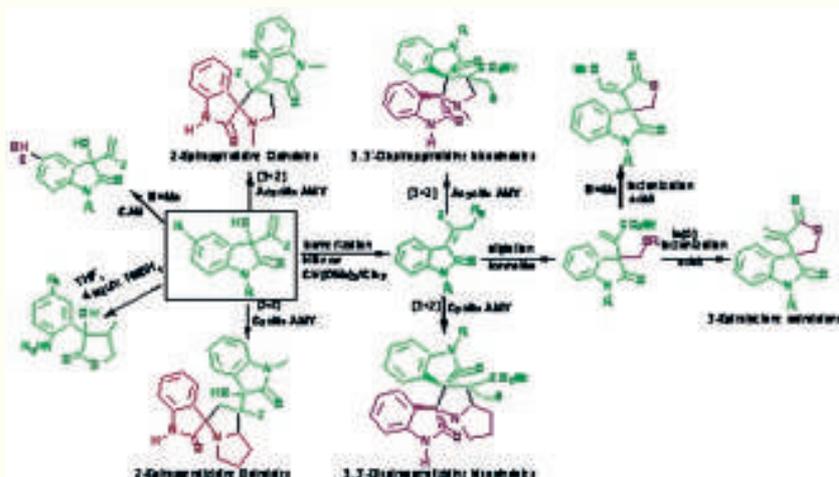
Calix[4]bis(spirodienones) can perform as either 4 π or 2 π components in cycloaddition reactions with various carbo- and hetero-dienophiles and with 1,2-benzoquinones leading to the formation of highly functionalized macrocycles. Highly regio- and stereoselective 1,3-dipolar cycloaddition reactions of a bis(spirodienone) derivative of calix[4]arene with nitrones that provided easy access to isoxazolidine derived macrocycles in excellent yields was demonstrated. These isoxazolidine derivatives could be considered as direct precursors of 1,3-amino alcohols (*Tetrahedron Lett.*, 2008,49,1750-52).



'Novel reactivity of bis spirodienone showing dipolarophilic behaviour'

Novel Synthetic Methodologies Based on Morita-Baylis-Hillman (MBH) adducts

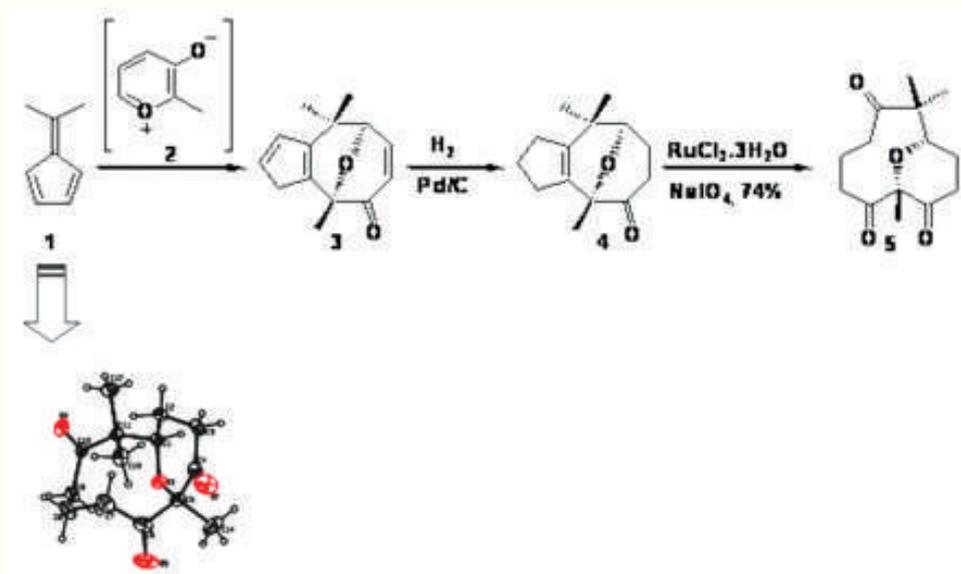
The MBH reaction has become a powerful tool for the atom economical construction a C-C bond and involves the coupling of α -position of activated alkenes with an electrophile under DABCO giving densely functionalized molecules which play an important role in bringing latitude to organic synthesis for the construction of complex molecular architectures. Garden *et al* reported the synthesis of MBH-adducts from isatin which has not been utilized for the synthesis of novel 3-spiro oxindole synthesis. Hence, the MBH adducts derived from isatin and heteroaldehydes were utilized for the construction of various pharmacologically important mono- and dispiro heterocyclic oxindoles using 1,3-dipolar cycloaddition reaction of azomethine ylides (AMY) and 3-spirolactone oxindoles using Indium chemistry. Reductive cyclization and CAN mediated oxidation gave highly functionalized compounds. The entire study is schematically shown below (*Org. Lett*, 2007, 9, 4095-98. *Tetrahedron Lett*, 2008, 49, 2611-15).



Novel Synthetic Transformations of MBH adducts of Isatin

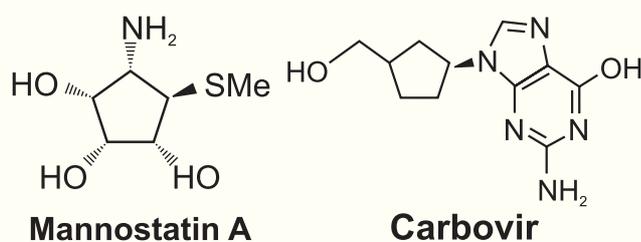


described herein is easy to perform and delivers densely functionalized carbocycles in good yields. The procedure is noteworthy as it hardly requires an elaborated catalytic system and proceeds with high level of atom efficiency from cheap and easily available starting materials (*Eur. J. Org. Chem.*, 2008, 35, 5847-51).



Palladium Catalyzed Desymmetrization of Mesocyclic olefins towards Pharmaceutical Intermediates

One of the most important goals in contemporary synthetic organic chemistry is the development of stereoselective carbon-carbon coupling reactions providing a broadly applicable method to synthesize complex structures from simple precursors. There are no general methods available for the synthesis of 3,4-disubstituted cyclopentenes and most of the reported syntheses involve several steps and usually result in low or moderate yields. Desymmetrization of meso compounds provides an efficient route to asymmetric synthons of high value in a limited number of steps.

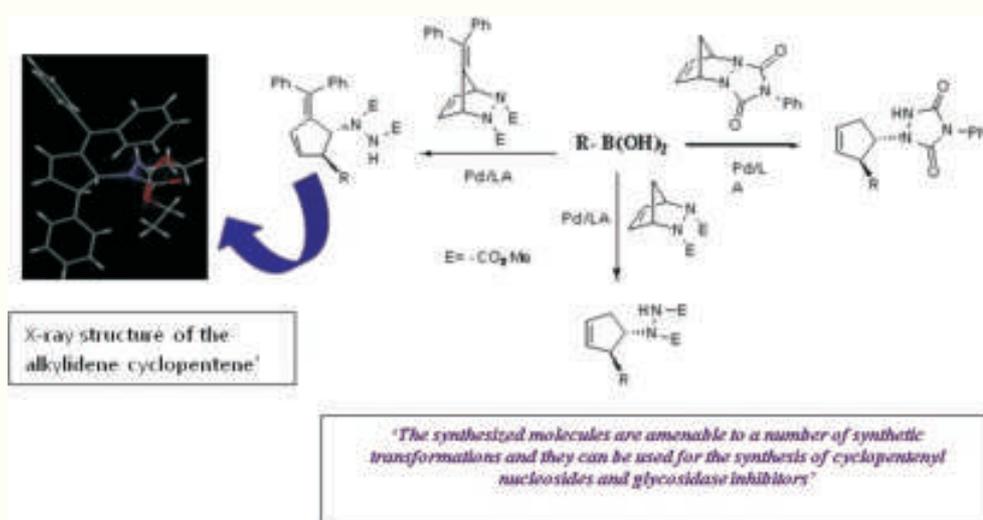


Biologically active substituted cyclopentanes



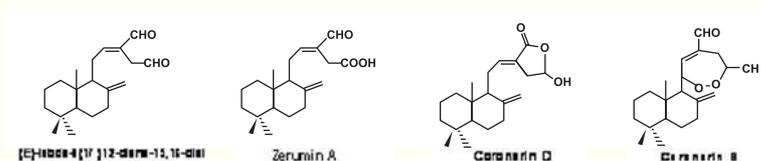
Chemical Science & Technology

A mild and general methodology for the stereoselective synthesis of *trans*, vicinal disubstituted cyclopentanes was developed through palladium/Lewis acid mediated ring opening with the formation of a new carbon-carbon bond (*Org. Biomol. Chem.*, 2007, 5, 4010-19).



Natural Product isolation and biological Screening

In the natural products program, the institute is involved in harnessing the natural wealth (plant/herbal) of the region to obtain novel biologically active compounds or leads for drug synthesis. Specific attention is given to the discovery of antioxidants, anti-inflammatory agents and anticancer compounds from well known medicinal plants used in Ayurveda and Sidha. Plants chosen for study include *Alpinia calacarata*, *Kaempferia rotunda*, *Curcuma amada*, *Curcuma malabarica* and *Oryza sativa* medicinal variety called 'njavara'. Several biologically active compounds have already been isolated and characterized from these plants.



Biologically active compounds isolated from *Curcuma amada*



Curcuma amada plant



inflorescence



rhizome



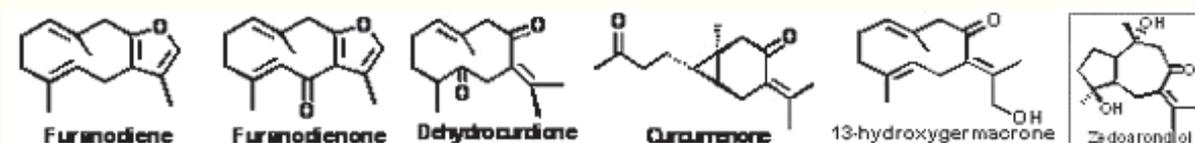
Chemical Science & Technology

A project on 'Chemical prospecting and *in vitro* antioxidant bio activity of Njavara' was sponsored by Kerala State Science, Technology & Environment (KSCSTE) last year. Studies carried out with different solvent extracts of the samples showed that "Njavara" samples have significantly higher antioxidant activity, compared to ordinary variety as evaluated by different *in vitro* methods. The total phenolic content of Njavara rice extract was (39.0 ± 1.71) and that of rice bran was 1570 ± 8.20 mg/100g. HPLC, methods were used to isolate and identify the bioactive compounds in it.

The EC50 values based on different radical scavenging studies also showed that Njavara samples (both bran and rice fractions) were nearly four-fold more effective in antioxidant, radical scavenging effects compared to similar extracts of ordinary, non-medicinal rice samples. 'Activity- guided' fractionation of the different extracts of the Njavara samples is progressing using different procedures.

Isolation of chemical constituents from Curcuma Malabarica

This plant is traditionally used for the treatment of stomach ache and enhancement of digestion. Following chemical constituents were isolated (*Mol. Carcinogenesis, 2007, 46, 231-41*).

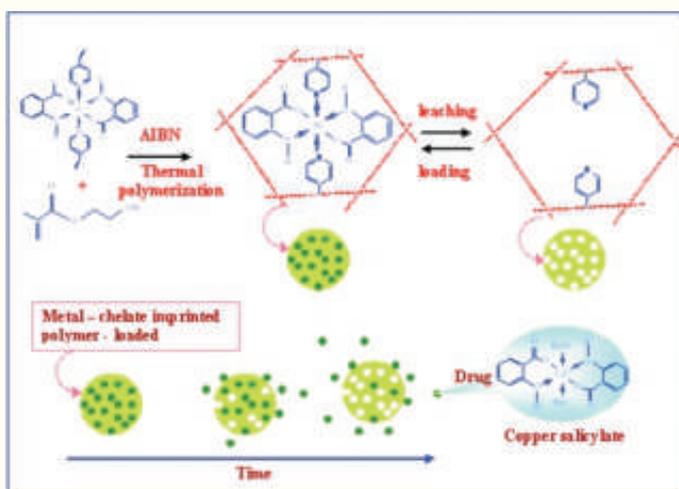


'Curcuma malabarica plant showing Leaf, inflorescence & rhizome'

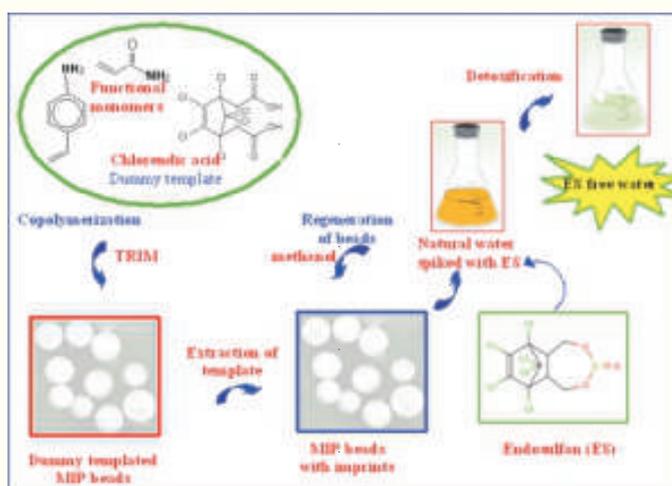
3. INORGANIC & POLYMER MATERIALS

Metal based drug delivery

Imprinted polymers based drug delivery system (DDS) was developed for metal - based drug: copper salicylate (an non-steroidal anti-inflammatory drug). The schematic representation of development of such DDS is given below.



Detoxification of Endosulphan contaminated natural waters

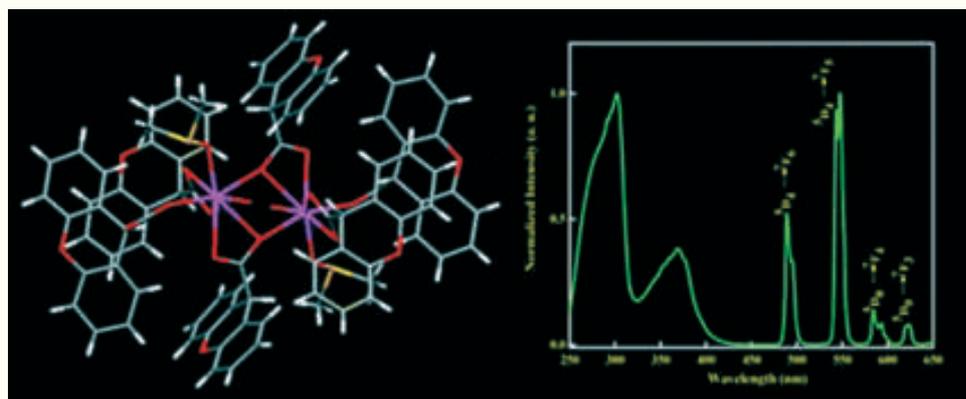


MIP micro beads utilizing Dummy Template concept (Chlorendic acid) suitable for detoxification of endosulfan contaminated natural waters prepared. The micro beads were prepared using 4-Vinyl aniline and acryl amide as functional monomers and 1, 1,1-tris(hydroxy methyl) propan-trimethacrylate



as the cross linking monomer. The methanol washed MIP beads removed endosulphan present in contaminated natural waters down to levels much below the maximum permissible level stipulated by WHO i.e. 20 ppb. This concept will be a forerunner for detoxification of other deadly toxins like persistent organic and inorganic pollutants (POP's & PIP's), actual chemical warfare agents (CWA's) and radionuclides.

Terbium-Xanthene-9-carboxylate as light conversion molecular device



Luminescence studies demonstrated that the xanthene-9-carboxylate ligand exhibited a good antennae effect with respect to the Tb^{3+} ion due to efficient intersystem crossing and ligand-to-metal energy transfer. The triplet state of the ligand was located at $\sim 25839 \text{ cm}^{-1}$, which resulted in a sizable sensitization of the Tb^{3+} -centered luminescence (quantum yield 7.30 (0.73%; lifetime $1.11 \pm 0.01 \text{ ms}$), whereas the luminescence of Eu^{3+} was only poorly sensitized. Thus, the present results demonstrate that the xanthene-9-carboxylic acid complex of Tb^{3+} may find potential applications as a light conversion molecular device in many photonic applications. (*Inorg. Chem.* 2007, 46, 11025; *Inorg. Chem. Commun.* 2007, 10, 393; *Inorg. Chem. Commun.* 2007, 10, 1091)

Environmentally benign brown-red rare earth colorant

Novel environmentally secure inorganic pigments by doping praseodymium into CeO_2 matrix of $TiCeO_4$ were synthesized having colours ranging from white to brick red. The colour of the pigments arises from the introduction of an additional electronic energy level in the forbidden band of the unpaired 4f electron of the praseodymium ion. The





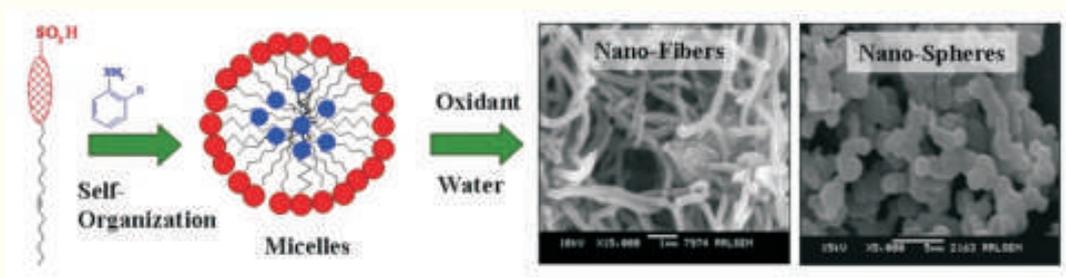
brown red ceramic pigments were found to be interesting alternative to existing toxic pigments for various surface coating applications (*Dyes and Pigments* 2008, 77, 427)

Microbial mediated removal of iron minerals from kaolin for value addition

Among the different clays and organisms tried, the china clay from Orissa containing iron in pyrite form responded well to leaching with certain fungi giving improved brightness and reduction in iron content.

Conducting polymer nano-materials

A renewable resource based amphiphilic surfactant was designed and developed for soft templating polyaniline nano-materials such as nano-fibers, nano-rods, nano-spheres and nano-tubes. Tailor made synthetic methodologies were also developed for nano-spheres bearing mono and bis-hydroxyl functional groups at the nano-surface to trace the molecular interactions through vitamin-C sensing. (*Macromolecules*, 2007, 40, 7311-19.; *J. Phys. Chem. C*. 2007, 111, 3591-600.; *J. Phys. Chem. B*. 2007, 111, 12772-80)



Protease immobilized in sol-gel matrix, stability and catalytic activity in xerogels

The protease, Subtilisin was encapsulated in sol gel matrices using alkoxysilane precursors of different chain lengths. The entrapment efficiency of the sol-gel glass was about 80%. The resultant glass enzyme had the same optimum pH of 7.0, but the optimum temperature was shifted to a higher temperature of 60°C. The biocatalyst sol gel particles retained 50% of the original activity even after 11 cycles of repeat use. The SEM micrograph of the immobilized enzyme showed uniform round particles of 5-20 microns. The specific surface area of the immobilized subtilisin in VTMS (Vinyl tri methoxy silane) was found to be 38 m²g⁻¹. This immobilized enzyme is useful for the synthesis of peptides in



ionic liquid. The formation of dipeptides and tripeptides of L-alanine was confirmed by TLC, HPLC and FT-IR analysis. (*Applied Catalysis* 2008, 341, 168)

Entrapment of biomolecules in chitosan nano/micro particles

In the course of the past decade, the field of drug delivery has been revolutionized with the advent of nanotechnology, wherein biocompatible nanoparticles have been developed as inert systemic carriers for therapeutic compounds to target cells and tissues for effective medicinal usage for health care. Many natural colours including anthraquinones, diferuloyl methane, dihydroxy 1,6 benzo quinones, beta carotene, lutein and lycopene have colouring property as well as pronounced health benefits. Some of these molecules were encapsulated in nano/micro particles of biodegradable polymers for improved bioavailability and bioactivity useful for pharmaceutical, medical, cosmetic and other industrial applications. (*J. Applied Polymer Sci.*, 2008, 2899-908)

Xyloglucan composite gels for novel applications

Xyloglucan has a β (1-4) linked D – glucan back bone that is partially substituted at the O-6 position of glucopyranosyl residues with the α –D –xylopyranose. A transparent, colourless gel was formed when dialdehyde xyloglucan was covalently bonded to chitosan. The composite gels were thermally more stable and gave a strong gel as compared to chitosan and xyloglucan as shown by TG-DTA, DSC and rheology studies. A PCT patent was filed.



MATERIALS AND MINERALS DIVISION

Objectives

- Basic and applied research on advanced ceramics for structural and functional applications.
- Sol-gel synthesis of ceramic precursors for nano particles, coatings/membranes, catalysts as well as ceramic fabrication.
- Developmental work in the area of high T_c superconductivity, electronic ceramics and ceramics for communication.
- Exploitation and value addition of renewable and non-renewable material resources and mineral based technologies.
- Development of new light alloys, their metal matrix composites and functionally graded materials for strategic as well as societal needs.
- Microstructure and microchemical analysis of materials using EM
- Materials for societal applications

Highlights

- Successful road testing of Al-SiC functionally graded brake rotor disc in a multi utility vehicle for automotive applications. Structural integrity of the disc was very good with closer braking efficiency compared to conventional cast iron disc.
- Friction stir welding of dissimilar material joint of Al(356) alloy to Al(356)- 10% SiC composites for structural engineering applications.
- Synthesis of boron carbide reinforced aluminium matrix composites by liquid metal stir casting techniques for nuclear shielding applications.
- Synthesis of in-situ formed nano-crystalline aluminium nitride reinforced aluminium matrix composites for electronic packaging applications.
- A prototype all ceramic membrane setup successfully tested at BHEL where the pore size reduction from 1500 nm to <200nm was achieved by the technique developed in NIIST.
- A new ultra low temperature (650°C) sinterable LTCC material developed which had permittivity of 17 with low loss tangent of 0.006 at 7GHz.
- Perovskite oxides prepared by the solid state reaction technique indicated that they are ionic conductors with conductivities of the order of 10^{-3} - 10^{-4} S/cm at 750°C useful for fuel cell fabrication. Superconducting current leads having ratings upto 1000A at 77 K and 2000A at 64 K were developed and delivered to RRCAT Indore (DAE) for use.
- The eco-friendly process for production of synthetic rutile developed at NIIST was suitably modified and transferred to M/s Cochin Minerals and Rutile limited to setup a pilot plant with an estimated cost of Rs.100 crores. This is one of the biggest technology transfers of CSIR.
- Pressure sensitive adhesives with strengths higher than commercial counterparts based on natural rubber, polychloroprene rubber and PCNSL developed.
- A Coconut Climbing Bike developed with a lift capacity of 65 kg. This has a climbing speed of 6m/min. and a descending speed of 3.8m/min.

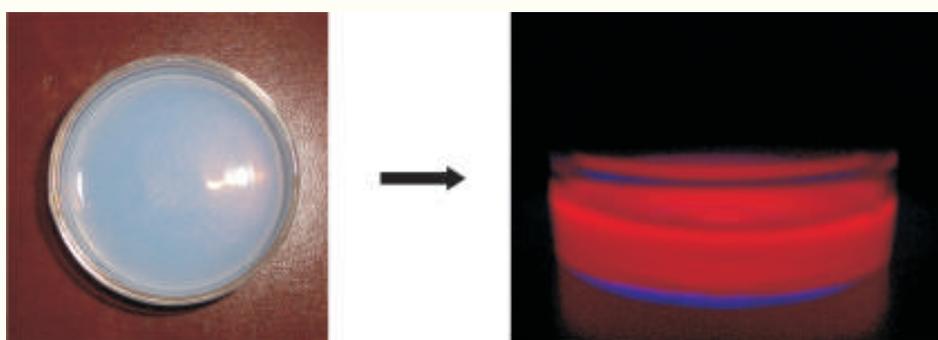


1. CERAMIC MATERIALS DEVELOPMENT

1.1. Nanomaterials Programme

Pilot plant for nano Rare Earth Phosphate •at M/s Indian Rare Earths Limited, Kollom

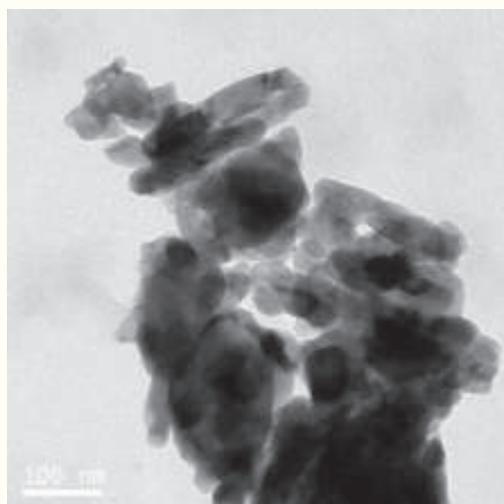
Under the IRE sponsored project for creating a facility for the synthesis of 10-15 Kg rare earth phosphate (lanthanum phosphate) at IRE, Kollam, the lanthanum phosphate synthesized in the lab at 1 Kg capacity was fully characterized for particle size and phase stability. Average particle size of nanosized lanthanum phosphate colloids was < 100 nm and that of bulk > 300 nm. The details of the processing conditions along with the material balance (including the amount of solvent use and recovery) were estimated for further calculations for pilot plant at IRERC. Development of Rare earth phosphate nano phosphors and composites for thermal barrier coatings were developed at laboratory level for further scale up.



Room temperature photo luminescence in Europium doped lanthanum phosphate gel

Reactivity and wetting behaviour of molten metals with nanosize rare earth phosphate and sintered ceramics and coatings

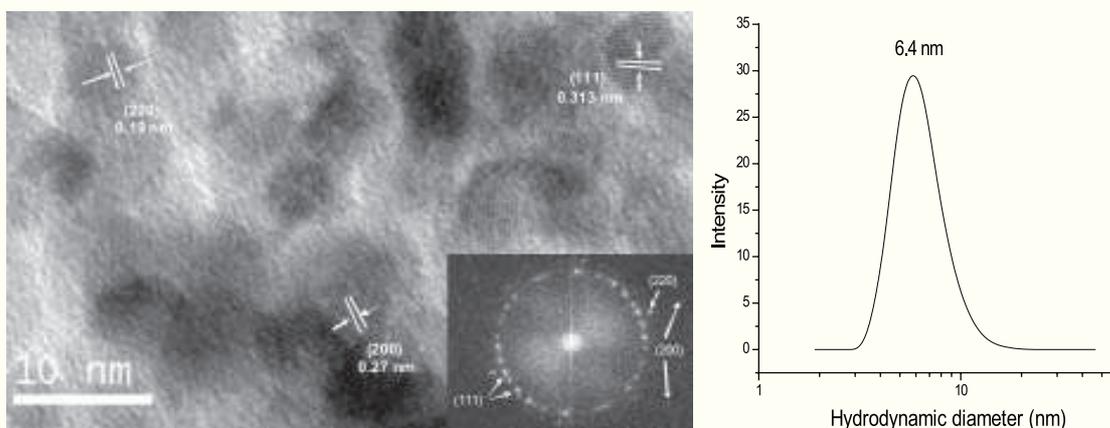
Synthetic parameters of Yttria-Lanthanum phosphate nano particulates (100-150 nm) were investigated through sol-gel route. The dried product was completely characterised by XRD, IR and TGA. The grain growth of lanthanum phosphate-yttria composites was limited to only ~ 270 nm even after sintering the composite precursor at 1000°C . Spherical polyhedra as well as extended polyhedral (rod-like) particles of size ~ 50 nm were observed in the TEM micrograph. 150gms of the composite was used for coating on metal by Plasma-spray method at the collaborator's laboratory (BARC, Mumbai).



TEM Micrograph and particle size distribution of $\text{LaPO}_4:20\%\text{Y}_2\text{O}_3$ at 1000°C

Cerium oxide based Nanomaterials for Applications as Chemical-Mechanical-Polishing (CMP) Slurry.

Nanosized cerium oxide (4-8 nm) was reproducibly synthesised by wet chemical methods with a control over the kinetics of the reaction. HR-TEM, X-ray diffraction and BET Surface area were used to understand complex relation among particle size and related crystal properties e.g., lattice parameter, strain and anisotropy. The small particles were single crystals as evident from the 'one type of lattice fringes' in one particle as shown in the TEM image below. Particle growth and polydispersity were completely avoided by employing surfactant in the syntheses. The light scattering data for one such monodisperse fine crystals is shown in the PCS pattern.



HR-TEM image of CeO_2 nanospheres of average size 7.4 nm displaying three prominent lattice fringes. The inset is the FFT analysis of the image and photon correlation spectral data of 6.5 nm monodispersed suspension (indicated by low PDI of 0.20) synthesised through precipitation in mixed solvent using steric stabiliser.

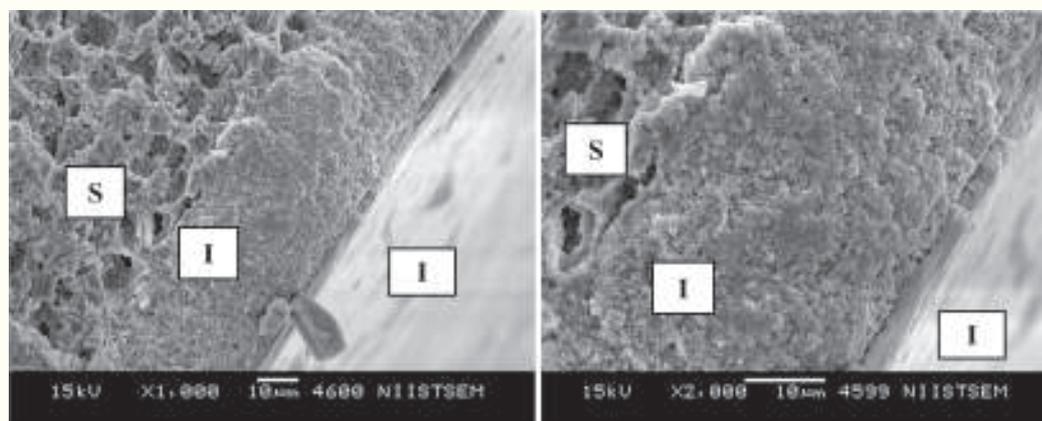


High energy field varistors through nano precursors

ZnO varistor with Bi_2O_3 , CoO , Cr_2O_3 , Sb_2O_3 , Pr_2O_6 and Y_2O_3 dopants were synthesised through co precipitation followed by reflux route. The powder morphology, sintering characteristics, thermal decomposition behaviour, and particle size were characterised. Dry pressed varistors discs were sintered by conventional sintering (1150 deg) and step sintering (850 deg). Chemically derived varistors powders were mixed up to 10 wt% with conventional spray dried varistors powder and varistors discs were fabricated under laboratory conditions. The composite varistors showed fine grained microstructure and average grain size as low as 5 microns were achieved. Current vs. voltage characteristics have been studied and composite varistors showed enhanced break down voltage from the basic value of $B_v = 150\text{-}350$ V.

Ultra filtration ceramic membranes

The Project for developing techniques of applying gradient ceramic membrane coating on 19 channel 200 and 500 mm long sintered porous alumina tubes for water filtration is in the final stage. The BHEL supplied tubes have average pore diameter $1.4\mu\text{m}$ which were brought down to $\sim 50\text{nm}$ in the laboratory experiments. The porous substrates were coated with an initial layer (precoat) of alumina slurry having thickness of $\sim 20\mu\text{m}$ and pore dia of $\sim 300\text{-}500\text{nm}$. They were further coated with aqueous nanocolloids of boehmite and titania to a thickness of $4\text{-}5\mu\text{m}$ and pore size was $\sim 50\text{nm}$ for all tubes. The flow rate and amount water filtered through the tubes under the different hydraulic pressures were evaluated. Modules containing 25 number of 19 channel coated tubes of 500mm length were fabricated at BHEL and tested for industrial water filtration and fabrication of larger modules containing 1000 mm tubes are in progress as part of commercialisation.



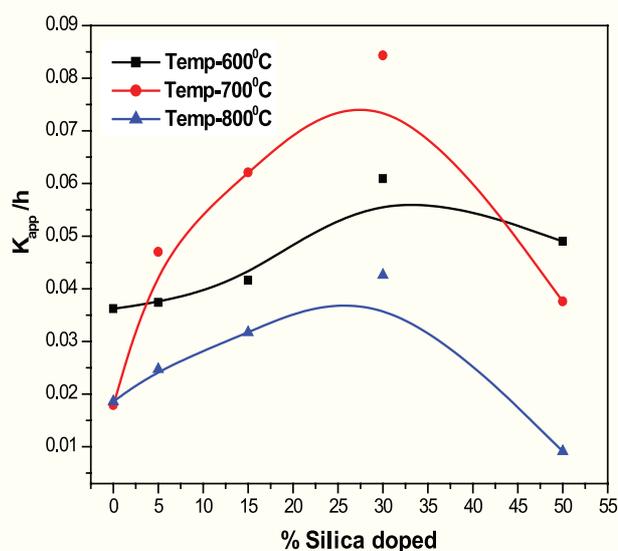
SEM image of coated 19 channel porous tube for filtration application (S) 19 channeled porous alumina Substrate (I) Intermediate layer alumina layer (T) Top titania layer



Antialgal, antibacterial and antisoiling coatings on traditional ceramics

Algae growth and soiling of roofing and ceramic products is a cause of great concern in areas having moderate to high humidity as the aesthetics and colour of the tiles are affected. Commercial glazed tiles were coated with a thin layer of pure and doped titania sols by dip coating technique. Different titania based colloid compositions were developed using alumina and silica additions in the range 5-30%. The dried mixed colloids and the coated tiles were calcined at temperatures in the range 600°-800°C and characterised for photoactivity. Coating composition with SiO₂ is successfully prepared which are stable even up to a calcination temperature of 800°C.

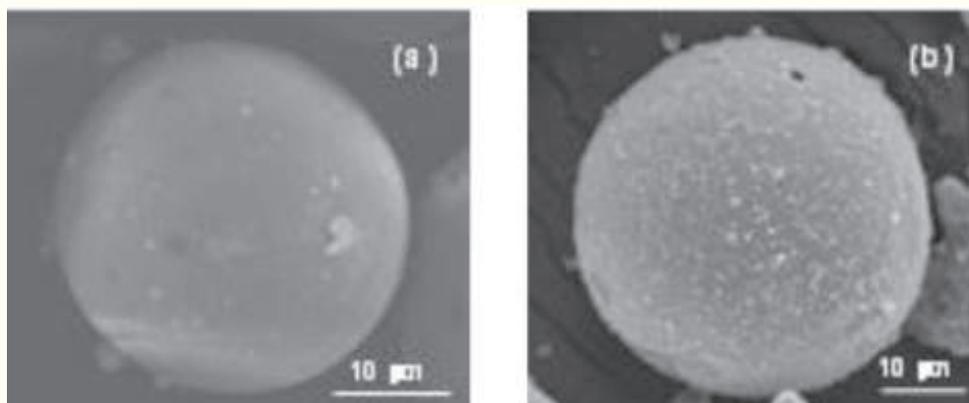
Similar coatings were developed on fired terracotta bodies and sintered flux bonded flyash tiles. As a part of scale up, titania sol of fixed composition up to 10 litre volume was synthesised in the laboratory and coatings were made in the collaborating industry. The coated tiles and ceramic products exhibited good self cleaning and ant algal properties.



Variation of degradation rate SiO₂ added TiO₂ coated glazed floor tile at different calcinations temperatures.

Titania-based functionally graded nanocomposite as a photocatalyst for hydrogen production and other industrial applications

High surface-area nanocrystalline TiO₂ with higher photocatalytic activity than the commercial Degussa-P25 was synthesized by modifying the conventional sol-gel process using an organic polymer. A new theoretical model was developed to explain the synergistic effect in the photocatalysis using the multiphase nanocrystalline TiO₂. Sol-gel derived nanocrystalline TiO₂ photocatalyst was used probably for the first time as surface-sensitizer for the electroless copper-coating of flyash.



Electroless copper-coating of flyash using nanocrystalline TiO_2 as surface-sensitizer

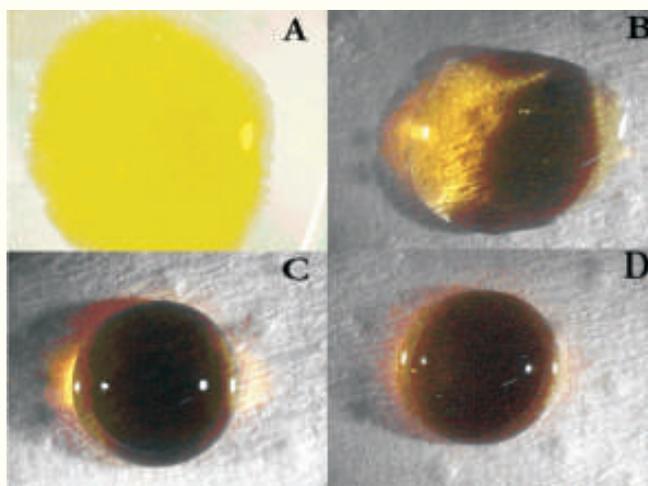
Aerogels through subcritical drying Route

Highly porous silica monoliths like aerogels find applications in a wide range of fields ranging from catalysts to high energy particle collectors. Strengthening the gel network by aging in precursor solution is a viable technique adopted for ambient pressure drying for these porous solids. The extension of an ambient pressure drying technique to organic inorganic hybrid systems was successfully demonstrated. Due to the high density of organic functionality in these porous hybrids they may find applications as gas storage materials. The 3-glycidoxypropyltrimethoxysilane ormosils have been incorporated into the tetraethoxysilane derived inorganic network through co-condensation and organic networking catalysed by an amine. The final dried gel with negligible shrinkage is provided in figure given below. The adsorption isotherms obtained for the gels were of the type IV nature indicating that they are mesoporous. The density obtained for the hybrids prepared by varying the hydrolysis conditions show the effect of hydrolysis water on the density and very low density as low as $0.3 \text{ m}^2 \text{ g}^{-1}$ could be achieved.



Biocompatible silica-chitosan hybrids and hydrophobic coatings

A new organic-inorganic hybrid was synthesized through a sol-gel process starting from alkoxy silane and chitosan and functionalized by the *in situ* hydrolysis-condensation reaction of methyltrimethoxysilane (MTMS) and vinyltrimethoxysilane (VTMS) in the reaction medium. The process yielded highly transparent and hydrophobic silica-chitosan hybrids. The condensation of the hybrid over the silica-chitosan particles imparted hydrophobicity. Glass substrates coated with functionalized SiO₂-Chitosan sol showed ~100% optical transmittance in the visible light.

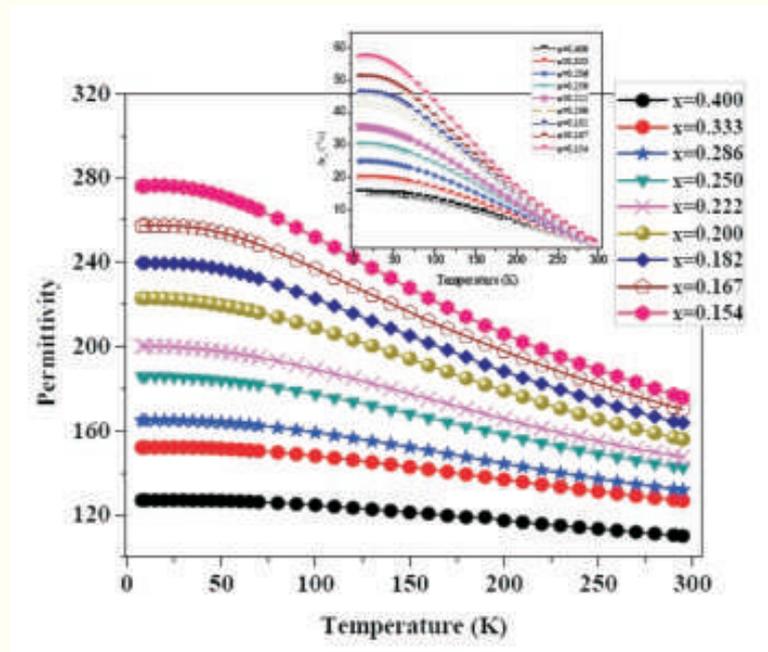


Stereomicrographs of water drops on glass slides A) Uncoated B) SiO₂-2wt% chitosan (MTMS:TEOS = 1) C) SiO₂-2wt%chitosan(VTMS:TEOS = 2.5) and D) SiO₂-2wt%chitosan (MTMS:TEOS = 2.5)

1.2. Materials for Electronics and Communication

Materials for wireless Communication: New incipient ferroelectric materials

Displacive ferroelectrics contain a group of incipient ferroelectrics or low temperature ferroelectrics having a variety of interesting properties and applications. The relative permittivity of incipient ferroelectrics increases with a decrease in temperature and after reaching a maximum value it saturates indicating the absence of a ferroelectric transition. SrTiO₃ is a well known incipient ferroelectric material. The microwave dielectric properties of a group of novel incipient ferroelectric materials, Sr_{2+n}Ce₂Ti_{5+n}O_{15+3n} (n>8), were investigated in the temperature range 8 to 295K. The permittivity increases with decrease in temperature and saturates below 30K indicating the incipient ferroelectric nature (figure). The dielectric loss tangent decreased with decrease in temperature, reaching a minimum at about 80-120K depending on the composition, and again increased with further cooling.



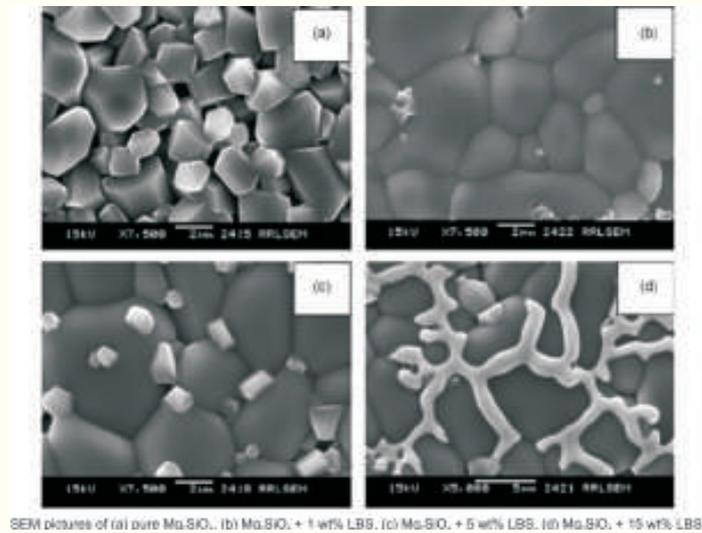
Variation of relative permittivity at cryogenic temperatures

Low Temperature Cofired Ceramics (LTCC)

Small light weight and multifunctional electronic components are attracting much attention because of the rapid growth of the wireless communication systems and microwave products in the consumer electronic market. In the development of complex miniaturized circuits, flexible glass ceramic tapes called the low temperature cofired ceramic (LTCC) enable fabrication of three dimensional ceramic modules with low dielectric loss and embedded silver electrodes etc.

Several low loss LTCC ceramic-glass composites, cofireable with silver, the common electrode material were developed. Fosterite (Mg_2SiO_4) + 15 wt% $Li_2O-B_2O_3-SiO_2$ glass, $0.83ZnAl_2O_4-0.17TiO_2$ + 10% $BaO-B_2O_3-ZnO-SiO_2$ glass, and $CeO_2-BaTi_4O_9$ + 12% $B_2O_3-1\% CuO$ had low sintering temperature ($<950^\circ C$) with no chemical reactivity with the silver electrode material. These composites were temperature stable and had low permittivity and dielectric loss tangent.

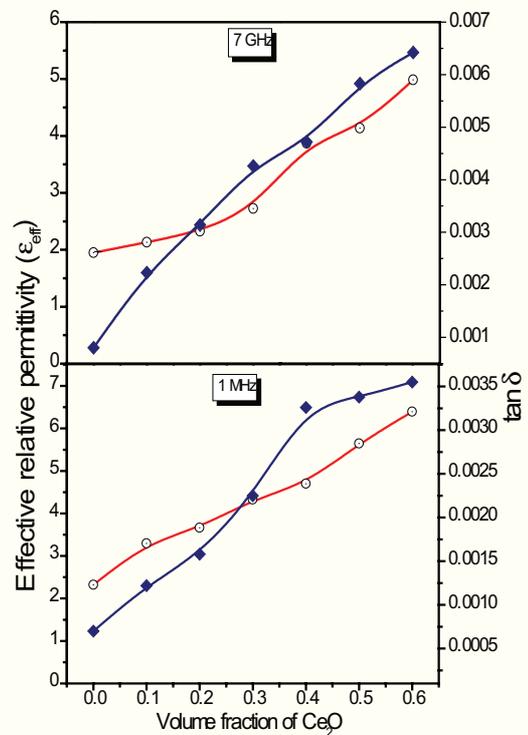
A new composite $Zn_2Te_3O_8$ was developed as an ultralow temperature ($650^\circ C$) sinterable LTCC material. Addition of a small amount of rutile improved the temperature stability of the LTCC. Tapes of the composite were made from a slurry of the ceramic binders and plasticizer. The tapes were then stacked and fired and the properties of the LTCC were measured in the radio and microwave frequency ranges. The stacked and sintered LTCC had a permittivity of 17 with a loss tangent of 0.006 at 7 GHz.



SEM pictures of (a) pure MaSiO₃, (b) MaSiO₃ + 1 wt% LBS, (c) MaSiO₃ + 5 wt% LBS, (d) MaSiO₃ + 10 wt% LBS

Ceramic-polymer composites for electronic packaging applications

Ceramic-polymer composites consisting of ceramic particles filled in a polymer matrix form a potential group of materials for producing demanding and functional packages, since they combine the electrical properties of ceramics and the mechanical flexibility, chemical stability and ease of processing of polymers. The key properties of the composite material viz. the dielectric constant, thermal conductivity and coefficient of thermal expansion are dependent on various factors such as the number of components or phases, volume fraction of the filler, the individual properties of the phases, preparation method and the interaction between the filler and the matrix. Thus with a judicious selection of filler ceramic and polymers, composites with desired properties can be synthesized. PTFE/ZnAl₂O₄-TiO₂, CeO₂-PTFE/polyethylene, SrCe₂Ti₅O₁₆-polystyrene were prepared. The composites which were prepared by hotpressing showed a very low permittivity in the range 5 to 20 and low loss tangent in the microwave frequency range as shown in figure given.



Variation of relative permittivity and loss tangent at 1 MHz and 7 GHz as a function of CeO₂ ceramic content in PTFE/ CeO₂ composites



Giant permittivity composite materials

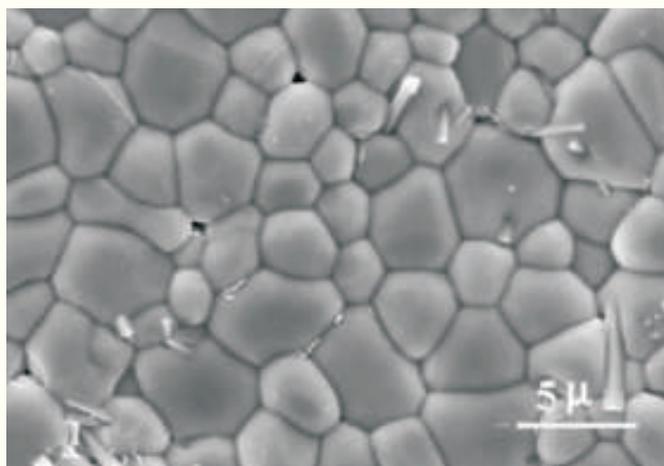
Composites with conducting phases dispersed in an insulating matrix exhibit high permittivity near the percolation limit of the conducting phase. The influence of conducting phase characteristics on dielectric properties of insulator-conductor composites was demonstrated by studying composites of polytetrafluoroethylene and different volume fractions of $\text{La}_{0.5}\text{Sr}_{0.5}\text{CoO}_3$ (LSCO). LSCO was prepared as coarse grained powder by solid state reaction and as fine powder by citrate gel method. The composites with fine powder of LSCO showed a rapid increase in permittivity and conductivity at 30% while the corresponding value for coarse powder was 50%. The percolative behaviour was found when the interparticle distance reduced to ~ 250 nm in both cases. The permittivity and conductivity of the composites were found to increase with the interfacial area.

1.3. Materials for Electrical and Electro Optic applications

Novel functional ceramic oxides for electrical and electro-optical applications

(i) New perovskite type Ionic conductors

Yttria Stabilized Zirconia (YSZ) is one of the popular electrolytes in solid oxide fuel cell (SOFC) which have got conductivity of $0.1 \text{ S}\cdot\text{cm}^{-1}$ at 1000°C . But high temperature operation of SOFC causes many serious problems. In the course of searching a new material which exhibit equivalent conductivity value in intermediate temperature range, perovskite oxides were synthesized by use of the conventional solid state reaction. New oxides of the type, NaATiMO_6 and NaAZrMO_6 ($\text{A}=\text{Ca}$ or Sr ; $\text{M}=\text{Nb}$ or Ta), were prepared by the solid state reaction technique. Phase identification by powder X-ray diffraction (XRD) showed that NaCaTiMO_6 & NaCaZrMO_6 had orthorhombic perovskite type structure (Space group, Pnma) and NaSrTiMO_6 & NaSrZrMO_6 had cubic perovskite type structure (SG, Pm3m). The grain morphology observation by scanning electron microscope (SEM) showed well sintered grains. AC impedance spectral measurements in air, wet oxygen and dry oxygen atmosphere indicated that they were ionic conductors with conductivities of the order of 10^{-3} - 10^{-4} S/cm at 750°C .

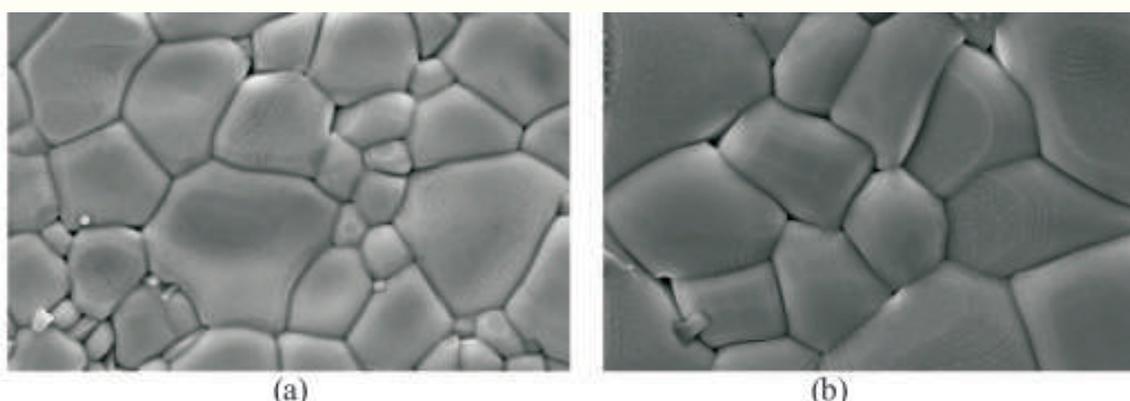


SEM Micrograph of NaSrZrNbO_6



(ii) Development of Novel Semiconducting Oxides

Semiconducting oxides find several applications as thermistors, PTCR materials, sensors, photoelectrolysis of water etc. A new series of pyrochlore type semiconducting ceramic oxides in Ca – Ce – Ti – M – O (M = Nb or Ta) system was synthesized in different stoichiometric compositions by the conventional ceramic route. The electrical conductivity measurements showed that these compounds exhibit semiconducting behaviour and the conductivity increases with the Ce content in the compound. The activation energy of the carriers was found to be in the range of 0.4eV to 1.6eV based on the Arrhenius equation for conductivity. The electrical conductivity in this compound is probably due to the presence of Ce^{3+} , which remains in the reduced state without being oxidized to Ce^{4+} by structural stabilization. The structure refinement of X-ray powder diffraction data using Reitveld analysis established that these oxides belong to cubic pyrochlore crystal system in the space group Fd3m (No.227).



Typical scanning electron micrographs of (a) $Ca_4Ce_3Ti_6Nb_3O_{28}$ (b) $Ca_3Ce_4Ti_7Nb_2O_{28}$

(iii) New phosphor Materials for white light emitting diodes (WLEDs)

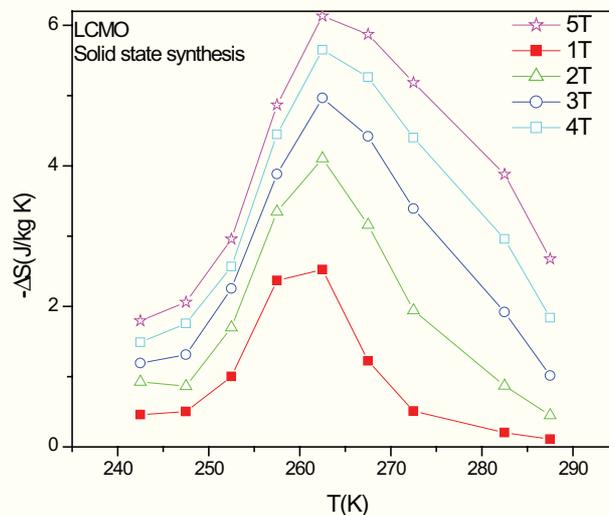
The luminescent properties of new phosphor materials based silicate phosphates $SrYSiP_3O_{12}$, $CaYSiP_3O_{12}$ prepared and characterized by XRD earlier, were studied from their Emission Spectra. The samples were excited at 393 nm. The Emission intensity of YPO_4 was of the order of 10^4 , but the silicate phosphate samples showed much enhanced intensity, of the order of 10^7 . The intense red emissions (554-559, 593, 613-620, 650-661, and 695-703nm) were observed for the sample corresponding to 5D_0 to ${}^7F_{0,1,2,3,4}$ transitions in Eu^{3+} levels. For both silicate phosphates, full red colour emission was observed with high intensity. Work is in progress to optimize the calcination temperature for good and stable structure.



The micro structural and micro chemical characterization of wide variety of samples both organic and inorganic materials have been carried out using SEM/EDS for the development and understanding of the new materials. Consultancy services were also rendered to outside agencies such as VSSC, Kerala University, Medical and Dental College etc.

1.4. Materials for Magnetic Applications

Rare earth manganite perovskite has attracted considerable attention because of its high magnetocaloric effect (MCE) and its potential for application as magnetic refrigerant. Based on the utilization of manganites for magnetic refrigeration purposes a new project was taken up for scaling up of various synthesis method for preparing different manganites. Various chemical as well as physical methods for preparing manganites were adopted. LCMO was prepared by solid state method and the measured MCE of the material showed large magnetic entropy change at temperature near to room temperature. The magnetic entropy change increases with increasing magnetic field as shown in the figure below.



Variation in magnetic entropy change with magnetic field

Nanoparticulate Magnetite slurry for ferrofluid applications

Superparamagnetic (single crystals) magnetite ($\text{FeO} \cdot \text{Fe}_2\text{O}_3$) in the size range 6-30 nm was successfully synthesised by various methods with control over the size distribution. It was difficult to inhibit clustering in aqueous suspensions by normal techniques. However, monodisperse single domain particles of magnetite was synthesised by surfactant assisted coprecipitation method. Magnetite crystals



Materials and Minerals

of size ~ 10 nm synthesised by coprecipitation were purely superparamagnetic (single crystalline) as was indicated by the zero remnant magnetisation in the hysteresis loop. High saturation magnetisation and small remnant magnetisation in the hysteresis loop were indicative of multidomain nature in 30 nm magnetite particles synthesised through flash combustion technique.

1.5. Material for Superconducting applications

Development of superconducting current leads for DAE

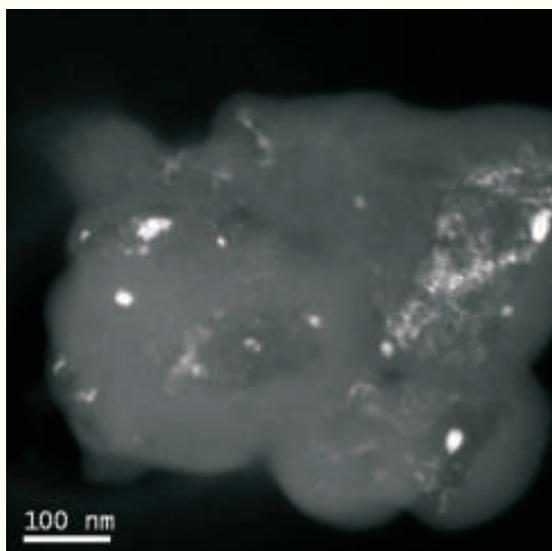
The project has the main objective of developing general purpose conduction cooling superconducting current leads of ratings 50 A, 100A, 200 A, 500 A and 1000 A at 77 K and 100A, 200 A, 500 A 1000 A and 2000 A at 64 K respectively for application in high current superconducting system. These were successfully developed for the first time in the country and the prototypes were subjected to all the testing and evaluation procedures at NIIST and further validated by RRCAT. The products were delivered to the user.



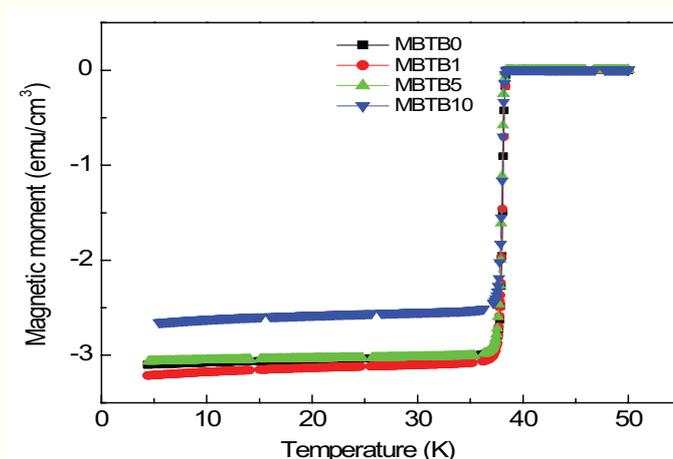
*The superconducting current leads developed by NIIST in collaboration with RRCAT
(Current ratings from 50 to 1000 A at 77 K)*

Feasibility study on MgB₂ superconducting wire development

The project envisages to study the technical feasibility of making MgB₂ based multifilamentary wires. Short length Fe sheathed multifilamentary MgB₂ superconducting wires with transport critical current density (J_c) $> 10,000$ A/cm² and critical temperature 38.5 K was successfully made by a powder-in-sealed-tube (PIST) method. Development of long length wires with higher J_c and H_{irr} is in progress.



Dark field HRTEM image of MgB_2 showing nano intragrain inclusions which acts as flux pinning centers



Magnetization plots MgB_2 samples showing sharp superconducting transitions

Basic research on metal-insulator transition and rare earth modification in (Bi,Pb)-2212 superconductor

Studies on the effects of rare earth substitution at different sites of (Bi,Pb)-2212 superconductor on metal-insulator transition (MIT), crystal structure, transport and superconducting properties were carried out. The results led to the identification of conduction mechanism in several compositions exhibiting MIT and many modified superconductors with highly improved properties.

XRD Analytical support. Extended XRD analytical support to different divisions of the laboratory and outside organizations that includes TCS, Pune, TTPL, Trivandrum and several other CSIR Laboratories, Universities and Colleges. A total number of ~3500 samples were analysed during 2007-08.



2. LIGHT METALS, ALLOYS AND COMPOSITES

Processing of Boron Carbide Reinforced Aluminium Matrix Composites for Nuclear Applications.

Boron carbide is one of the potential neutron absorption materials used in nuclear applications. Boron carbide reinforced metal matrix composites (MMC) are uniquely suited as a structural neutron shielding material, where tailorable properties of neutron absorption as well as enhanced mechanical properties such as high strength, stiffness and hardness can be obtained. Boron carbide reinforced aluminium matrix composites were successfully fabricated using stir casting method. The microstructural evaluation showed uniform distribution of particles in the matrixes such as commercially pure Al, 356 cast and 6061 wrought aluminium alloys. The addition of boron carbide increased the hardness in both as cast and heat treated condition. Further evaluation is in progress.

Processing and Characterization of prototype Al-SiC FGM Brake Rotor Discs for automotive applications.

Al-SiC functionally graded prototype brake rotor discs containing 20% SiC particle were processed by vertical centrifugal casting and supplied to M&M. The characterization of Al-20% SiC functionally graded composite disc showed enhanced structural and mechanical properties towards the outer periphery of the casting. The presence of higher concentration of silicon carbide particles towards the outer periphery provided higher hardness, tensile and compressive properties compared to the inner periphery having particle depleted region. The improved properties in the braking area of the disc enhance its overall performance and braking efficiency. The road tests of the discs were carried out by fitting it to a multi utility vehicle. Structural integrity of the disc was very good during testing and there was no remarkable wear on the disc surface. The braking efficiency of the FGM disc was slightly lower compared to that of cast iron disc due to non compatibility of the conventional brake liner used for cast iron. Alternate brake liner more suitable to Al FGM disc has to be developed.



Al-SiC functionally graded prototype brake rotor disc



Development of Friction Stir Welded Similar and Dissimilar Material Joint of Al(356) Alloy and Al(356)- 10% SiC Composites for Engineering Applications

Friction stir welding (FSW) is an advanced solid-state joining technique, in which a threaded tool rotates and moves forward along the weld seam with a high speed of stirring producing a plasticized region of material. The weld quality is excellent due to porous free joint and the mechanical properties are better than the fusion welding. A detailed investigation on the effect of FSW process parameters on structure and properties of dissimilar joint of Al (356)-10 vol% SiC MMC with 356Al cast alloy (Figure) and similar joints of alloy to alloy and composite to composite were carried out. The stir zone of 356 Al alloy to Al (356)- SiC MMC dissimilar joint showed fine recrystallized primary aluminium grains without dendritic structure and fine eutectic Si phases more uniformly dispersed compared to base materials. SiC particles were uniformly distributed in the stir zone and the particles were finer compared to the base composite. The hardness values of weld zone were found in between base alloy and composite due to finer and low volume fraction (5%) of SiC particles, even though the refinement of primary aluminum and eutectic Si phases had taken place during friction stir welding. Impact toughness test showed the toughness value increased twice that of base materials and tensile test of transverse specimen of weld showed lower values than that of base materials. In both cases failure occurred at the same weld to alloy interface. The formation dissimilar weld joints by FSW can be applied for making dissimilar materials joints with enhanced properties for various structures in aerospace, automotive, defence and general engineering applications.

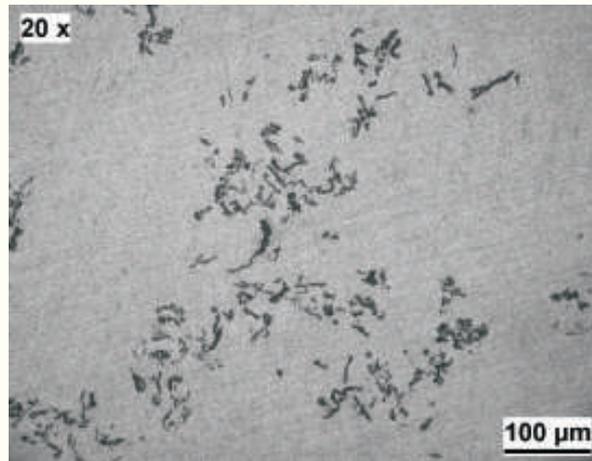


356Al - 356Al/10% SiCp plates joined by friction stir welding.

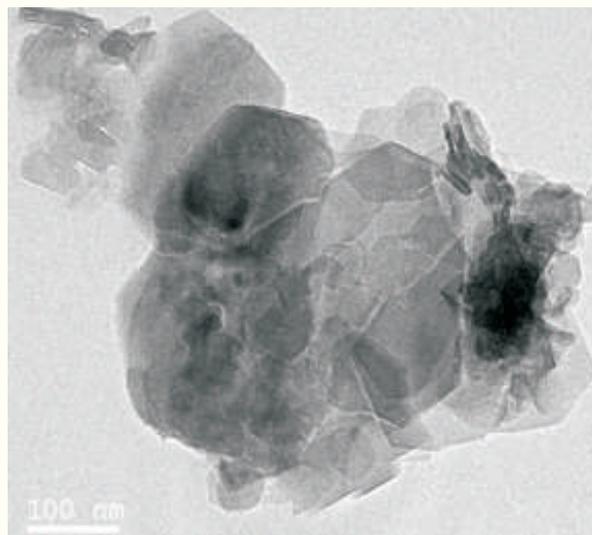


Synthesis and characterization of in-situ Al/AlN composites

Al-AlN in-situ composite has been successfully synthesized by bubbling nitrogen gas in Al melt. In order to examine the size and morphology of the reaction products in a detailed manner, the reaction products were extracted from the casting by leaching out the Al matrix using NaOH. Then the settled particles were dried and examined by X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), TEM /Energy Dispersive X-ray analysis. The morphology of the particles was found to be hexagonal. The sizes of the AlN particles were found to be in the range from nano to a few microns. XRD analysis of the extracted particles confirmed the formation of AlN in the melt. Further work in optimizing the process parameters is in progress.



Optical micrograph of the in-situ Al-AlN composite after 4 hours nitridation

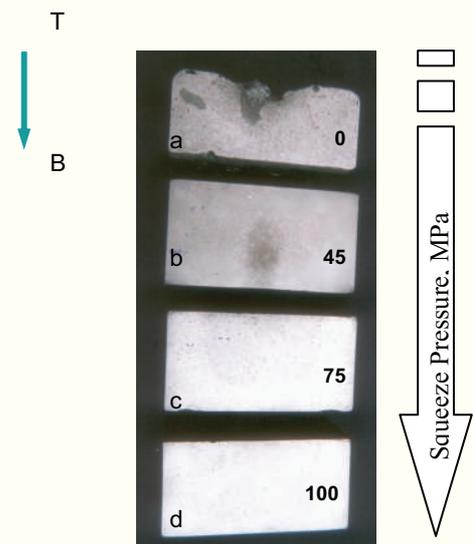


TEM photograph showing hexagonal morphology of the extracted AlN particles from Al-AlN in-situ composite



Squeeze Casting and Characterization of Al 2124 Alloy and 2124-10%SiCp Metal Matrix Composite

Aluminium 2124 alloy and its composite with 10% SiC particles of average particle size of $23\ \mu\text{m}$ were squeeze cast at different pressures. The effect of squeeze pressure during solidification was evaluated with respect to microstructural characteristics using optical microscopy and image analysis and mechanical properties by tensile testing. The microstructural refinement, elimination of casting defects such as shrinkage and gas porosities and improved distribution of SiC particles in the case of the composite resulted when pressure was applied during solidification. A pressure level of 100 MPa was found to be sufficient to get the microstructural refinement and very low porosity level in both the alloy and the composite. The improved mechanical properties observed in the squeeze cast alloy and the composite could be attributed to the refinement of microstructure within the material.



Macro photograph of 2124 -10SiCp composite squeeze cast at different pressures.

Metallurgical characterization of metallic materials for space applications

The objective of the project is the microstructural investigation and characterisation of mechanical properties of both ferrous and non ferrous alloys and their components to understand their performance in space applications. The microstructural analysis carried out using optical metallographic techniques on AFNOR 7020 Al alloy rolled plates revealed acceptable microstructure. The ASTM micro grain size of the plates measured using Heyns' intercept method was found to be between 5 and 6 which was also found to be in the acceptable range.

Magnesium Alloy Development

The use of magnesium has grown considerably since early 1990 and continues to rise in the automotive industry due to the lightness and the high strength-to-weight ratio compared to many commonly used structural metals. Among the Mg alloys, AZ91(Mg-9%Al- 1%Zn-0.2%Mn) is one of the major alloy system in magnesium alloys and offers excellent mechanical, chemical and foundry properties but with major high temperature behaviour problems. Introduction of thermally stable



Materials and Minerals

intermetallics in the microstructure through minor alloying additions is an effective way to improve its high temperature behaviour and an investigation was carried out with the addition of Si, Sb and Sr elements in AZ91 alloy to study the effect of these elements on the high temperature behaviour. Substantial improvement in the creep properties as well as high temperature properties were obtained with individual and combined alloying additions. Addition of Si and Sb greatly increased the total creep life of the AZ91 alloy. Besides, fatigue characteristics of Low Pressure Cast (LPC) AZ91 alloy have also been evaluated. It was also found that LPC AZ91 alloy yielded better fatigue properties than gravity cast AZ91 alloy.

3. MATERIALS FROM BEACH SAND MINERALS

As part of the major research activity based on ilemanite for synthetic rutile, the following investigations were carried out:

Optimisation of hydrocyclone separation of iron oxide and rusted ilemanite

In order to address the challenge of contamination of Iron oxide in ilemanite stream, and ilemanite stream in hydro cyclone separation of hydrated iron oxide and beneficiated ilemanite after aeration rusting in the commercial plants, hydro cyclone separation was carried out at various inlet pressures ranging from 1 to 4 kg/cm². The composition of overflow and underflow collected for a fixed time interval in terms of iron oxide and TiO₂ content was analyzed. Several hydro cyclone separation experiments at various combinations of vortex and apex diameter as well as inlet pressures resulted in best results of overflow containing 61.45% Fe (Total) and 10.45% TiO₂ content. The employment of silicate based dispersants in one of the experiment resulted in a overflow product containing 64.38% Fe (Total) and 8% TiO₂. A few separation experiments were also carried out at BMRC, IREL at Kollam using their combined hydrocyclone separation and wet magnetic separation (WHIMS).

Investigations on pelletisation of iron oxide and subsequent induration at varying temperatures

The iron oxide produced during the aeration rusting of metallised ilemanite in sufficient quantities has to be utilised as a salable product for additional revenue generation as well as for effective disposal. Experiments were carried out in the laboratory for pelletisation of iron oxide and induration of the pellets at various temperatures to effectively use this as a feed stock for DRI production. Pelletisation using a disc pelletiser was found to be more suitable technique for its agglomeration and



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the quantity of moisture and binders required were slightly higher than the iron ore fines. The investigations revealed that, a moisture level of minimum 25% in the iron oxide feed was required for the formation of green pellets of 10-20 mm size. This was higher than the recommended moisture level of maximum 10% for iron ore fines. Addition of bentonite @ 1% by weight as the binder in the iron oxide mixture was found optimum. Schedule of drying, pre heating and firing of green pellets had to be properly arrived at in order to render pellets free from excessive swelling, cracking etc. Firing of pre heated and dried pellets at 1100 °C was necessary for imparting sufficient shatter strength to the pellets.

Investigations on the possible decrease of coke rate and temperature during the Metallisation in the rotary kiln

Coal is used both as the reductant and the fuel to sustain the reduction temperature in the rotary kiln in the metallisation of ilemanite. Reduction experiments carried out at 1050 °C using ilemanite /coal ratio at 40% provided a metallised product with 67% metallisation. This product on subsequent rusting in 2% FeCl₂ solution resulted in a beneficiated product containing 11% Fe (T) after 8 hours duration. This clearly suggested that, the coal rate hitherto employed at 0.6 to 0.75 can be reduced to 0.4 without appreciably affecting the rusting efficiency of the product which in turn significantly improved the economy of the process.

Synthetic Rutile technology transferred to CMRL

One of the biggest technology transfers in the history of CSIR taking into view the capacity of production, level of investment, environment impact and quantum of royalty payable is the technology transfer agreement with CMRL for the commercialisation of a new processes for the production of synthetic rutile from ilemanite.

Detailed technology transfer document was handed over by Prof. S. K. Brahmachari, Director General, CSIR to Shri. S. N. Sasidharan Kartha, Managing Director, CMRL, Aluva at a function organised at NIIST on January 16, 2008 in the presence of the Director and Scientists involved in the development of technology.

The new technology ,developed essentially based on sustained and focused research spanning over 2 decades, was subsequently modified jointly by NIIST and CMRL to suit the available raw materials. The modified process is unique in terms of by product utilization as all the iron values from ilemaniteare recovered as salable by product rendering the process flow sheet more eco-friendly.

CMRL would be able to achieve near zero effluent status owing to very low acid consumption in the new process in addition to the production of quality grade synthetic rutile with more than 97% TiO₂ and ratio activity levels acceptable to International standards.

By adopting the new technology at an estimated cost of 100 crores, CMRL proposed to double the capacity of its plant at Aluva and the commercial plant is expected to be commissioned within 2 years.



Physical and chemical characterisation of sillimanite mineral

Aluminium – silicon alloys are extensively used in automotive applications as it reduces the weight of the automobile leading to reduced fuel consumption. Detailed investigations were initiated at developing a process for the production of aluminium – silicon master alloys from sillimanite by carbothermal reduction employing highly energy efficient and fast plasma process. A systematic physical and chemical characterization of sillimanite mineral revealed that the mineral is brownish in colour and has a specific gravity of 3.21 with bulk density 2.1344 gm/cc. It is conchoidal in nature and has a surface area of 0.12 m²/g. Particle size of the sillimanite falls between 90-250 μ . X-ray diffraction pattern shows all the characteristic peaks of Sillimanite. Wet chemical analysis shows a composition of SiO₂ 37.18% and Al₂O₃ 58.12 % by weight. The total iron content was 0.57% by weight. EDAX analysis showed Al content varied from 25.8 % by weight in 170 ASTM fraction to 39.47% by weight in 80 ASTM fraction and Si content varied from 13.56 in 170 ASTM size fraction to 22.1% by weight in 80 ASTM fraction. Preliminary experiment on carbothermic reduction using a vacuum induction furnace produced aluminum - silicon alloy with 23% Si and 65% Al. X-ray diffraction pattern of alloys confirmed that the major peaks of Si and Al.

A plasma reactor for the reduction melting of sillimanite was procured and commissioned during the reporting period. A few preliminary reduction experiments were also conducted for sillimanite in the above reactor. The alloy samples collected were subjected to chemical analysis and XRD investigations.

4. SOCIETAL PROGRAMMES

Development of PCNSL based contact adhesives

A new solvent based contact adhesive based on blend of phosphorylated cashew nut shell liquid pre-polymer, natural rubber and polychloroprene rubber (PCNL/NR/CR), which has higher T-peel strength compared to a commercial adhesive (Fevicol SR 998), was developed for bonding flexible substrates such as vulcanized rubber, leather and rexin. The adhesive, by appropriate compositional variations, can also find various applications. The synthesis of PCNSL was scaled up to 20 kg level.

Development of Coconut Climbing Bike

The envisaged objective is to develop a palm climber with a speed of 12 trees/ hr. A prototype of this machine was developed with a lift capacity of 65 kg. This has been achieved through the synchronized operation of 3 pneumatic double acting pistons operating at a pressure of 0.8 MPa. The



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present model is suitable of climbing on a pole of 63 mm diameter with a climbing speed of 6m/min. and a descending speed of 3.8m/ min. An approximate variation of $\pm 10\%$ in pole diameter could also be accommodated in the present model. Development of a model, to suit to tree trunk, is in progress with the financial assistance of Coconut Development Board.

The machine climbing with a weight of 65 kg.



International Conference on Advanced Materials and Composites (ICAMC - 2007) was organised by Light Alloys and Composites Section during October 24-26, 2007, Thiruvananthapuram. The conference was attended by more than 400 delegates from India and abroad. About 60 invited lectures in the field of advanced metals, ceramics, polymers and composites have been given. A special session on metal matrix composites was arranged.



PROCESS ENGINEERING AND ENVIRONMENTAL TECHNOLOGY

Focusing to achieve in the generation and application of knowledge at the Science-Computation-Engineering interfaces leading to competitive processes, software products, high impact publications/patents, technology upgradation of industries and societal applications.

Objectives :

Chemical & process engineering

- Scale-up of laboratory scale processes to commercial levels
- Chemical engineering investigations on unit operations and unit processes for minerals and other R&D programmes of the laboratory
- Development of decentralized processing systems for rural applications

Computational modeling and simulation

- Development of software tools for understanding and design of molecules, materials and processes
- Development of technical software for commercial use and to provide computational support to other groups within the laboratory
- Bio and Chemo-informatics

Dioxin research

- Analytical protocols and emission control of Dioxin and other POPs

Environmental technology

- Design and development of industrial effluent treatment processes & plants
- Design and development of biological treatment systems for liquid and solid wastes
- Design and development of odour and VOC control systems
- Environmental impact assessment studies and services

1. CHEMICAL AND PROCESS ENGINEERING

Evaluation for the beneficiability of silica sand

Two silica sand samples (viz., White sand and Yellow sand) supplied by M/s GSRC was evaluated for their use in glass making. Both samples contained iron and titania impurities. The samples were subjected to wet sieving and fractionation so as to get the required minus 600 plus 300 and minus 300 and plus 125 fractions. These were blended to obtain the glass making sand composition. This



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blended sample was attrited, sieved and subjected to wet high intensity magnetic separation. The Fe_2O_3 in white sand could be reduced to 0.05% from a raw sand value of 1.4% thus upgrading the same for Grade II level glass making sand. The silica assay was 98.9%. The yellow sand could not be value-added to glass making grade since the final iron value was 0.15% which is higher than the permissible value of 0.1% as per IS 488: 1980. Incidentally, the Fe_2O_3 assay of the raw yellow sand was 0.95%. A detailed report on the evaluation submitted to the sponsor.

Value addition of “Indian” china clay and optimum utilization of channel waste

The raw clay sample supplied by M/s KCCPL, Kannur was subjected to blunging and screening in order to remove coarse grits. The undersize slurry from the screen is classified using a 2 inch stub hydrocyclone for eliminating the medium grits. The overflow of the stub cyclone was again classified using a 2 inch standard hydrocyclone. The particle size of the overflow slurry solids was determined at every stage for assessing the quantum of minus 2 micron in the product stream. While the raw clay measured a brightness of 61.0 %ISO, the overflow slurry solids of 2 inch std. cyclone measured a brightness of 65.0%ISO. Further classification and value addition work is in progress.

Development of a process for the production of reactive silica from rice husk

The process for the production of reactive silica (microsilica) from rice husk developed at micropilot plant scale was reported earlier. Based on the micropilot plant data, commercial process design has been done for a 59 Tons Per Day (TPD) rice husk processing plant which will produce 10 TPD of microsilica. Tests showed that the material produced at the Institute was an excellent pozzolan for the concrete particularly for its chloride ion resistance. The cost analysis shows that the process was economically viable. The process know how was transferred to the sponsor, M/s BMPTC, New Delhi in March 2008. Further development is underway.



(source of silica) before processing



Microsilica after processing



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Societal Programmes

Reverse flow natural convection driers have become a convenient tool for the drying needs of farmers, small scale and cottage industries, self employed women's group etc. The recent developments are given below:

- The modified NC drier for drying of rubber sheets reported last year was further improved. This low cost drier was made of hollow cement concrete bricks. The drier can dry 30 numbers of rubber sheets within a time span of 2 days and the holding capacity is 60 rubber sheets. The MRP cost of the drier works out to be Rs.15,000/- per unit, all inclusive.
- Based upon the studies conducted, a prototype drier for the accelerated drying of coconuts to make ball copra was designed and fabricated for the drying of 3000 numbers of whole coconuts (coconuts with husk) per batch to make ball copra within a time span of 3 to 4 months. The full capacity drying trials are being carried out.
- Assistance was given to public on the use of NC driers for their different drying needs. Assisted in standardizing the drying conditions for making hand rolled tea leaves in cottage scale to an user from Nilgiri, Tamil Nadu.



Drier for producing ball copra

2. COMPUTATIONAL MODELING AND SIMULATION

The R&D activities comprise of investigation on manufacturing processes and natural phenomena through computer simulations in a wide range of areas like metallurgical engineering, chemical engineering, chemistry and biology.

Modeling of Metallurgical Processes

Software for casting process design – VirtualFeed to complement Virtual Casting

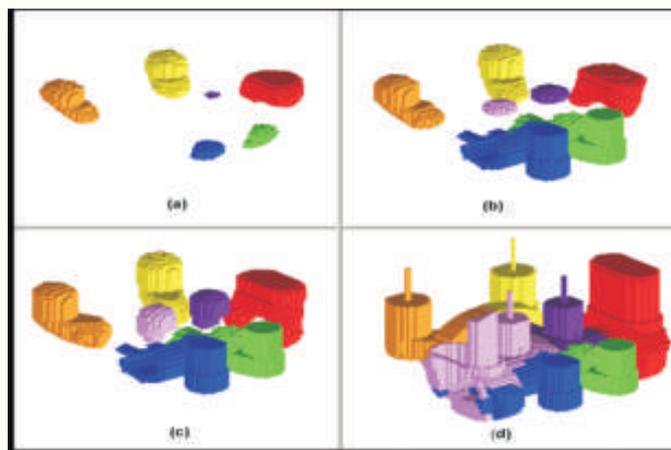
Metals shrink on solidification; therefore the casting process requires that extra metal is supplied through feeders positioned appropriately in the mold. The design and positioning of feeders is the most critical

*Looking into invisible worlds
through Computer Simulations.....*



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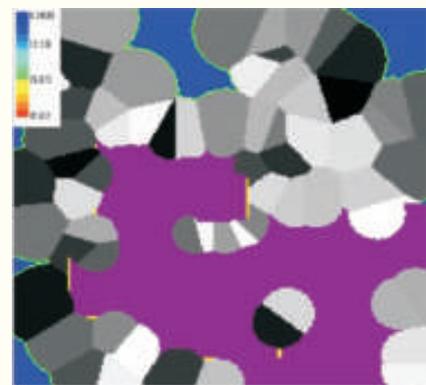
aspect of casting process design. Three years ago the institute brought out the software, *Virtual Casting* that simulates the casting process and provides a virtual environment for testing the adequacy of feeder design. The software is attracting the attention of industry as well as academia. One limitation of any simulation software is that simulations can only test a given design – it cannot generate the design. *Virtual Feed* that creates a simulation-based initial design of feeders by integrating the complementary strengths of the rigorous heat transfer analysis of *Virtual Casting* and practically derived design rules was developed. Based on the simulation results from *Virtual Casting*, a novel pattern recognition algorithm divides the casting into clusters, each cluster being a “feeding section” requiring a separate feeder. From the volume and modulus of a feeding section, the size of the feeder is calculated. For every feeding section, a genetic algorithm finds a class of feeder dimensions such that the yield is maximized. The design can be iteratively refined using further simulations.



The clustering of a complex casting into seven feeding sections

Bubbles in solidifying metals – studying microporosity formation in castings through computer simulations

As automobile industries switch over to light weight alloys for casting the engine block, one of the problems they face is the reduction of fatigue strength in critical regions due to the presence of microporosity. General Motors Corporation USA has sponsored a project for investigating microporosity formation in castings through computer simulations. The novel features brought into the simulation were the movement and redistribution of gas bubbles in solidifying melts and the interaction of growing bubbles with the solidification microstructure that played a critical role in determining the size and shape of microporosity.



A Bubble (shown in purple) grows in the space between growing solid grains giving rise to complex shaped porosity.

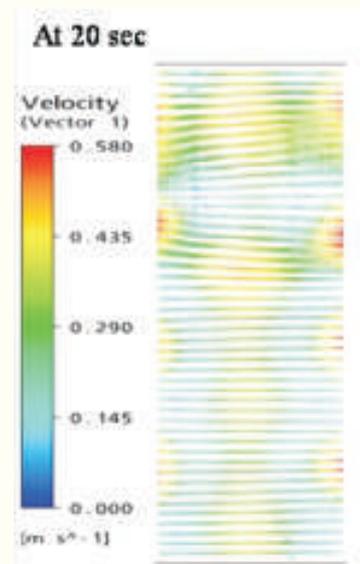


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A cellular automaton simulation model was used as a virtual experimental set up to study growth of gas bubbles in solidifying Aluminum castings. The model assumes that gas porosity originates from pre-existing micro-bubbles that grow by diffusion of hydrogen from the growing solid into the bubbles. The finite time available for the diffusion of hydrogen as well as the space constraint imposed by the growing solid limit the growth of the bubbles. The cellular automaton model with rules specially adapted for bubble growth, tracks the solid-liquid and bubble-liquid interfaces explicitly on a fine grid. The size of the pre-existing bubble and the microstructural environment in which it finds itself are seen to be the critical factors that determine the final size and morphology of porosity.

Solidification Morphology in Electromagnetically Stirred Alloys

When alloys are cooled through their solidification range under constant stirring, the solid assumes morphologies that are very different from the dendritic structures that ensue from normal solidification. Defence Metallurgical Laboratory, Hyderabad has sponsored a project to study the velocity profiles and solidification morphologies that result from electromagnetic stirring of alloys in the solid-liquid state. Three types of coil design were studied: (1) coils that produce a radial magnetic field, (2) coils that produce an axial magnetic field and (3) combination of both. The components of the force vector were calculated for all three cases. These forces were input to a CFD analysis to calculate the velocity fields.



Velocity profiles developed under combination of axial and radial magnetic fields

Models of Chemical Processes

Design of rotary kiln for Ilemanite Metallisation

A computational tool developed allows simulation of the kiln performance over a wide range of design and operating parameters. The tool has various sub models for:

- The granular flow of ilemanite/coal mixture in rotary cylinder which predicts the variation of bed height along the length of the kiln
- The mixing behavior of coal/ilemanite mixture in the rotary kiln using discrete element method
- Pneumatic coal injection from the discharge end which predicts the trajectories and heat generated by the injected coal particles



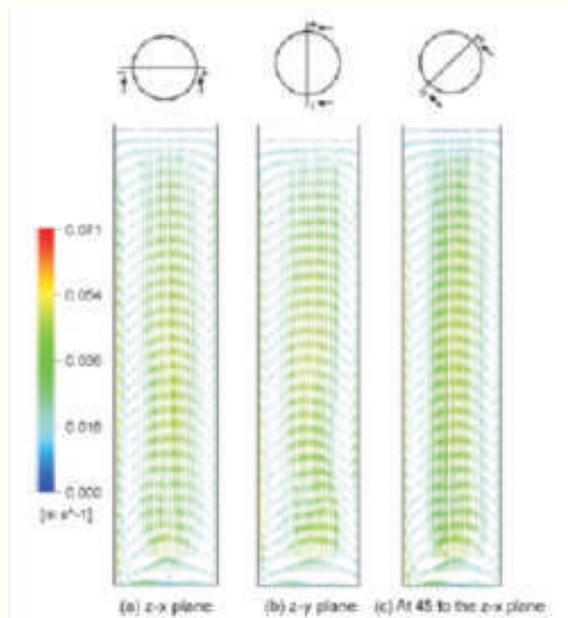
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(d) Overall Heat and mass balance calculations which predicts the various heat loads, primary and secondary air requirements and exhaust gas velocities

The various sub modules were validated with available experimental/pilot plant results. Using this computational tool, a rotary kiln was designed for a capacity of 350 TPD of synthetic ilemanite after validating its performance and pilot scale and other reported literature values

Multiphase CFD simulation of fluidized bed and mechanically agitated reactors

CFD simulations were carried out for the prediction of flow patterns in a liquid–solid fluidized bed using Eulerian–Eulerian framework. Solid mass balance in the core and annular regions were computed for verifying conservation of mass and energy flows due to various dissipation mechanisms. Energy required for solid expansion in liquid fluidized bed was also compared with energy required for solid suspension in an equivalent stirred tank contactor at similar operating conditions. The influence of various interphase drag models on solid motion in liquid fluidised bed was investigated. A comprehensive CFD methodology was proposed to model the hydrodynamics of liquid–solid fluidized bed.

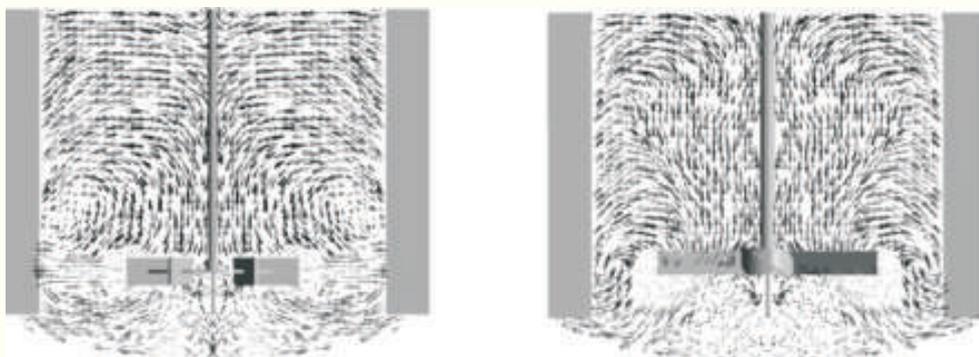


Typical time averaged azimuthally averaged axial solid velocity profile

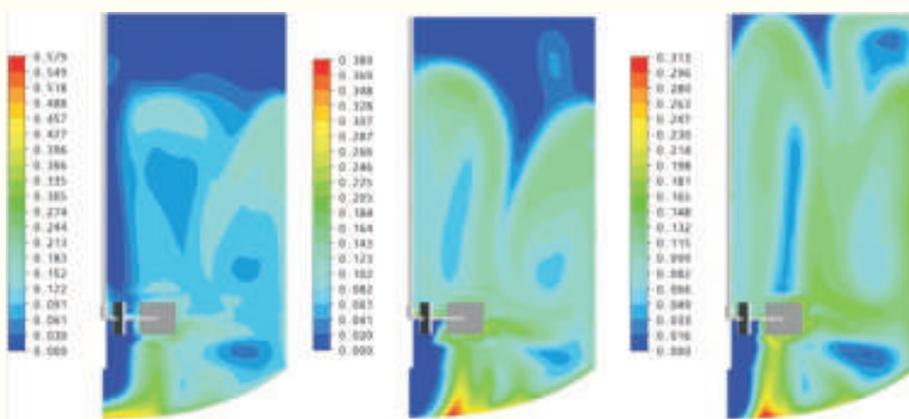
CFD simulation of hydrodynamics and solid motion in liquid fluidised bed was carried out by employing the multifluid Eulerian–Eulerian approach. The predicted flow pattern demonstrated that the time averaged solid velocity profile exhibits axi-symmetric pattern with downward velocity at the wall and maximum upward velocity at the center of the column and higher value of solid holdup at the wall and lower value of that at the center.

CFD simulations were carried out to study solid suspension in Liquid-Solid and Gas-Liquid- Solid mechanically agitated reactor using Eulerian-Eulerian Multi-fluid approach. A multiple frame of reference (MFR) was used to model the impeller and tank region.

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Solid flow pattern obtained from CFD in mechanically agitated Gas-Liquid- Solid reactor



Solid suspension height predicted by CFD for different impeller rotational speeds.

Computational Biology

Simulating Collective cell behavior and Cancer

As part of a CSIR Inter Agency project "New insights in Cancer Biology: Identification of novel targets and development of target based molecular medicine" the Institute is developing a multi-agent simulation for collective cell behavior with application to cancer development. In these simulations the agents represent different types of cells that act co-operatively to produce the normal tissue structure and function. The breakdown of the co-operative behavior will lead to diseases like cancer. These simulations are expected to serve as a virtual experimental facility for testing different hypotheses and assessing therapeutic strategies.

Computational Chemistry

Theoretical methods such as quantum mechanical (QM) ab initio, density functional theory (DFT), molecular mechanics (MM), and molecular dynamics (MD) implemented in advanced hardware



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setups have been used to model chemical structure and reactivity. Several problems were solved in pursuit of ambitious goals such as optimizing new homogeneous transition metal catalysts, development of powerful organocatalysts for stereoselective C-C bond formations, the design of photoactive molecules, better understanding of quantitative structure activity relationships (QSAR) in organic and bioorganic molecules, to test predictive power of theoretical techniques, to prove or disprove conceptual hypothesis, etc. The following are the significant contributions.

i) HIV protease-inhibitor complexes: A theoretical study was conducted on six such complexes to understand the role of "conserved" structural water molecules in the ligand binding mechanism. The QM/MM hybrid and MD methods were used for the study. The simulations showed that the conserved water molecules had a direct influence on the mechanism of drug action as it enhanced the H-bond dynamics occurring at the Asp bound active site region of the protease-inhibitor system (*J. Comp. Chem.* **2008**, *29*, 1840).

(ii) Polycyclic aromatic hydrocarbons (PAHs): These are one of the most potent carcinogenic mutagens frequently found in the biosphere mainly due to incomplete combustion of biomass and fossil fuels. A systematic QM study conducted on a variety of PAH systems revealed the characteristic electronic features of aromatic rings leading to a classification to K, L, M, and N regions. The QSAR model suggested that the K and M regions were activating while L and N regions were deactivating the carcinogenic property of PAHs. This feature is supportive of the two popular theories of PAH carcinogenesis, viz, K, L region and the bay region theories (*J. Comp. Chem.* **2008**, *29*, 1808).

(iii) Stereoelectronic profile phosphine ligands: The determination of the stereoelectronic profile of a variety of phosphine ligands (PR_3) was achieved using a combined approach of QM and MM methods, leading to a general classification of the ligands into four categories, namely, ligands with $(+E_{\text{eff}}, +S_{\text{eff}})$, $(+E_{\text{eff}}, -S_{\text{eff}})$, $(-E_{\text{eff}}, +S_{\text{eff}})$, and $(-E_{\text{eff}}, -S_{\text{eff}})$, where plus and minus signs indicate electron donation and electron withdrawal properties, respectively and E_{eff} and S_{eff} are the electronic and steric effects, respectively (*Inorg. Chem.* **2007**, *46*, 10800).

(iv) DNA metal-ion interactions: QM/MM approach was also used to study the interactions of hydrated alkali metal ions such as Li^+ , Na^+ , and K^+ with a DNA fragment containing two phosphate groups, three sugar units, and a GC base pair modeled in the anion and dianion states. Among the three metal-binding combinations studied (outer-sphere, inner-sphere monodentate, and inner-sphere bidentate), the outer-sphere binding mode showed the highest binding energy (BE) for hydrated Li^+



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ions (103.1 kcal/mol) while the hydrated Na^+ and K^+ ions preferred the inner-sphere monodentate binding modes to the phosphate group of the anionic DNA fragment ($\text{BE} = 87.9$ and 98.2 kcal/mol for Na^+ and K^+ , respectively). These data showed good agreement with the previous experimental findings (*J. Chem. Theor. Comput.* **2007**, *3*, 1172).

(v) Interpretation of lower critical solution temperature (LCST) behavior: A theoretical interpretation of the contrasting LCST behavior of *N*-isopropylacrylamide-co-maleimide (NIPAM-co-MI) and *N*-isopropylacrylamide-co-maleic anhydride (NIPAM-co-MA) was obtained by quantum mechanical (QM) modeling on small structural units of the polymers as well as MD simulations at LCST and above the LCST on 50-unit oligomer model of the polymers. The QM models showed that the MI based polymer was more inclined towards bend structure, higher hydration, and higher intramolecular hydrogen bond formation between its monomer units when compared to those of the MA based polymer. The results of the large scale MD simulation was in complete support of the QM results as it showed the formation of a more folded and highly hydrated NIPAM-co-MI than NIPAM-co-MA (*Polymer*, **2007**, *48*, 6707).

(vi) Multiple hydrogen bonds: The intramolecular hydrogen bond (H-bond) energies in several polyhydroxy systems were estimated using an isodesmic/homodesmic reaction approach as well as a molecular tailoring approach (MTA). It was shown that the isodesmic/homodesmic reaction approach as advocated in the literature did not give true H-bond energy but included the effect of strain energy due to the formation of a ring structure. Such a ring strain was duly accounted for in the MTA method. Using the decitol molecule, it was shown that the MTA method was able to predict not only the H-bond energies but also the trends in conformational energies (*J. Phys. Chem. A* **2007**, *111*, 6472).

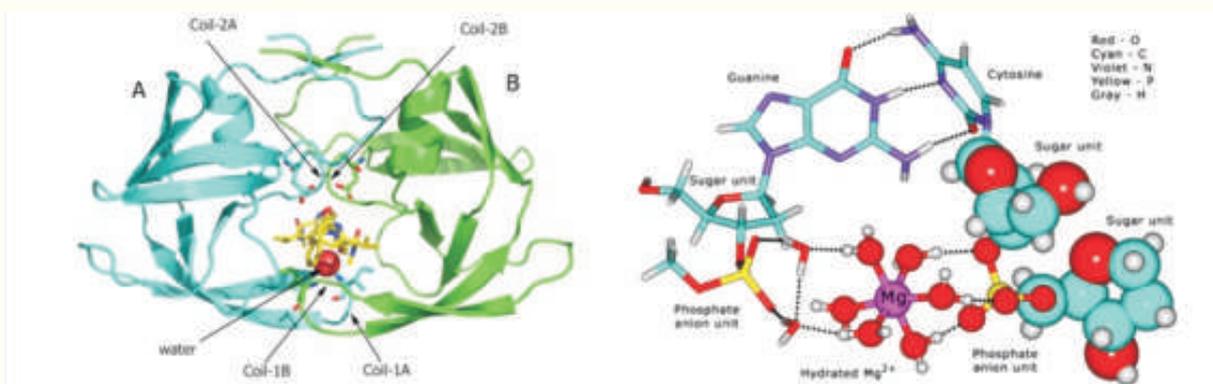
(vii) CH...O and CH... π interactions: Host-guest interactions in an azapolycyclic system was investigated using DFT and semiempirical PM3 methods. The calculations showed that the guest molecule ethylacetate was trapped inside an aromatic pocket due to multiple CH...O and CH... π interactions. Theoretical results showed good agreement with the experimental structure of the complex (*Bull. Chem. Soc. Jpn.*, **2007**, *80*, 484).

(viii) Surface modeling of alkoxy substituted phenyleneethynylene: Molecular modeling using semiempirical AM1 method was carried out to understand two dimensional organization of the alkoxy substituted phenyleneethynylene. The results from the study strongly suggested that the driving force for the observed self organization pattern was the existence different modes of alkyl CH... π interactions (*J. Phys. Chem. C* **2007**, *111*, 14933).



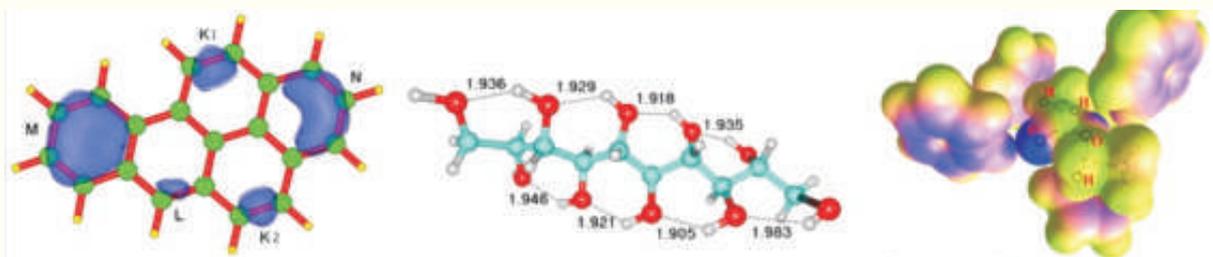
Process Engineering & Environmental Technology

(x) **Photochemistry of dibenzobarrelene:** This was investigated using time dependent DFT methods. The study strongly supported that the excited singlet state of dibenzobarrelene undergoes rapid intersystem crossing to its triplet state, followed by intramolecular δ -H abstraction, to yield the triplet biradical intermediate. The absorption spectrum of the triplet biradical, displayed an intense absorption maximum at 670 nm, which was in good agreement with the observed absorption peak at 700 nm. The results strongly supported the intervention of a long-lived triplet biradical in the photochromism of appropriately substituted dibenzobarrelenes (*J. Am. Chem. Soc.* 2007, 129, 9439).



HIV protease-inhibitor complexes

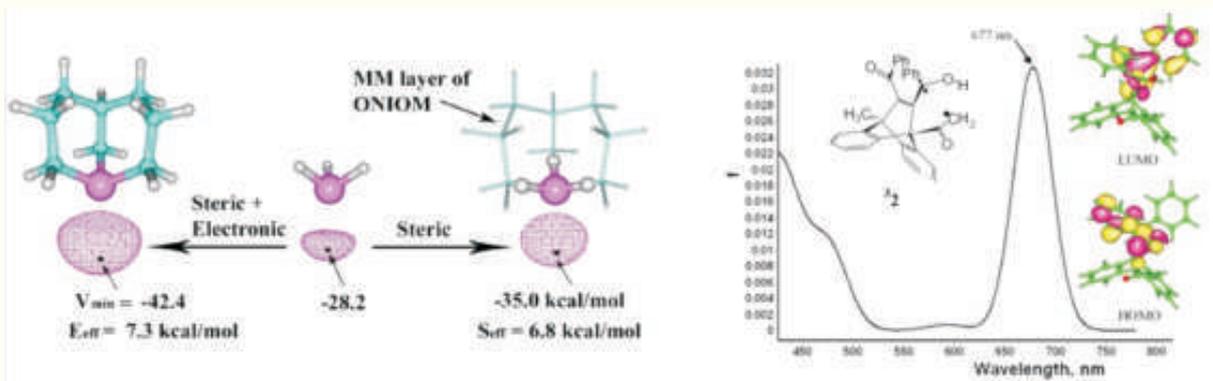
Model for DNA metal-ion interactions



K, L, M and N regions of PAH

Multiple hydrogen bonds in decitol

CH... π and CH...O interactions on host-guest complexation



Stereoelectronic profile phosphine ligands

Photochemistry of dibenzobarrelene



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Retting area sediments are marked by high concentration of heavy metals - copper (between 100 and 400 mg kg⁻¹), zinc (above 100 mg kg⁻¹), lead (up to 77 mg.kg⁻¹). In the control sites, these metals were always less than 10 mg kg⁻¹. Cadmium, however, was low (max. 5mg kg⁻¹). The abundantly found benthic aerobic mollusks (354 no/m²), snails (979 no/m²) and crustacean species (62 no/m²) present in the control sites were totally absent in the organic rich sediments. Absence of fishes was also noticed in the retting areas.

Anaerobic treatment for seafood processing wastewater

The seafood processing industries include strings of pre-processing and processing units which pollute the long coastal belt of the country. An important issue in the anaerobic treatment of seafood industry wastewater is the removal of solids and fats. A biological method for separating fats & solids in wastewaters by floating out fats and solids using anaerobically generated gases. It leaves mainly the dissolved impurities which are easily treated (95% COD removal) in the laboratory level anaerobic reactor. A patent application was filed for the method and device for separation of fats & suspended solids from wastewater.

Household sewage treatment device

This project aims at the development of a "Household Sanitation Device" (HSD) suitable for complete decentralized sewage treatment and indented to replace the conventional septic tank devices. The device has a two stage anaerobic digestion system for both black and grey water. It has a settler for retention of solids and provision for gas collection. The HSD was fabricated in FRP and now installed in one of NIIST quarters for continuous testing. The effluent is continuously monitored for pH, COD, TSS, TDS. The effluent meets the discharge standards in marine coastal areas.



Sewage treatment device HSD installed at an apartment



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Zero discharge process for paddy parboiling

Rice, a staple food of this region, is consumed in parboiled form which reduces grain breakage and reduces insect infestation while improving nutrient contents and enhances the cooking as well as eating quality (less stickiness). The hot soak parboiling process requires about 1 tonne of water/ton of paddy processed and about 0.8 t soak water is discharged as effluent. Untreated parboil effluent quickly becomes putrefied and is a serious environmental concern with the formation of polyphenolic compounds which are recalcitrant (difficult to degrade).

zero-discharge process was developed for parboiled rice mills. Anaerobic treatment of parboil effluent was adopted for removal of the COD content. It was found that the effluent can be recycled after anaerobic treatment. The laboratory studies showed that soak water can be fully recycled after anaerobic treatment without affecting the quality of the rice. Study involved characterization of the soak water for its chemical and biological constituents based on the paddy parboiling conditions, degradation of the pollutants under anaerobic conditions and evaluation of rice quality. A zero-discharge pilot plant was set up by Kalady Rice Mill Consortium Ltd., at Pavizham Rice Mill in Kalady. The plant has a 2 tonne/batch parboiling tank, heat exchanger and UASB reactor. The specially designed UASB can store treated water without air contact, for reuse. The UASB reactor produces 1.5 m³ biogas/m³ effluent. This corresponds to 3 kg COD removal per litre of effluent, which sufficient for recycle. The effluent was recycled for parboiling and 12 successive batches of paddy were evaluated. Rice quality (taste, odour, appearance) between the successive batches was unaffected in blind tests. UASB loading rate up to 8 kg COD/m³ active-volume/d was obtained in the pilot plant trials. A full scale unit is planned based on the pilot tests.



UASB reactor for parboil effluent treatment pilot plant

Anaerobic Leach bed technology for treatment of solid wastes

The management of Municipal Solid Wastes (MSW) is the single biggest issue engaging the urban bodies and claims a major portion of the expenditure. "Windrow composting", an aerobic



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biological treatment system, is usually chosen for the MSW treatment. This system has many limitations such as extreme odour, fly nuisance, exposure of workers to unhygienic work environment, severe leachate pollution from dumped rejects, low price for recovered compost, etc.

Anaerobic digestion for stabilization of putrescible fraction of MSW overcomes the above limitations of biological treatment. The anaerobic leach bed reactor (ALBR) is formed by dumping of coarsely shredded wastes into a tank and soaked in liquor circulated through a UASB reactor. Volatile fatty acids (VFA) are formed during rapid decay of organic wastes in the ALBR. The UASB reactor converts VFA to biogas. Odour is avoided because odorous gases dissolve in the leachate which is at neutral pH. Furthermore, the leach bed does not develop high temperature as in a windrow that causes the emission of odour because of natural convection. Covering the leach tank restricts the entry of insects.

In the laboratory studies at 5kg level, it was found that 5 days ALBR retention time was sufficient for complete hydrolysis of putrescibles. The maximum rate of generation of VFA from 1 kg unsorted MSW was found 200 m.moles per day for average MSW containing 25% food waste with proportionate increase for every additional food waste fraction. Total biogas generation was 40 L/ Kg(wet) unsorted MSW. Alkalinity and pH of the anaerobic reactor effluent were well within the allowable concentration for further leachate generation in ALBR. The same liquor can be re-circulated batch after batch with no toxicity to UASB. No chemicals are required for pH control. Volume of waste reduced to 50 % after 5 day's leaching. If the quantity of food waste is of 50 %, then the volume reduction will be in the order of 65% after 5 days. The stability of the leach bed treated MSW was tested by measuring oxygen consumption rate with a specially developed respirometer.

A proposal for a pilot cum demonstration plant prepared and submitted to the Ministry for Renewable Energy.

Biodegradation of Antimicrobial compounds

Excess use of antimicrobial compounds (eg: Triclosan, Tricarbon etc.) in household products (soaps, detergents, cosmetics, etc) lead to the development of antibiotic resistant bacteria and interfere with the normal micro-flora in natural environments. Also, the presence of antibiotic compounds in treated water reduces its reuse potential. The environmental effects of these xenobiotic compounds are yet to be elucidated. The ongoing research funded by International Foundation



Clear zone indicating Triclosan degradation by bacteria growing on Triclosan added agar medium

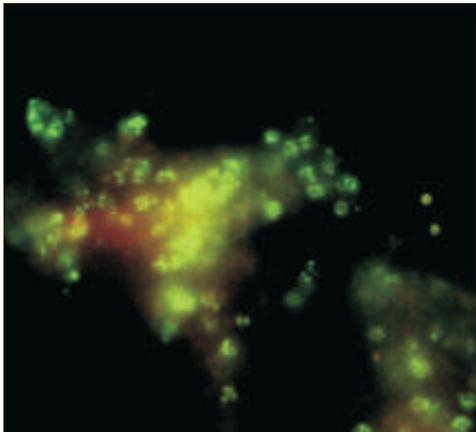


Process Engineering & Environmental Technology

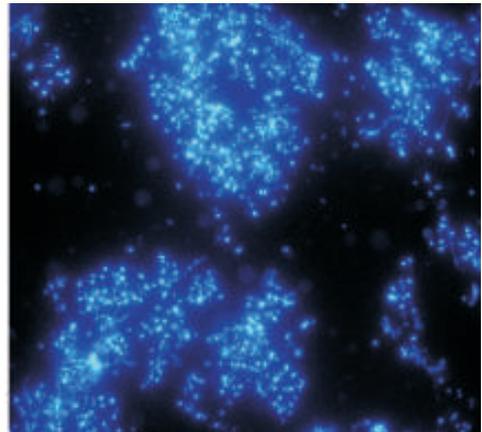
for Science (Sweden) in Environmental technology lab focus on biodegradation of antimicrobial compounds, analysis of the degradation products, elucidation of probable degradation pathway and to analyze the microbial communities involved.

Microbial analysis with molecular markers

16S rRNA and DNA targeted microbial analysis in wastewater treating bioreactors and environmental samples generate valuable information about the microbial community structure and dynamics. rRNA based whole cell Fluorescent In-situ Hybridization (FISH) analysis revealed the presence of methanogenic microorganisms in anaerobic marine sediments. Differential staining with fluorescent dyes like DAPI and Propidium Iodide provided information about the live/dead cell count in various environmental samples. Compared to the conventional plate culture methods fluorescent dye based approach are more reliable and convenient.



FISH image of Methane producing Archaea



Epi-fluorescent microscopic image of DAPI stained microbial cells

Higher trophic organisms in anaerobic bioreactors

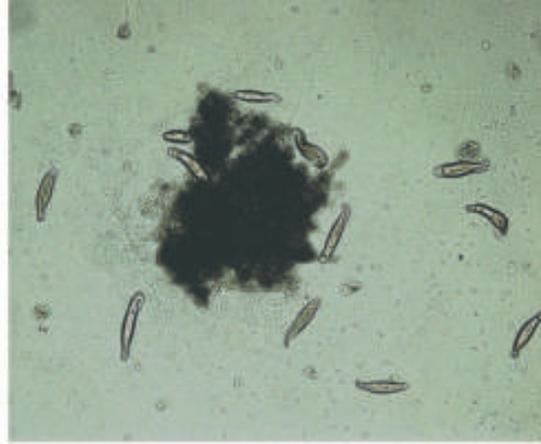
Anaerobic protozoa (mainly ciliates and flagellates) micro-metazoa (rotifers, dipteran larvae, worms, etc.) were studied for their ecological niche and functional importance in overall waste treatment especially for particulate COD containing wastewater. Some of these organisms were direct indication of the overall performance of a bioreactor. Ciliate such as *Metopus* keeps methanogenic microbial populations intracellular. Studies have revealed a high correlation between ciliate count and methane production and also a significant reduction in mixed liquor suspended solids (MLSS).



Process Engineering & Environmental Technology



Phase contrast image of Metopus harbouring intracellular methane producing Archaea



Bright field image of anaerobic ciliates grazing over anaerobic sludge floc

Environmental Management Services

A Rapid Environmental Assessment was carried out for the proposed Kaolin processing plant at Kinfra Industrial park for M/s Ashapura Minechem Ltd, Mumbai as per MOEF guidelines. Major impacts on the environment due to dust emission, traffic, consumption of water and rejects management were documented in the report. Existing environmental data with respect to the above parameters constituted the baseline data based on which the implications of the possible impacts were assessed and mitigation measures recommended. Battelle environmental system was used for evaluation of impacts. Mathematical models have been used to quantitatively predict the impacts on air and water quality.

Detailed marine ecological survey was conducted to establish the existing status of the marine water around three proposed project sites for M/s Mumbai Port Trust, Tata Pwer Corporation and Mirkarwada Fisheries. The study included data collection and analysis of physicochemical and biological characteristics of marine and sediment samples, collection of mangrove samples for detailed analysis, enquiry with fisheries department and local fishermen as per MOEF guidelines.

Completed a field survey & site selection for the proposed berth based on environmental sensitivity of Pawas Bay for Finolex Ltd, Ratnagiri, Maharashtra. Keeping in view of the proposed location, the navigational channel, shallow and deep regions, point of inflow, outflow and human activities, water and sediment sampling were done at four locations in and around the proposed project site and their physical, chemical and biological diversity characteristics were analyzed and reported.

Prepared an environmental appraisal report on the two proposed bauxite mining areas at Manjeswar block panchayat, Kasargod district for Directorate of Mining & Geology, Thiruvananthapuram. This study included data collection, analysis of the reports on Geology, deposit details, drainage and hydrogeology contributed from DMG, observations made directly, and possible significant impacts assessed and mitigation measures..



RESEARCH PLANNING AND BUSINESS DEVELOPMENT

Agreements/MoUs signed during 2007-08

Technology Licensing and Transfer agreements:

1. Assignment deed with NRDC, New Delhi for commercialization of 14 technologies/process know-how.
2. Agreement for developing a Business Plan for setting up Farmers Service Centre (FSC) in Kerala with the Agriculture and Organic Farming Group India (AGFG India), Delhi.
3. Agreement for utilizing the know-how developed by NIIST in the treatment of rice parboiling soak water in the factory at Kalady with M/s. Kalady Rice Millers Consortium Pvt. Ltd. (KRMCP).
4. Agreement for licensing of know-how on Bioprocess to extract banana fibers from banana pseudo stem and fruit bunches with Mr. R. Murugan, Coimbatore – 641 023, Tamil Nadu.
5. Agreement for licensing of technology for processing fresh spices in Mizoram with Community Development Action & Reflection (CDAR), Aizwal-796001.
6. Agreement for licensing of technology for processing fresh spices with Arunachal Agri-Biotech Pvt. Ltd, Itanagar, Papumpari District Arunachal Pradesh – 791 111.
7. Agreement for technology transfer and licensing of knowhow for setting up of an integrated spice processing facility in the state of Sikkim with Horticulture and Cash Crops Development Department, Government of Sikkim, Krishi Bhawan, Tadong –737 102, Gangtok.
8. Agreement for licensing of know-how for making white pepper from dried pepper (black) and matured green pepper with Shri. N.S.Jithendra Kumar, New Jithendra Traders, Chickmanglur – 577 101.

Agreements signed for taking R&D and Consultancy work:

9. Agreement for Research on application of colloidal processing techniques for improving the performance of advanced ceramic materials with M/s Crompton Greaves Ltd., Worli, Mumbai 400 030.
10. Agreement for Development and evaluation of techno-economics through pilot scale demonstration of value added building materials from high volume flux bonded Fly Ash with Building Materials and Technology Promotion Council (BMTPC), Lodhi Road, New Delhi – 110 003.
11. Consultancy agreement for restructuring the on-going training and training material for technical programmes under the cosmile brick project for capacity building of firemen community working on Bulls Trench kilns in East Uttar Pradesh with The Energy and Resources Institute, Lodhi Road, New Delhi – 110 003.
12. Memorandum of agreement for Scale-up studies on the production, characterization and application of cold active beta-galactosidases - a therapeutic agent for lactose intolerance with DBT, New Delhi.
13. Consultancy agreement for “N situ CO₂ separation in energy recovery by chemical looping in combustion system: computer aided process modeling, optimisation and material characterization” with M/s Thermax Ltd., Chinchwad, Pune – 411 019.



14. Consultancy agreement for conducting regional EIA study in clay mining areas of Mangalapuram, Thiruvananthapuram with Directorate of Mining and Geology under Department of Industries, Government of Kerala, Thiruvananthapuram – 4.
15. Agreement for mapping regions under coir retting in the coastal areas of Kerala state chosen for EIA studies with Directorate of Mining and Geology under Department of Industries, Government of Kerala, Thiruvananthapuram – 4.
16. Consultancy agreement to set up a rice bran oil refining unit with Kalady Rice Millers Consortium, a Private Limited Company Kalady, Ernakulam District, Kerala.

Agreements with foreign agencies:

17. Umbrella agreement on design & operation of Jokaso, river and lake restoration, measurement, analysis and research of persistent organic pollutants in India with HIYOSHI Corporation, Omihachiman, Shiga, Japan.
18. Development work agreement on Investigation, Research, Development and Design work to develop photo chromic dyes suitable for use in ophthalmic and sun-glass lenses with M/s CORNING SAS, 7 Bis avenue de Valvines, 77210 Avon France.
19. Non-disclosure agreement on "Handling and protection of certain proprietary information that may be disclosed regarding processes and know-how related to solid-state fermentation for the production of industrial enzymes" with Cover Technologies, Inc., 95 State Street, Suite 812, Springfield, Massachusetts 01103.
20. Confidential information/sample agreement on Synthesis and evaluation of polymers and coatings related to biodegradation with PPG Industries Inc., a US Corporation, One PPG Place, Pittsburgh, PA 15272, USA.

Contract Research Programmes

AGRO PROCESSING DIVISION

| CLIENT | PROJECT TITLE | PROJECT LEADER |
|--------------|--|--|
| TMOP | Development of Supercritical Fluid Extraction for Edible oil | Dr. C. Arumughan |
| TMOP | Development of technology of refining and production of Down Stream products from RBO and other Oils Phase II | Dr. C. Arumughan |
| TMOP | R&D Industry Consortia approach to develop a new generation process and high value products from oil seeds and by products | Dr. C. Arumughan |
| STCL TMOP | Setting up chilli processing plant in Karnataka Establishment of 2.5 Ton FFB/hr palm oil mill in the state of Orissa | Mr. M.M. Sreekumar Dr. C. Arumughan |
| CSIR Ayush | Standardisation of plants, plant products and formulations in terms of phytochemical and chemical markers, chemical characteristics of bhasmas | Dr. C. Arumughan |



BIO-TECHNOLOGY DIVISION

| CLIENT | PROJECT TITLE | PROJECT LEADER |
|-----------------------|--|---|
| KSCSTE | Molecular Cloning over expression and Biochemical characterisation of beta lactamases of Mycobacterium tuberculosis | Dr. K. Madhavan Nampoothiri |
| DBT | Molecular Studies on peptide deformylase and the Methionine Amino Peptidase involved in peptide deformylase of M.Tuberculosis H37 Rv | Dr. K. Madhavan Nampoothiri |
| DBT INDO FRENCH | Scale up studies on the production of galactosidases Mannolipids and mannose metabolism in mycobacterium tuberculosis | Dr. P. Prema Dr. K. Madhavan Nampoothiri |
| DBT | Metabolic activities and Genetic manipulation leading to nutraceutical products from lactic acid bacteria for novel applications | Dr. K. Madhavan Nampoothiri |
| DBT | Development of efficient probiotic to combat vitamin B12 folic acid and iron deficiency | Dr. K. Madhavan Nampoothiri |
| MOEF | Utilisation of brown coir waste pith for Lignin degrading enzymes production and development of value added products from fermented waste pith | Dr. Mrs. P. Prema |
| DST | Microbial mediated removal of iron mineral impurities from kaolin for value addition | Dr.SathyChandrashekar/ Dr.Prema |
| DBT | Production, characterization and application of microbial alpha galactosidase- A therapeutic enzyme for flatulence | Dr. P. Prema |
| DBT | Construction and screening of environmental DNA libraries for novel beta-lactamase inhibitors and lipases | Dr. Ashok Pandey |
| CSIR | Bioethanol from lignocellulosic biomass | Dr. Ashok Pandey |
| DST | Isolation and cloning of glucose tolerant Beta-glucosidase from fungal isolate BTF-5 and the CBH1 control elements from Trichoderma reesei and studies on the properties of the enzyme | Dr. Rajeev K Sukumaran |
| DBT | Development of thermostable and low pH tolerant phytase from Aspergillus niger using site directed mutagenesis | Dr. Ashok Pandey |

CHEMICAL SCIENCES & TECHNOLOGY DIVISION

| CLIENT | PROJECT TITLE | PROJECT LEADER |
|----------|---|----------------|
| DST/CSIR | Design and development of materials for photonic applications | Dr. Suresh Das |
| DST | Design & development of photoinduced electron transfer system with dendritic architecture for artificial photosynthesis | Dr. Gopi Das |



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|-----------|--|---------------------------|
| DST | Optical & electronic studies of photoactive molecules on meta nanoparticles & their molecularly bridged arrays on surfaces | Dr. George Thomas |
| DST | Investigation on the liquid crystalline phase of cation induced components and Nano structured DNA; implication for Gene Therapy | Dr. (Mrs) Emilia Abraham |
| DST | Novel component reaction involving nucleophilic carbenes and related things | Dr. G. Vijay Nair |
| DST | Design, synthesis and biological studies of Neo Glyco Conjugates | Dr. K.V. Radhakrishnan |
| TIRUPATHI | Development of efficient luminescent molecular devices based on lanthanide complexes | Dr. MLP Reddy |
| MOEF | Development of Novel Solid waste remediation process through resource recovery and its reintegration as value added state of art products in titanium minerals processing industry | Dr. MLP Reddy |
| DRDO | Biomimetic sensors for detection of chemical warfare agents | Dr. T. Prasada Rao |
| KSCSTE | Design and development of polymeric material for organic pollutants in natural waters | Dr. T. Prasada Rao |
| DST FAST | Novel self assembled Supra Molecular containing polymers for electronic devices | Dr (Mrs) AshaKannan |
| KSCSTE | Design and development of Novel PI conjugated material | Dr. JayaKannan |
| NMITLI | Design and development of Environmentally secure RE based colorants for surface coating applications | Dr. MLP Reddy |
| DST | Calixpyrroles, Novel Anion and Neutral Substrate receptors | Dr. A. Srinivasan |
| BRNS | Recovery of Uranium from Sea Water via solid phase extraction using tailored ion imprinted polymer materials | Dr. T. Prasada Rao |
| DST | Establishment of high resolution TEM at RRL TVM | Director |
| DST | Development of Novel Probes based on organic ligands | Dr. Ramaiah |
| VSSC | Development of EMI shielding/Static charge dissipating materials from electrically conducting PANICNs for space applications. | Dr. J.D. Sudha |
| DST | Exploration of a novel reactivity of epoxides | Dr. Shanmughan |
| DST | J.C. Bose fellowship to Prof. T.K. Chandrasekhar | Prof. T. K. Chandrasekhar |
| STEC. GOK | Chemical prospecting and in vitro activity evaluation of the bioactive compounds of Njavara | Dr. A. Jayalekshmi |
| KSCSTE | Design and development of novel hydrogen bonding resins for UV curable applications | Dr. AshaKannan |
| DMSRDE | Synthesis of spinnable grade PBO | Dr. AshaKannan |
| IRE | Design & development of environmentally secure rare earth based colorants | Dr. MLP Reddy |
| DBT | Investigations on immobilized enzyme nano particles(ENCP) for novel catalytic applications | Dr. (Mrs) Emilia Abraham |



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|-------------------------|---|--------------------------------|
| DST | Ramanna fellowship to Dr. Ajay Ghosh | Dr. Ajay Ghosh |
| DST | Metal-coordinated imprinted polymers for drug delivery applications | Dr. T. Prasad Rao |
| DST | Melt/Solution processable conducting polyaniline based magnetic films | Dr. JayaKannan |
| DST | Functional nanomaterials of pi-conjugated molecules | Dr. A. Ajayaghosh |
| Proctor and Gamble, USA | PMC Transformations understanding for scalability | Dr. Jayakannan |
| M/s. Corning | Research project to develop superior photo-chromic dyes | Dr. S. Suresh Das |
| KSCSTE | Microanalytical investigations of urinary stones: FTIR spectroscopy vs SEM-EDAX | Dr.R.Luxmi Verma |
| IFCPAR | Functional hybrid nanomaterials of polymeric gels and Pi conjugated self assemblies | Dr. A. Ajayghosh |
| DST | Engaging N-Heterocycles and N-Heterocyclic carbenes as organocatalysts for Novel carbon carbon and carbon Heteroatom bond forming reactions | Dr. G. Vijay Nair |
| BRNS | Study of photoinduced electron transfer in cyclodextrin based supramolecular systems | Dr. Gopidas |
| DST | Development of Sensitizers based on NMR Dyes | Prof.T.K.Chandrashekar/Ramaiah |

MATERIALS AND MINERALS DIVISION

| CLIENT | PROJECT TITLE | PROJECT LEADER |
|---------------------------|--|--------------------|
| KERALA GOV | Development and Demonstration of environmentally friendly technologies in Kerala building material sectors | Dr. KGK Warriar |
| BRNS/BAR | Development of HTS current leads as products for high current superconducting systems | Dr. Syama Prasad |
| DST | Material for wireless communication | Dr. M.T. Sebastian |
| KSCSTE | Microwave ceramic dielectric resonators based on AO-LE203-TiO2(A=Ca,Ba,Sr) for wireless communication | Dr. M.T. Sebastian |
| DRDO | Fatigue characteristics of low Pr. cast AZ91 MG Alloy | Dr. U.T.S. Pillai |
| DRDO/CUSAT | Thermal, elastic and dielectric properties of new microwave substrate materials | Dr. M.T. Sebastian |
| DST | Development of Mg based alloys for high temperature applications(Coll. with NML Jamshedpur) | Dr. U.T.S. Pillai |
| KSCSTE | Development of Pressure sensitive adhesives | Dr. ARR Menon |
| KSCSTE | Low loss ceramic polymer composites for Micro electronic Packaging application | Dr. C. Pavithran |
| Areva T & D Lightning Ltd | Development of high energy varistors through nanoprecursors | Dr. Ananthakumar |
| DST | Design, Synthesis and Characterisation of Novel polysilane high polymers for UV and NUV LED's Materials | Dr. S.K. Shukla |
| ICDD | Preparation of new ceramic oxides & generation of XRPD patterns | Dr. Jose James |



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|---------------------------|---|----------------------|
| KSCSTE | Studies on novel rare earth based phosphates for phosphor and dielectric applications | Dr. Peter Koshy |
| DST | Studies on Novel Oxide Semiconductors $A_3 Ce_3 B_5 C_5 O_{30}$ and $CA_3ce_3B_7C_2O_{26.5}$ (A=Ba, Sr; B=Ti, Zr and C=V, Nb, Ta) and their thermal cycling for possible applications in NTC thermisters. | Dr. Peter Koshy |
| ICDD | Generation of powder X-ray diffraction pattern | Mr. Prabhakar Rao |
| IRELTDC | Pilot scale production facility for nanosize rare earth phosphates and development of industrially potential application areas | Dr. K. G. K. Warriar |
| BHEL, Bangalore | Development and demonstration of multifunctional ultra filtration ceramic membrane for industrial applications | Dr. K. G. K. Warriar |
| IRE | Development of cerium oxide based nanomaterials for applications as chemical mechanical planarisation/polishing slurry | Dr. S. K. Ghosh |
| Coconut Development Board | Developing of coconut climbing bike | Dr. V. John |
| LPSC | Metallurgical characterisation of metallic materials for space applications | Sri. K. Sukumaran |
| DST | Nanostructured dielectric LTCC composite tapes for modern high speed communication integrated circuits | Dr. Manoj Rama Varma |
| DST | Pilot scale demonstration and technical feasibility of nano size photo catalytic titanium oxide for anti algal, anti bacterial and anti soiling coating on terra cotta, glazed ceramic surfaces | Dr. K.G.K. Warriar |
| IRE Mumbai | Investigations on the production of aluminium-silicon master alloys from sillimanite through plasma processing | Dr. P. N. Mohandas |
| DST | An investigation on the technical feasibility of making long multifilamentary mgb ₂ superconducting wires | Dr. U. Syamaprasad |
| BRNS, Bombay | Ceramic-metal and polymer-metal composites for electromechanical applications | Dr. Jose James |
| CMRL, Alwaye | Rendering Scientific and technical support to M/s. CMRL synthetic rutile commercial plant. | Dr. P. N. Mohandas |
| DRDO | Development of ceramics-based nano structured magnetic refrigerators | Dr. Manoj Rama Verma |
| BMTPC | Development and evaluation of techno economics through pilot scale demonstration of value added building materials from high volume flux bonded fly ash | Dr.K. G. K. Warriar |
| ICDD | Preparation of new cramic oxides and generation of their XRPD patterns | Dr. Jose James |
| DST | Tunable microwave materials and devices | Dr. Jose James |
| BRNS | Development of Boron carbide reinforced aluminium matrix composites for nuclear applications | Dr. T. P. D. Rajan |



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|------|---|--------------------|
| BRNS | Investigation on the reactivity and wetting behaviour of molten metals with nano size lanthanum phosphate sintered ceramic and coatings | Dr. KGK Warriar |
| ISRO | Development of ultrafine grain aluminium alloy and composite through equal channel angular pressing (ECAP) for space applications | Dr. T. P. D. Rajan |
| ICDD | Generation of powder X-ray diffraction patterns for new generation ceramic oxide compounds | Dr. Prabhakar Rao |

PROCESS ENGINEERING & ENVIRONMENTAL TECHNOLOGY DIVISION

| CLIENT | PROJECT TITLE | PROJECT LEADER |
|--------------------------|---|---------------------------|
| MOEF | Development of modular HSD for Deneutralised sewage treatment | Mr. J. Ansari |
| DMRL | Prediction of solid Morphology in Mushy alloys | Dr. Roschen Sasikumar |
| ARDB | Simulation based design of rigging system | Dr.(Mrs). Elizabeth Jacob |
| CSIR | Development of ball copra NC Driers | Dr. P.P. Thomas |
| MOEF | Pilot plant for eco friendly coir retting and waste water treatment under the scheme for assistance of abatement of pollution | Dr. V. B. Manilal |
| DST | Quantum chemical and QSAR studies on carcinogenic activities of polycyclic aromatic hydrocarbons and their epoxide derivatives | Dr. K. P. Vijayalakshmi |
| DST | Investigations on layer by layer vapour phase coating on oxidic microparticles in a fluidized bed. | Mrs. Ani K. John |
| IFS | Biodegradation of Triclosan under aerobic and anaerobic conditions | Dr. B. Krishna Kumar |
| GMDCSRC | Evaluation for the beneficiability of silica sand | Mr. P. Raghavan |
| DST | Rational discovery of novel photoresponsive molecules and materials: molecular modeling, simulations and synthesis | Dr. C. H. Suresh |
| DST | Development of a molecular aggregation model for the co precipitation synthesis of Ba(Mg _{1/3} Ta _{2/3})O ₃ dielectric ceramic nano particles | Dr. S. Savithri |
| DBT | Anaerobic degradation of perchlorate and development of a bioprocess for removing perchlorate in aqueous phase | Dr. B. Krishna Kumar |
| M/s. General Motors Ltd. | Nucleation, movement and growth of gas bubbles in aluminium castings | Dr. Roschen Sasikumar |
| KCCPL | Value addition of Indian China clay and optimum utilisation of channel waste for M/s. Kerala clays & Ceramic products, Kannur | Mr. P. Raghavan |



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|------|--|----------------------|
| DBT | Anaerobic degradation of perchlorate and development of a bioprocess for removing perchlorate in aqueous phase | Dr. B. Krishna Kumar |
| ICAR | Pilot project on research cum demonstration of technology on coconut husk retting | Dr. V.B. Manilal |
| DBT | Microbial analysis of marine sediments with special effort to develop an anaerobic consortium for application in waste water treatment | Dr. V.B. Manilal |

CONSULTANCY PROGRAMMES

| CLIENT | PROJECT TITLE | PROJECT LEADER |
|---|--|----------------------|
| STCL | Consultancy for chilli processing plant in Karnataka | Sri. M. M. Sreekumar |
| Lakshmi Balaji Oils Pvt Ltd. | Consultancy on establishment of palm oil mills at Orissa | Dr. C. Arumugan |
| Kaladi Rice Millers Consortium, Kaladi | Consultancy for the establishment of rice bran oil refinery plant for for M/s Rice Millers Consortium, Kerala. | Dr. A. Sundereshan |
| Hort. & Cash Crop Dev. Department, Govt of Sikkim | Consultancy for spice processing unit at Sikkim | Sri. M.M. Sreekumar |
| Hitech Bio-sciences India Ltd. Pune | Isolation and evaluation of Microbial strains for the production of nitrilase, reductase and hydantoinase | Dr. Ashok Pandey |
| Colgate Palm-olive, USA | Literature survey on the production of amino acids, especially glutamic acid, arginine and citrulline | Dr. Ashok Pandey |
| Terra Tile | Consultancy & Technical support to M/s Terra Tile Consortium Ltd. | Dr. K. G. K. Warriar |
| IRE | Engineering consultancy to the setting up of a pilot scale production for nanosized rare earth phosphates for M/s IRE Ltd. | Dr. K. G. K. Warriar |
| BHEL, Bangalore | Consultancy for sol-gel mullite mullite coatings on porous silicon carbide hot gas filtration comps. | Dr. K. G. K. Warriar |
| Astra Zeneca Pharma India Ltd. | XRD method for quality control drugs | Dr. U. Syamaprasad |
| Tata Energy and Resource Institute, New Delhi | A report on raw materials and processing of clays for quality building products | Dr. K. G. K. Warriar |
| BHEL, Bangalore | Development of Gel casting direct coagulation method for the fabrication of SiC filter | Dr. C. Pavithran |
| Thermax Ltd | In situ CO ₂ separation in energy recovery by chemical looping computer aided process modeling | Dr. S. Savithri |
| DIR Mining and Geology | EIA study in clay mining areas of Mangalapuram | Mr. J. Ansar |



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|--------------------------|--|-----------------|
| IRE | EIA study for IRE | Mr. J. Ansari |
| Mechwell Industries Ltd. | Coal combustion model for low NOx burners for wall fired and cornered fired coal boilers | Dr. S. Savithri |

PATENTS

Patents granted (India)

| | | | |
|--------|------------|--|---|
| 197050 | 14/11/2007 | A novel process for the manufacture of superior speciality coconut products such as snow-white coconut, white copra lauric oil and protein rich fraction | N Sreedhara |
| 213822 | 17/01/2008 | A process for the preparation of a novel ceramic material useful for microwave integrated circuit applications | Harihara Iyer, Sreemoolanathan, Raveendran Ratheesh, Mailadil Thomas Sebastain, Pezholil Mohanan |
| 213357 | 27/12/2007 | Squaraine based dyes | Das S, Thomas KG, Biju VP, Sonthosh U, Suresh V |
| 214935 | 18/02/2008 | Novel ceramic substrate BAZDYMO S:S (M=ZR,SN & HE) | Jacob Koshy, Jose Kurian, Poo Kodan Sajith, Krishnan Sudersan Kumar, Rajan Jose, Asha Mary John, Alathur Damodaran Damodaran |
| 215126 | 21/02/2008 | An improved drier useful for processing agricultural products | Pokkattu Pathrose Thomas, Thiruthanathil Pathrose Poulouse, Punathil Balan, Narayanan Sudhilal |
| 215578 | 27/02/2008 | A process for the preparation of aqueous emulsion from cashew nut shell liquid / cardanol based resins | Chennakkattu Krishna Sadasivan Pillai, Janardanan Nair Devakiamma Sudha, Vadakkethonippurathu Sivankutty Nair Prasad, Padmanabhan Anandan |
| 215620 | 28/02/2008 | A process for the manufacture of an aluminium conductor alloy with improved conductivity | John Verghese, Ballembettu Chandrasekhar Pai, Muttathupara Chellappan Shaji, Raman Marimuthu Pillai |
| 216251 | 11/03/2008 | An improved process for the synthesis of 4,4-Diamino Diphenyl Methane and its substituted derivatives | M Lalitambika, Rugmini Sukumaran, D Bahulayan and KR Sabu |
| 216517 | 14/03/2008 | A process for the preparation of a new microwave ceramic dielectric resonator in the BaO-Nb ₂ O ₅ -TiO ₂ system | Mailadil Thomas Sebastain |



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|--------|------------|--|--|
| 216824 | 19/03/2008 | A process for the preparation of melt processable liquid crystalline Poly (4-Phenylene Naphthalene -2,6-Carboxylate -CO-8 (S-Oxyphenyl)s -(4-Polyphenylene, 2-Methoxy Naphthalene | Veena Vijayanathan, Vadakkethonippurathu Sivankutty Nair Prasad, Chennakkattu Krishna Sadasivan Pillai |
| 217730 | 28/03/2008 | A process for the preparation of potassium titanyl phosphate nonlinear optical crystal from potassium sodium fluoride phosphate solution | Suma S, Santha N I, Sebastian M T |

Patents granted (Foreign)

| | | | |
|-------------------|------------|---|---|
| ZL01823130.6 (CN) | 16/05/2007 | An improved natural convection drier useful for household laundry drying | Pokkattu Pathrose Thomas, Thir |
| 723992(KR) | 25/05/2007 | An improved natural convection drier useful for household laundry drying | Pokkattu Pathrose Thomas, Thir |
| GB2424893 (GB) | 25/07/2007 | Synthesis of ion imprinted polymer particles for solid phase extractive preconcentration of Erbium ions and a process thereof | Kala Ramakrishnan, Mary Gladis Joseph, Talasila Prasada Rao |
| ZL03826256.8 (CN) | 14/11/2007 | Mg ₂ , MM'O _{6+x} (M=Y, Rare Earth Metal and M=Sn or Zr) dielectric ceramics and their preparation as nano particles | Jose James, Selvaraj Senthilkumar and K.Oonnikrishnan Nair |
| 10-0800129 (KR) | 25/01/2008 | A Novel low temperature glasses for the synthesis of ultra-fine rutile phase titanium dioxide particle through vapour phase hydrolysis of titanium tetra-chloride | G.D. Surender, K.S. Anie, K.R. Prasad and S. Savithri |
| 7347983(US) | 25/03/2008 | Mg ₂ , MM'O _{6+x} (M=Y, Rare Earth Metal and M=Sn or Zr) dielectric ceramics and their preparation as nano particles | Jose James, Selvaraj Senthilkumar and K.Oonnikrishnan Nair |

Patents filed (India)

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| 1711DEL2007 | 10/08/2007 | An improved process for the isolation of 2, 5- Dihydroxy-1, 4-Benzoquinone derivatives like Embelin from natural resources | Chami Arumughan, Nuyampaditharayil Madhavan Soumya, Arimboor Ranjith |
| 1974DEL2007 | 18/09/2007 | Nanocomposite material useful for the preparation super hydrophobic coating and a process for the preparation thereof | Ayyappanpillai Ajayaghosh, Sampath Srinivasan, Vakayil K Pravin |
| 2748DEL2007 | 28/12/2007 | Pyrrole end-capped Bipyridine assay powder for selective detection of zinc ions and a process for the preparation thereof | Ayyapanpillai Ajayaghosh, Sivaramapanicker Sreejith |
| 2749DEL2007 | 28/12/2007 | White light emitting Organogel and process thereof | Ayyappanpillai Ayajaghosh, Chakkooth Vijayakumar, Vakayil K Praveen |
| 0370DEL2008 | 12/02/2008 | Stable oxide coating on SiCp,Cr and Al ₂ O ₃ for use as reinforcements in al MMCs | Kavithaa S, Pai BC, Pillai RM, Satyanarayana KG, Banerjee S |
| 0525DEL2008 | 05/03/2008 | A method for anaerobic process coupled separation and refining of plant materials | Vattackatt Balakrishnan Manilal, Ajit Hardas |



Patents filed (Foreign)

| | | | |
|----------------------|------------|--|---|
| PCT/IB07/001095 (WO) | 27/04/2007 | Fermentive production of clavulanic acid under solid state fermentation conditions using agro-industrial residues | Saudagar Parag Subhash, Singh Sudheer Kumar, Singhal Rekha Satishchandra, Pandey Ashok |
| 0278NF2006/CN (CN) | 19/02/2008 | Development of yellow pigments comprising alkaline earth, praseodymium and transition metal oxides and process thereof | Padala Prabhakar Rao, Mundlapudi Lakshmipathi Reddy |
| 0851116(FR) | 21/02/2008 | Development of yellow pigments comprising alkaline earth, praseodymium and transition metal oxides and process thereof | Padala Prabhakar Rao, Mundlapudi Lakshmipathi Reddy |
| 2008-041921(JP) | 22/02/2008 | Development of yellow pigments comprising alkaline earth, praseodymium and transition metal oxides and process thereof | Padala Prabhakar Rao, Mundlapudi Lakshmipathi Reddy |
| 12/036848(US) | 25/02/2008 | Development of yellow pigments comprising alkaline earth, praseodymium and transition metal oxides and process thereof | Padala Prabhakar Rao, Mundlapudi Lakshmipathi Reddy |
| PCT/IN08/00143 (WO) | 07/03/2008 | A novel economical and efficient process for commercial production of high purity lignans from sesame oil | Chami Arumugham, Chandrasekharan Pillai Balachandran, Mullan Velandy Reshma, Andikannu Sundaresan, Shiny Thomas, Divya Sukumar, Syamala Kumari Sathyanandan Saritha |
| 295/2008(PK) | 18/03/2008 | A novel economical and efficient process for commercial production of high purity lignans from sesame oil | Chami Arumugham, Chandrasekharan Pillai Balachandran, Mullan Velandy Reshma, Andikannu Sundaresan, Shiny Thomas, Divya Sukumar, Syamala Kumari Sathyanandan Saritha |



LIBRARY & INFORMATICS

The year 2007-08 was a period of major accomplishments for the Library & Informatics department with immediate impact and beneficial changes for the long run. The overriding goal of the library has been to provide the best network based services possible to the S & T Community. The section made significant progress in creating and further strengthening the infrastructure, resources and rendering services. Highlights of the achievements include:

Information Resource Management

Collection Strength

The total collection has gone up to 40,000 plus documents which include 12,258 Books, 10947 Standards and 8019 Bound Volumes of Periodicals. The total number of the print versions of periodicals received during the year was 174 Titles (Subscribed : Foreign - 82, Indian – 82 & Gratis -10)

Databases and Database Searches

Updated the in-house databases of Books, Periodicals, Reports/Reprints, PhD Theses, Publications of NIIST Scientists, etc. The last two databases were up-linked to the Lab's Website as well as Intranet. Conducted regular and extensive CD-ROM and Online database searches including those of Standards and Patents.

e-Resources Access Facility under the CSIR Consortia Programme.

Trial access followed by regular access to the e-resources under the CSIR e-Journals Consortia Programme was facilitated through the desktops of all scientists, research students and other functionaries across the Lab in IP- enabled mode. The list of access facilities/ publishers whose e-journals full text databases are accessible is furnished below (* indicates new additions during the year of reporting) :

- American Chemical Society
- Blackwell
- Cambridge University Press
- Elsevier (Science Direct)
- Emerald
- IEEE
- Oxford University Press
- Royal Society of Chemistry
- Springer/ Kluwer
- Taylor & Francis
- Wiley Interscience
- Nature *
- Sage *
- Indian Jls.com of Divan Enterprises *



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|------------------------------------|---|--|
| Bibliographic & Citation Databases | - | Web of Science – Science Citation Index Expanded |
| Patent Databases | - | Delphion & Derwent Innovations Index |
| Standards | - | ASTM Standards on CD-ROM and BIS online |

This was in addition to the Trial access of Science Direct e-Books, ASTM Standards and ASTM Digital Library

e- Resource Access facilities arranged under the Lab Funds:

SCOPUS of Elsevier: The usage of e-resources has been overwhelming particularly those of ACS and Elsevier (Science Direct and SCOPUS). The regular monitoring of usage and various promotional programmes have enhanced the level of usage.

e-Resources promotional activities undertaken to enhance usage

- Broadcasted regular messages of new facilities/ services initiated and hosted the same in the intranet with search links to each item
- Initiation of new members to the various services of Library & Informatics

In addition, resource facilities and services were extended to external users, primarily from research, industrial and academic sectors.

Analysis of Publications

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 SCI Papers (2007) has gone up to 204 with an average IF value of 2.57. The total no. is excluding 6 papers published in new journals for which no IF is furnished in JCR Science edition 2006, even though the titles are covered in Web of Science, Science Citation Index Expanded.

Library Automation & Web OPAC

Majority of the Library in-house activities and services including the Circulation System have been automated using Libsuite - Integrated Library Software. Completed Barcoding of Library documents. New barcoded membership cards getting ready for issue.

Institutional Repository

Steps have already been initiated to create an Institutional Repository of NIIST Publications, Annual Reports, Thesis, Audio and Video Clippings of major Programmes and Conferences held at our lab, News Paper Clippings etc.



Physical Verification & Binding

Commenced Physical Verification of Library Books & Periodicals. Binding of back volumes of periodicals and Books are in progress.

Better Physical Ambience & Facilities

Air-conditioning of L & I completed. Action initiated for total modification of interiors and creation of additional access facilities for achieving better ambience, comfortable reading environment and more facilities to users.

IT-Enabled Systems and Services

- * High Speed Internet Connectivity to the desktops of all Scientists & Technical Officers through LAN/WAN segments of the 24x7 Network System Facility
- * 2 Mbps leased line of BSNL
- * Alternate Leased Line (in the process of implementation)
- * E-mail & Messaging System
- * MIS with the tie up of NIO, Goa
 - First phase implemented successfully
 - Second phase in progress
- * Information Communication Technology (ICT) Programme Implementation
 - Total Cyber Security (implemented / nearing completion)
 - Storage Devices (implemented)
 - Video Conferencing Facility (in the process of implementation)
 - Wi-Fi System Facility – implemented
 - Up gradation of PCs and addition of new devices (ongoing)



LIST OF PUBLICATIONS: 2007

SCI Titles

| SI No | Description |
|-------|---|
| 1 | ABDUL KHALAM (L) and SEBASTIAN (M T) Low loss dielectrics in the $\text{Ca}(\text{B}'_{1/2}\text{Nb}_{1/2})\text{O}_3$ [$\text{B}' = \text{Lanthanides, Y}$] system <i>Journal of the American Ceramic Society</i> 90(5):1467-1474; May 2007 |
| 2 | ABDUL KHALAM (L), SHERIN THOMAS and SEBASTIAN (M T) Temperature-stable and low-loss dielectrics in the $\text{Ca}(\text{B}'_{1/2}\text{Ta}_{1/2})\text{O}_3$ [$\text{B}' = \text{Lanthanides, Y, and In}$] system <i>Journal of the American Ceramic Society</i> 90(8):2476-2483; Aug 2007 |
| 3 | ABDUL KHALAM (L), SHERIN THOMAS and SEBASTIAN (M T) Tailoring the microwave dielectric properties of $\text{M}_9\text{Nb}_2\text{O}_6$ and $\text{Mg}_4\text{Nb}_2\text{O}_9$ ceramics <i>International Journal of Applied Ceramic Technology</i> 4(4):359-366; Aug 2007 |
| 4 | ABHILASH (N P), DEVI (B R), SURESH (E) and VIJAY NAIR (G) An efficient multicomponent protocol for the stereoselective synthesis of oxazinobenzothiazole derivatives <i>Tetrahedron Letters</i> 48(25):4391-4393; 18 Jun 2007 |
| 5 | ABHILASH KUMAR (R G), VINOD (K) and SYAMAPRASAD (U) Preparation of MgB_2/Fe superconductor wire by electrical self-heating <i>Applied Physics A: Materials Science and Processing</i> 88(2):243-247; Aug 2007 |
| 6 | ABHILASH KUMAR (R G), VINOD (K), VARGHESE (N) and SYAMAPRASAD (U) Reactivity of sheath materials with Mg/B in MgB_2 conductor fabrication <i>Superconductor Science and Technology</i> 20(3):222-227; March 2007 |
| 7 | AJAYAGHOSH (A) and PRAVEEN (V K) π organogels of self-assembled <i>p</i> -phenylenevinylenes: Soft materials with distinct size, shape, and functions <i>Accounts of Chemical Research</i> 40(8):644-656; 21 Aug 2007 |
| 8 | AJAYAGHOSH (A), CHITRA (P) and REJI VARGHESE Self-assembly of Tripodal squaraines: Cation-assisted expression of molecular chirality and change from spherical to helical morphology <i>Angewandte Chemie International Ed</i> 46(1-2):230-233; Jan 2007 |
| 9 | AJAYAGHOSH (A), PRAVEEN (V K), SRINIVASAN (S) and REJI VARGHESE Quadrupolar π -gels: Sol-gel tunable red-green-blue emission in donor-acceptor-type Oligo(<i>p</i> -phenylenevinylene)s <i>Advanced Materials</i> 19(3):411-415; Feb 2007 |



| SI No | Description |
|-------|---|
| 10 | AJAYAGHOSH (A), PRAVEEN (V K), VIJAYAKUMAR (C) and SUBI J GEORGE Molecular wire encapsulated into δ organogels: Efficient supramolecular light-harvesting Antennae with color-tunable emission <i>Angewandte Chemie International Ed</i> 46(33):6260-6265;20 Aug 2007 |
| 11 | AMRUTHA (S R) and JAYAKANNAN (M) Structure control of π - conjugated polymers for enhanced solid-state luminescence: Synthesis and liquid crystalline and photophysical properties of new bulky poly(<i>p</i> -phenylenevinylene)s and oligo (phenylenevinylene)s bearing tricyclodecane pendants <i>Macromolecules</i> 40(7):2380-2391;3 Apr 2007 |
| 12 | ANAS (S), JUBI JOHN, SAJISHA (V S), JOSHNI JOHN, RANI (R), SURESH (E) and RADHAKRISHNAN (K V) Iodine assisted palladium catalyzed ring opening of bicyclic hydrazines with organoboronic acids: Stereoselective synthesis of functionalized cyclopentenes and alkylidene cyclopentenes <i>Organic & Biomolecular Chemistry</i> 5(24):4010-4019;2007 |
| 13 | ANAS (S), MANGALARAJA (R V), MUKUNDAN (P), SHUKLA (S K) and ANANTHAKUMAR (S) Direct synthesis of varistor-grade doped nanocrystalline ZnO and its densification through a step-sintering technique <i>Acta Materialia</i> 55(17):5792-5801;Oct 2007 |
| 14 | ANAS (S), SAJISHA (V S), RANI (R), KUMARAN (R T) and RADHAKRISHNAN (K V) Ionic liquid [bmim] PF ₆ -mediated synthesis of 1,2-orthoesters of carbohydrates and the glycosidation reactions of 4-pentenyl orthoesters <i>Bulletin of the Chemical Society of Japan</i> 80(3):553-560;Mar 2007 |
| 15 | ANAS (S), SYAM KRISHNAN (K), SAJISHA (V S), ANJU (K S), RADHAKRISHNAN (K V), SURESH (E) and SURESH (C H) Interplay of dual reactivity in the reaction of pentafulvenes with 1,2,4- triazoline-3,5-diones: Experimental and theoretical investigations <i>New Journal of Chemistry</i> 31(2):237-246;Feb 2007 |
| 16 | ANILKUMAR (P) and JAYAKANNAN (M) Fluorescent tagged probing agent and structure-directing amphiphilic molecular design for polyaniline nanomaterials via self-assembly process <i>Journal of Physical Chemistry C</i> 111(9):3591-3600;8 Mar 2007 |
| 17 | ANILKUMAR (P) and JAYAKANNAN (M) Single-molecular-system-based selective micellar templates for polyaniline nanomaterials: Control of shape, size, solid state ordering, and expanded chain to coil-like conformation <i>Macromolecules</i> 40(20):7311-7319;02 Oct 2007 |
| 18 | ANISHA (G S) and PREMA (P) Production of α -galactosidase by a novel actinomycete <i>Streptomyces griseoloalbus</i> and its application in soymilk hydrolysis <i>World Journal of Microbiology and Biotechnology</i> 23(6):859-864;June 2007 |



| SI No | Description |
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| 19 | ANJANA (P S), SEBASTIAN (M T), AXELSSON (A-K) and ALFORD (Neil McN) Microwave dielectric properties $\text{CeO}_2\text{-}0.5\text{ AO-}0.5\text{ TiO}_2$ (A=Ca,Mg,Zn,Mn,Co,Ni,W) ceramics <i>Journal of the European Ceramic Society</i> 27(12):3445-3452;2007 |
| 20 | ANTONY (M J) and JAYAKANNAN (M) Amphiphilic azobenzenesulfonic acid anionic surfactant for water-soluble, ordered, and luminescent polypyrrole nanospheres <i>Journal of Physical Chemistry B</i> 111(44):12772-12780;Nov 8 2007 |
| 21 | ARAVIND (P R), SITHARA (L), MUKUNDAN (P), KRISHNA PILLAI (P) and WARRIER (K G K) Silica alcogels for possible nuclear waste confinement - A simulated study <i>Materials Letters</i> 61(11-12):2398-2401;May 2007 |
| 22 | ASHA POORNA (C) and PREMA (P) Production of cellulase-free endoxylanase from novel alkalophilic thermotolerant <i>Bacillus pumilus</i> by solid-state fermentation and its application in wastepaper recycling <i>Bioresource Technology</i> 98(3):485-490;Feb 2007 |
| 23 | BABITHA (S), SOCCOL (C R) and PANDEY (A) Solid-state fermentation for the production of <i>Monascus</i> pigments from jackfruit seed <i>Bioresource Technology</i> 98(8):1554-1560;May 2007 |
| 24 | BABITHA (S), SOCCOL (C R) and PANDEY (A) Effect of stress on growth, pigment production and morphology of <i>Monascus</i> sp in solid cultures <i>Journal of Basic Microbiology</i> 47(2):118-126;Apr 2007 |
| 25 | BABU (N), SURESH BABU (D S) and MOHAN DAS (P N) Impact of tsunami on texture and mineralogy of a major placer deposit in southwest coast of India <i>Environmental Geology</i> 52(1):71-80;Mar 2007 |
| 26 | BAIJU (K V), PERIYAT (P), KRISHNA PILLAI (P), MUKUNDAN (P), WARRIER (K G K) and WUNDERLICH (W) Enhanced photoactivity and anatase thermal stability of silica-alumina mixed oxide additives on sol-gel nanocrystalline titania <i>Materials Letters</i> 61(8-9):1751-1755;Apr 2007 |
| 27 | BAIJU (K V), SHAJESH (P), WUNDERLICH (W), MUKUNDAN (P), KUMAR (S R) and WARRIER (K G K) Effect of tantalum addition on anatase phase stability and photoactivity of aqueous sol-gel derived mesoporous titania <i>Journal of Molecular Catalysis A - Chemical</i> 276(1-2):41-46;17 Oct 2007 |
| 28 | BAIJU (K V), SHUKLA (S), SANDHYA (K S), JOSE JAMES and WARRIER (K G K) Photocatalytic activity of sol-gel-derived nanocrystalline Titania <i>Journal of Physical Chemistry C</i> 111(21):7612-7622;31 May 2007 |



| SI No | Description |
|--------------|---|
| 29 | BAIJU (K), PERIYAT (P), WUNDERLICH (W), KRISHNA PILLAI (P), MUKUNDAN (P) and WARRIER (K G K) Enhanced photoactivity of neodymium doped mesoporous titania synthesized through aqueous sol-gel method <i>Journal of Sol-Gel Science and Technology</i> 43(3):283-290; Sep 2007 |
| 30 | BALAKRISHNAIAH (R), VIJAYA (R), BABU (P), JAYASANKAR (C K) and REDDY (M L P) Characterization of Eu^{3+} - doped fluorophosphate glasses for red emission <i>Journal of Non-Crystalline Solids</i> 353(13-15):1397-1401; 15 May 2007 |
| 31 | BALASUBRAMANI (N), SRINIVASAN (A), PILLAI (U T S) and PAI (B C) Effect of Pb and Sb additions on the precipitation kinetics of AZ91 magnesium alloy <i>Materials Science & Engineering A</i> 457(1-2):275-281; 25 May 2007 |
| 32 | BALASUBRAMANI (N), SURESH (M), SRINIVASAN (A), PILLAI (U T S) and PAI (B C) Observation of the suppression of $\text{Mg}_{17}\text{Al}_{12}$ formation in a La-containing AZ91 alloy <i>Journal of Materials Science</i> 42(19):8374-8376; October 2007 |
| 33 | BASHEER (M C), SANTHOSH (U), ALEX (S), GEORGE THOMAS (K), SURESH (C H) and SURESH DAS Design and synthesis of squaraine based near infrared fluorescent probes <i>Tetrahedron</i> 63(7):1617-1623; 12 Feb 2007 |
| 34 | BEENA JAMES, SURESH (E) and MANGALAM S NAIR Friedel-crafts alkylation of a cage enone: Synthesis of aralkyl substituted tetracyclo[5.3.1.0 ^[2,6] .0 ^[4,8]] undeca-9,11-diones and the formation of fascinating novel cage compounds with pyrrole and thiophene using montmorillonite K-10 <i>Tetrahedron Letters</i> 48(34):6059-6063; 20 Aug 2007 |
| 35 | BEENA JAMES, VIJI (S), SOUMINI MATHEW, MANGALAM S NAIR, DIVYA LAKSHMANAN and AJAY KUMAR (R) Synthesis of novel highly functionalized biologically active polycyclic caged amides <i>Tetrahedron Letters</i> 48(35):6204-6208; 27 Aug 2007 |
| 36 | BEENA JOY and SOBHANA (D) Antibacterial activity of kauranes from <i>annona squamosa</i> L. pericarp <i>Asian Journal of Chemistry</i> 19(4):2773-2778; Jul-Aug 2007 |
| 37 | BEENA JOY, AKHILA RAJAN and EMILIA ABRAHAM (T) Antimicrobial activity and chemical composition of essential oil from <i>hedychium coronarium</i> <i>Phytotherapy Research</i> 21(5):439-443; May 2007 |
| 38 | BENHERLAL (P S) and ARUMUGHAN (C) Chemical composition and <i>in vitro</i> antioxidant studies on <i>syzygium cumini</i> fruit <i>Journal of the Science of Food and Agriculture</i> 87(14):2560-2569; Nov 2007 |



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| 39 | BIJITHA BALAN and GOPIDAS (K R) An anthracene-appended α -Cyclodextrin-based dyad: Study of self-assembly and photoinduced electron-transfer processes <i>Chemistry - A European Journal</i> 13(18):5173-5185;15 Jun 2007 |
| 40 | BIJITHA BALAN, DEEPTHI (L S) and GOPIDAS (K R) Interaction of pyromellitic diimide derivatives with β -cyclodextrin and anthracene-appended β -cyclodextrin: Rim binding vs inclusion complexation <i>Organic Letters</i> 9(14):2709-2712;5 Jul 2007 |
| 41 | BIJU (A), ALOYSIUS (R P) and SYAMAPRASAD (U) Structural and superconducting properties of $\text{Bi}_{1.7}\text{Pb}_{0.4}\text{Sr}_{2-x}\text{Yb}_x\text{Ca}_{1.1}\text{Cu}_{2.1}\text{O}_y$ system <i>Materials Letters</i> 61(3):648-654;Feb 2007 |
| 42 | BIJU (A), GURUSWAMY (P) and SYAMAPRASAD (U) Influence of Pb on structural and superconducting properties of rare earth modified $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_y$ <i>Physica C: Superconductivity</i> 466(1-2):23-28;01 Nov 2007 |
| 43 | BIJU (A), SARUN (P M), ALOYSIUS (R P) and SYAMAPRASAD (U) Structural and superconducting properties of neodymium added $\text{Bi,Pb)}_2\text{Sr}_2\text{CaCu}_2\text{O}_y$ <i>Materials Research Bulletin</i> 42(12):2057-2066;04 Dec 2007 |
| 44 | BIJU (A), SARUN (P M), ALOYSIUS (R P) and SYAMAPRASAD (U) Comparison of superconducting properties of Ce added (Bi, Pb)-2212 with other rare earth additions <i>Journal of Alloys and Compounds</i> 433(1-2):68-72;16 May 2007 |
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GENERAL INFORMATION

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|------------------------|-------------------|--------------------------------------|------------|------------|
| Dr. K.M. Nampoothiri | France | IFCPAR-Collaborative project | 27-03-2007 | 28-04-2007 |
| | France | Indo-French Programme | 27-03-2008 | 22-04-2008 |
| Dr. Sudheer K. Singh | Argentina | DST-SeCyT collaborative project | 10-03-2007 | 28-03-2007 |
| Dr. Ashok Pandey | UK | The Royal Society Meeting | 23-04-2007 | 24-04-2007 |
| | South Korea | KSBB-07 Internatl. Symposium | 26-04-2007 | 28-04-2007 |
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| | South Korea | Bio Korea International Conference | 12-09-2007 | 14-09-2007 |
| | Singapore | Elsevier Editors conference | 22-02-2008 | 24-02-2008 |
| Dr. George Thomas | Italy | DST-MFA Collaborative Project | 14-05-2007 | 28-05-1007 |
| | China | Indo-China Meeting | 25-12-2007 | 29-12-2007 |
| Dr. A. Ajayaghosh | Japan | Tsukuba, Himeji and Osaka | 27-06-2007 | 31-07-2007 |
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| Dr. B. C. Pai | Sri Lanka | Chemtech International Conference | 20-06-2007 | 23-07-2007 |
| Prof. TK Chandrashekar | Italy | 41st World Chemistry Congress | 08-08-2007 | 14-08-2007 |
| Dr. Mrs. J. D. Sudha | Germany | Technical University, Dresden | 03-09-2007 | 01-01-2007 |
| Dr. Suresh Das | Japan - Hong Kong | DST-JSPS Exchange program | 01-09-2007 | 15-09-2007 |
| Dr. M. Anbu | Japan | Internatl. Conference on Dioxin 2007 | 01-09-2007 | 19-09-2007 |
| Dr. (Mrs) R. Sasikumar | USA | GE sponsored project | 13-09-2007 | 24-10-2007 |
| Dr. Rajeev K Sukumaran | Argentina | DST-Argentina Collaborative project | 15-03-2008 | 30-03-2008 |



HONOURS AND AWARDS

| | |
|--|---|
| Prof. T.K. Chandrashekar | CRSI Silver Medal - 2008 |
| Dr. A. Ajayaghosh | 1. Shanti Swarup Bhatnagar Prize (Chemical Sci.) -2007 2. MRSI Medal 2007 |
| Dr Suresh Das | MRSI Medal 2007 |
| Dr. K. George Thomas | Elected as the Fellow of Indian Academy of Sciences, Bangalore (2008) |
| Dr. Ashok Pandey | Honorary Doctorate Degree From Univ. of Blaise Pascal-2007 Appreciation Award, Federal University of Parana, Brazil |
| Dr. M. Jayakannan | CSIR Young Scientist Award (Chemical Sci.) – 2007 |
| Dr.J. Mary Gladis | “Prof.H.J.Arnika Best Thesis Award” by IANCAS, BARC- 2006 |
| S.Biju & D.B. Ambili Raj | Second prize for the poster Presentation, MTIC-XII) IIT, Chennai- 2007 |
| Reeta Rani Singhania | Best Paper Award on Biofuels by Elsevier Science, UK-2007 |
| M. Suresh, S.B. Shiju, A. Srinivasan, J. Swaminathan, U.T.S. Pillai & B.C. Pai, | ‘Best Paper Award’ in the Metal Sciences - I category (Oral-I prize)- IIM - NMD - ATM 2007 |
| K. Sukumaran, K.K. Ravikumar, S.G.K. Pillai & V. Antony | ‘Best Poster Award’ in the Non-Ferrous category (Poster – II prize) - IIM - NMD - ATM 2007 |
| Joby Joseph, T.P.D. Rajan, R.M. Pillai, B.C. Pai, V. Suryanarayanan & K Padmanabhan | ‘Best Technical Paper Award’ ICAMC -2007 |
| N. Balasubramani, K.R. Ravi, U.T.S. Pillai & B.C. Pai | ‘Best Technical Paper Award’ (Posters) ICAMC 2007 |
| Rajesh Kombar <i>et al.</i> | ‘Best Poster Award’ ICAMC 2007 |
| Satyajith Shukla K.G.K. Warriar | ‘Best Poster Award’ ICS-71 |



Ph.D. DEGREE AWARDED

| Student | Thesis Title | Supervisor | University |
|------------------------|--|---------------------|-----------------------------|
| L. Abdul Kham | The $A(B_{11}/2B''_{1/2})O_3$ [A=Ba, Ca, Sr, Mg; B'=RE and B''=Nb, Ta] microwave ceramics for wireless communications | Dr. M. T. Sebastian | Kerala |
| C Ashapoorna | Production of alkaline endo-xylanase by solid-state fermentation and its application for biobleaching of paper pulps | Dr. P. Prema | CUSAT |
| Bijitha Balan | Photoinduced electron transfer in Cyclodextrin based donor-acceptor systems | Dr. K. R. Gopidas | Kerala |
| K. Janardhan Reddy | Studies on liquid-liquid extraction of zirconium and hafnium with heterocyclic β -diketonates | Dr. M.L.P.Reddy | Sri Venkateswara University |
| P.N. Remya | Vanadophilic heterocyclic β -diketone: Synthesis, characterization and complexation | Dr. M.L.P.Reddy | CUSAT |
| R. Kala | Biomimetic polymer materials for the preconcentrative separation or sensing of lanthanides | Dr. T.Prasada Rao | Kerala |
| Elizabeth Kuruville | Synthesis and study of interactions of novel Acridinium derivatives with single strand and double strand DNA | Dr. D. Ramaiah | Kerala |
| Jyothish Kuthanapillil | Design of Quinoline based Squaraine dyes for photodynamic therapy: Synthesis and study of their photophysical and photobiological properties | Dr. D. Ramaiah | Kerala |
| Shibu Abraham | Synthesis and studies of novel donor-acceptor-substituted Butadiene systems | Dr. Suresh Das | Kerala |
| M. C. Basheer | Design and synthesis of some novel Squaraine based near infrared sensitizers and probes | Dr. Suresh Das | Kerala |
| N. S. Saleesh Kumar | synthesis, photophysical and liquid crystalline properties of some Butadiene based Mesogens | Dr. Suresh Das | Kerala |
| G. Narayanan | Photoactive Mesogenic sugars: Synthesis, liquid crystalline and photochemical properties | Dr. Suresh Das | Kerala |
| Reji Varghese | Self-assembly of linearly p-conjugated molecules: p-Phenylenevinylenes versus p-Phenyleneethynylenes | Dr. A. Ajayaghosh | Kerala |



| Student | Thesis Title | Supervisor | University |
|--------------------|---|--------------------------------|------------|
| V. K. Praveen | Oligo (p-phenylenevinylene) derived p-gels: Modulation of optical properties and application as excitation energy donor scaffolds | Dr. A. Ajayaghosh | Kerala |
| C. Vijayakumar | Design synthesis and self-assembly of a few oligo (p-Phenylenevinylene) derivatives: Control of Chromophore assemblies and optical properties of p-organogels | Dr. A. Ajayaghosh | Kerala |
| P. V. James | Synthesis and photophysical properties of phenyleneethynylene based molecular systems | Dr. K. George Thomas | Kerala |
| S.T. Shibu Joseph | Plasmon coupling in gold nanorods | Dr. K. George Thomas | Kerala |
| K. Syam Krishnan | Synthetic utilization of pentafulvenes towards fused ring cyclooctanoids and related chemistry | Dr. K.V. Radhakrishnan | Kerala |
| A. Biju | Structural and transport properties of rare earth modified (Bi,Pb)-2212 superconductors | Dr. U. Syamaprasad | Kerala |
| Rajesh Kombar | | Dr. K.G.K. Warriar | Kerala |
| S.S. Sreeja Kumari | Influence of alloying additions on the structure and properties of Al-7Si-0.3Mg alloy | Dr. R.M. Pillai & Dr. B.C. Pai | CUSAT |
| Abhilash, N.. | Engaging Zwitterions in novel carbon-carbon and carbon-heteroatom bond forming reactions | Dr. G. Vijay Nair | Kerala |
| Vidya, N. | Novel strategies for the synthesis of tris-heteroarylmethanes and biphenyl derivatives | Dr. G. Vijay Nair | Kerala |
| Sreekumar, V. | Novel carbon-carbon and carbon-heteroatom bond forming reactions mediated by N-heterocyclic carbenes | Dr. G. Vijay Nair | Kerala |
| B. Rema Devi | Novel heterocyclic constructions constructions mediated by 1,4-dipolar intermediates and related chemistry | Dr. G. Vijay Nair | Kerala |
| Smitha C Mathew | Novel reactions of triphenylphosphine and dialkylazodicarboxylate with carbonyl compounds | Dr. G. Vijay Nair | Kerala |



BUDGET 2007-08 (Rs in Lakh)



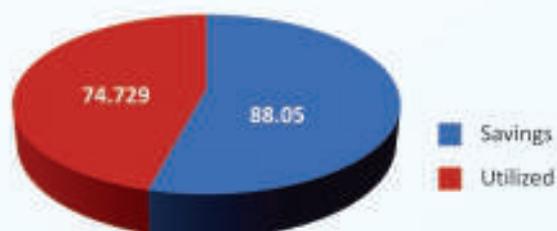
CSIR grant including expenditure met from LR

External Cash Flow (Rs in Lakh)



Lab Reserve

Generated Rs. 167.779 lakh
Utilized Rs. 74.729 lakh





MEMBERS OF THE RESEARCH COUNCIL (Apr' 2007 - Mar' 2010)

CHAIRMAN:

Dr. Dipankar Banerjee
Chief Controller R & D (AMS) & D.S
Room No. 301, DRDO Bhawan
Defence Research Development Organisation, New Delhi - 110 011

MEMBERS:

Prof. Ashutosh Sharma
Professor, Department of Chemical Engineering
Indian Institute of Technology, Kanpur - 208 016

Prof. K.S. Gandhi
Professor, Department of Chemical Engineering
Indian Institute of Science, Bangalore - 560 012

Dr. M. Radhakrishna Pillai, FASc
Director
Rajiv Gandhi Centre for Biotechnology, Jagathy, Trivandrum - 695 019

Prof. S. Ramakrishnan, FASc
Professor
Department of Inorganic & Physical Chemistry
Indian Institute of Science, Bangalore - 560 012

Dr. Pradeep
Senior Scientist
Tata Research Development & Design Centre
54B, Hadapsar Industrial Estate, Pune - 411 013

Prof. D.V. Khakhar
Professor
Department of Chemical Engineering
Indian Institute of Technology, Powai, Mumbai - 400 076

Dr. S.L. Govindwar
Adviser
Department of Biotechnology
Block-2, 7th Floor, CGO Complex, Lodhi Road, New Delhi - 110 003

Dr. M.G. Kulkarni
Head, Polymer Science & Engineering
National Chemical Laboratory, Pashan Road, Pune - 411 008

Prof. B.K. Mishra
Director
Institute of Minerals and Materials Technology, Bhubaneswar - 751 013

Prof. T.K. Chandrashekar
Director
National Institute for Interdisciplinary Science & Technology (NIST)
Trivandrum - 695 019

Dr. Naresh Kumar
Head
R & D Planning Division, CSIR,
Rafi Marg, New Delhi - 110 001

SECRETARY:

Dr. A. Sundaresan
Scientist
Agroprocessing & Natural Products Division
National Institute for Interdisciplinary Science & Technology (NIST)
Trivandrum-695 019



Members of the Management Council

(Period: 01.07.2005 to 30.06.2007)

CHAIRMAN: Prof. T.K. Chandrashekar, Director, NIIST

MEMBERS: Dr. B.C. Pai, Scientist, NIIST
Dr. U. Syamaprasad, Scientist, NIIST
Dr. A. Sundaresan, Scientist, NIIST
Dr. (Mrs.) Elizabeth Jacob, Scientist, NIIST
Dr. (Mrs.) Asha Jayakannan, Scientist, NIIST
Shri P. Guruswamy, Technical Officer, NIIST
Dr. Ganesh Pandey, Scientist, NCL, Pune
COFA, NIIST

MEMBER-SECRETARY: COA/AO, NIIST

(Period: From 01-07-2007)

CHAIRMAN: Prof. T.K. Chandrashekar, Director, NIIST

MEMBERS: Dr. Suresh Das, Scientist, NIIST
Dr. U. T.S. Pillai, Scientist, NIIST
Dr. K.Madhavan Namboothiri, Scientist, NIIST
Dr. (Mrs.) S. Savithri, Scientist, NIIST
Dr. C.S. Bhat, Scientist, NIIST
Shri K. Prasad, Technical Officer, NIIST
Dr. A.K. Gupta, Scientist, NPL, New Delhi
COFA, NIIST

MEMBER-SECRETARY: COA/AO, NIIST



STAFF

| Particulars | Sanctioned Strength | Number in position As on 01-04-2007 |
|---------------------------------|---------------------|-------------------------------------|
| A. SCIENTIFIC /TECHNICAL | | |
| Group IV | 100 | 85 |
| Group III | 35 | 34 |
| Group II | 35 | 33 |
| Group I | 10 | 10 |
| Others | | |
| Total A | 180 | 162 |
| B. ADMINISTRATIVE | | |
| Group A | 3 | 2 |
| Group B | 31 | 27 |
| Group C | 17 | 15 |
| Group D | 23 | 14 |
| Others | 2 | 2 |
| Total B | 76 | 60 |
| Total A + B | 256 | 222 |

LIST OF SCIENTISTS/OFFICERS

Prof T K Chandrashekar, Director

Agro-processing & Natural Products Division

Dr C Arumugan, Scientist G (Retired, 30/09/2007)

Dr A Sunderesan, Scientist F (Head)

Smt B Sankarikutty Amma, Scientist F (Retired, 31/08/2007)

Sri M M Sreekumar, Scientist F

Dr (Mrs) M A Sumathykutty, Scientist EII

Dr N Gopalakrishnan, Scientist EII

Sri Thomas Samuel, Scientist EII

Dr C Balachandran, Scientist EII

Smt A Nirmala Menon, Scientist EII

Smt Omanakutty Amma, Scientist EI



Dr (Mrs) K P Padmakumari Amma, Scientist C
Sri V V Venugopalan, Scientist C
Ms M V Reshma, Scientist B
Dr P Nisha, Scientist B
Sri P Jayamurthy, Scientist B
Sri R Babu, Technical Officer E1
Dr (Mrs) Beena Joy, Technical Officer C
Smt L Prasanna Kumari, Technical Officer B

Biotechnology Division

Dr Ashok Pandey, Scientist F (Head)
Dr (Mrs) P Prema, Scientist F
Dr K Madhavan Nampoothiri, Scientist E1
Dr Sudheer Kumar Singh, Scientist B (Transferred 19/03/2008)
Dr Rajeevkumar Sukumaran, Scientist B
Miss D S Suganya, Scientist B
Dr (Mrs) B Vijayalakshmi Amma, Technical Officer E1

Chemical Sciences & Technology Division

Dr Suresh Das, Scientist G (Head)
Dr T Prasada Rao, Scientist G
Dr (Mrs) Sathychandrasekhar, Scientist F
Dr (Mrs) A Jayalakshmi, Scientist F
Dr (Mrs) Mangalam S Nair, Scientist F
Dr (Mrs) T Emilia Abraham, Scientist F
Dr M Lakshmipathy Reddy, Scientist F
Dr Ajayaghosh, Scientist F
Dr K R Gopidas, Scientist F
Dr D Ramaiah, Scientist E11
Dr K George Thomas, Scientist E11
Dr (Mrs) R Luxmi Varma, Scientist E11
Sri P Shanmugham, Scientist E1
Dr A Srinivasan, Scientist E1
Dr K V Radhakrishnan, Scientist C
Dr M Jayakannan, Scientist C (Resigned 14/12/2007)
Dr (Mrs) S K Asha, Scientist C (Transferred 14/12/2007)
Dr V G Anand, Scientist C (Resigned 22/06/2007)
Dr (Mrs) J D Sudha, Technical Officer C

Materials & Minerals Division

Dr R M Pillai, Scientist G (Head)
Dr K G K Warriar, Scientist G (Head)
Dr P N Mohandas, Scientist G



Dr Peter Koshy, Scientist G
Dr C Pavithran, Scientist G
Dr U Syamaprasad, Scientist G
Dr M T Sebastian, Scientist G
Sri K Harikrishna Bhat, Scientist F
Dr Jose James, Scientist F
Dr V John, Scientist EII
Dr A R R Menon, Scientist EII
Sri M C Shaji, Scientist EII
Dr P Prabhakar Rao, Scientist EII
Sri K Sukumaran, Scientist EII
Dr U T S Pillai, Scientist EII
Dr Swapan Kumar Ghosh, Scientist EII
Dr Manoj Raama Varma, Scientist EII
Dr M Ravi, Scientist EII
Dr K Ravindran Nair, Scientist EI (Retired 31/01/2008)
Sri S Ananthakumar, Scientist EI
Sri P Krishna Pillai, Scientist EI
Dr T P D Rajan, Scientist C
Dr S V Shukla, Scientist C
Dr Sanjeev Kumar Shukla, Scientist B (Transferred 11/10/2007)
Sri M Sundararajan, Scientist B
Ms Aparna Mondal, Scientist B (Resigned 29/06/2007)
Sri S G K Pillai, Technical Officer E1
Smt M E Kochu Janaki, Technical Officer E1
Sri P Mukundan, Technical Officer E1
Sri S Velusamy, Technical Officer E1
Dr V S Prasad, Technical Officer C
Sri Brahma Kumar, Technical Officer C
Sri K K Ravikumar, Technical Officer C
Sri M Chandrasekharan, Technical Officer C
Sri P Perumal, Technical Officer C
Sri P Gurusami, Technical Officer B
Sri M R Chandran, Technical Officer A

Process Engineering & Environmental Technology

Dr P P Thomas, Scientist G (Head)
Sri Ajit Haridas, Scientist F
Dr (Mrs) Roschen Sasikumar, Scientist F
Sri P Raghavan, Scientist F
Smt Elizabeth Jacob, Scientist EII
Sri J Ansari, Scientist EII
Dr (Mrs) S Savithri, Scientist EII



Dr (Mrs) Rugmini Sukumar, Scientist E1
Dr V B Manilal, Scientist E1
Dr M Anbu, Scientist E1
Dr C H Suresh, Scientist C
Sri P Anand, Scientist B (Transferred 25/10/2007)
Dr B Krishnakumar, Scientist B
Smt Vijaya Prasad, Technical Officer B

Planning & Business Development

Dr B C Pai, Scientist G (Head, BD)
Sri S Suresh Kumar, Scientist F (Head, PME)
Dr C Chandrasekara Bhat, Scientist E11
Dr V G Mohanan Nair, Scientist E11
Sri D Bheemeswar, Scientist E1
Sri R S Praveen Raj, Scientist B
Dr M Sankaranarayanan, Technical Officer C

Library & Informatics

Smt Santosh Babu, Scientist E1 (Head)
Sri Nithiyanantha Vasagam, Scientist B
Sri V Moni, Scientist B
Sri M Ramasamy Pillai, Technical Officer C
Smt S Mini, Technical Officer C

Civil Engineering and Estate Management

Sri V P Thomas, Scientist F (Head)
Sri R Rajeev, E E(Telephones)
Sri K Prasad, AE
Sri K V Oonnikrishnan, AEE
Sri Chandra Babu, AEE (Civil)

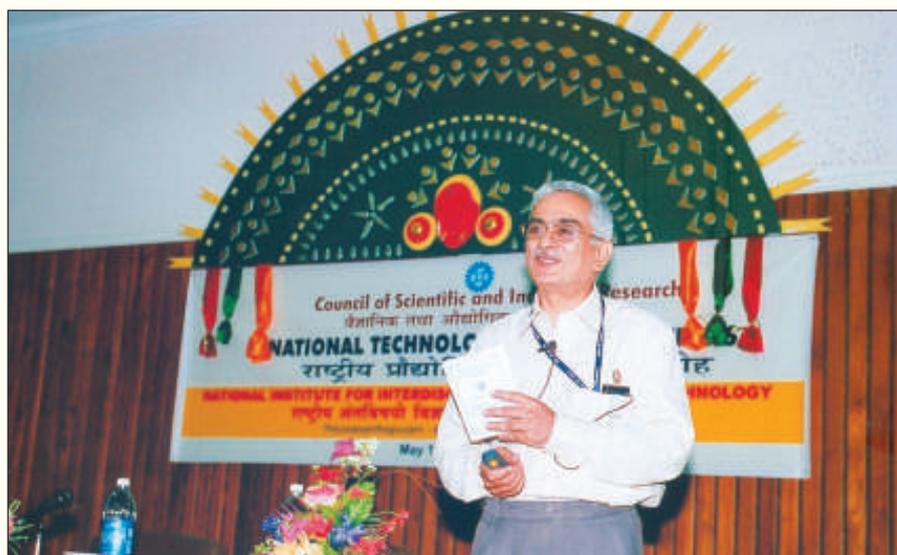
Administration

Sri T V Sankaran, COFA
Sri N S Raju, AO
Sri D P Maret, FAO (Tranferred 15/02/2008)
Sri M R Devasis, SPO(Adhoc)
Smt S Sobhana, SO
Smt P V Viji, SO(F&A)
Sri A V Thomas, SO(F&A)
Sri R Narayna Pillai, Private Secretary (Retired 31/10/2007)
Smt Sarada Nair, Private Secretary
Sri K Damodaran Pillai, Security Officer (Retired, 31/01/2008)



National Technology Day Celebration

National Technology Day to commemorate the triple success of Indian technologies namely, Inaugural flight of Hamsa, Successful flight of prithivi missile and Sensational Nuclear test at Pokhran was celebrated on May 11, 2007. National Technology Day Lecture was delivered by Dr. G.S. Bhuvaneshwar, Head, Biomedical Technology Wing, Sri Chitra Tirunal Institute for Medical Science & Technology, Trivandrum. In his lecture Dr. Bhuvaneshwar highlighted the synergistic effect of contribution of scientists, technicians, technocrats for the successful development of any technology. In the technical



National Technology Day lecture by Dr. G.S. Bhuvaneshwar

presentation on the development of Heart Valves and their clinical trials, Dr. Bhuvaneshwar attributed the success of laboratory to Industry transformation of heart valves developed by SCT to the contributions of various organizations. Dr. B. C. Pai, in his presidential address emphasized the importance of observing the Technology Day as mark of achievements of our maturity in technology in areas such as space, defense and atomic energy. He called upon the members to rededicate for the cause of developing technologies by pooling together expertise of scientists, technologists, technocrats and industries.

CSIR Foundation Day

CSIR Foundation Day was celebrated as an open day in the morning followed by Foundation Day Lecture in the afternoon on 26th September 2007. About 300 students from colleges and universities visited the Laboratory. With a brief introduction about CSIR in general and major R & D activities being pursued at NIIST, a video show on the contribution of CSIR to the society was arranged for the students. This was followed by a presentation of major contributions of NIIST and ongoing R & D programmes and facilities available thereon. Students were later grouped into different batches and taken to various laboratories such as Polymer, Agro Processing, XRD/AFM/NMR facility, Photochemistry, environment



technology, Process Engineering, Clay processing laboratory to witness experimental demonstrations using advanced techniques, state of art scientific instruments.

CSIR Foundation Day Lecture and felicitation of the staff members was arranged in the afternoon. Prof. S. Ranganathan, INAE Distinguished Professor & Honorary Professor, IISc, NIAS & JNCASR, Bangalore was the chief guest. The function was presided over by Prof. T. K. Chandrashekar, Director, NIIST. Prof. Ranganathan in his address first complimented the Institute for having aptly selected new name which signifies the importance of basic science and applied research both of which are interdisciplinary in nature. On a theme topic "Globalization of Materials Research" Prof. Ranganathan emphasized the need of education and research which play a key role in achieving Super Power status to the country. He further suggested that in a scenario of globalization one should pay attention to new frontiers of research, off shoring industrial R&D, foreign investment in R&D and forging of strategic alliances with the developed/developing countries. Material science is a field bound to explode by 2020 whereby India is likely to attain No. 4 in GDP, become 2 trillion economy and when about 200 GW energy is to be added. Prof. Chandrashekar, in his presidential address, briefed the various contributions of the laboratory in the areas of value addition to the natural resources of the region such as oil palm, coconut, ilmenite etc., He also presented a overview of the major R& D programmes in which the laboratory had registered major breakthrough. He also announced the news of winning of S. S. Bhatnagar prize for chemical Sciences for the second time in a row and young CSIR scientist award by NIIST scientists. The staff members who have completed 25 years of service in CSIR were felicitated with a memento. The chief guest also felicitated the staff members who have retired during the preceding year from the services of CSIR.

NIIST Foundation Day

NIIST Foundation Day, the first after being renamed as NIIST, was celebrated on 6th October, 2007. A large number of students from colleges and universities visited the Laboratory during the forenoon which was observed as an open day. Brief introduction about CSIR in general, major R & D activities being pursued at NIIST and a video show on the contributions of CSIR to the society were arranged for the students. After a power point presentation on major contributions of NIIST, ongoing R & D programmes and facilities available thereon, students were grouped into different batches and taken to various laboratories to witness experimental demonstrations using advanced techniques, state of art scientific instruments and R& D product outcomes.

NIIST Foundation Day Lecture and felicitation of the staff members arranged in the afternoon was presided over by Prof. T. K. Chandrashekar, Director, NIIST. Prof. V.S. Ramamurthy, Chairman, Recruitment & Assessment Board, CSIR & Former Secretary, Department of Science & Technology, New



NIIST Foundation Day lecture by Prof. V.S. Ramamurthy

Delhi was the chief guest who delivered the Foundation Day lecture entitled “Knowledge Management”. In his address Prof. Ramamurthy first congratulated NIIST for its outstanding performance in terms of high impact factor publications and transfer of major technologies in recent years and the greater visibility gained by it in light of 2 prestigious awards such as S. S. Bhatnagar Prize and CSIR Young Scientist award bagged by NIIST scientists in the year 2007. He further highlighted the importance of knowledge management which should be treated as an asset, as the generation of knowledge needs investment. He called upon the scientists to imbibe knowledge management and make every effort to assimilate knowledge, transform the knowledge to a saleable commodity. Prof. Chandrashekar, in his presidential address informed that the foundation day of the year assumes special significance for the laboratory as two of the scientists have bagged the coveted S.S. Bhatnagar Award for the chemical Sciences, second time in a row and CSIR young scientist award for the first time in the history of NIIST. He also informed that in order to recognize and motivate the staff members who deliver to the expectations would be suitably rewarded with appreciation awards. He called upon the staff to raise to the occasion when the Institution is doing its best to keep it growing in the years to come.

Five scientists selected for the outstanding R&D performance award for the year 2006-07 were felicitated by the chief guest. The staff members selected from the service departments and R & D departments for the appreciation awards were also felicitated by the chief guest with a certificate and memento.



Vigilance Awareness Week 2007

The Vigilance Awareness week 2007 was observed in the institute from 12th to 16th November, 2007 which was inaugurated by Shri Ramesh Chandra Bhanu, IPS, Transport Commissioner after administering pledge in Hindi and English by the Director. As a part of the celebration, competitions on elocution, cartoon drawing and slogan writing were conducted with wide participation. The celebrations ended with the distribution of prizes to the winners and a valedictory lecture by Shri Radhakrishnan Nair, former Director, CBI on 16th November, 2007.



Vigilance Awareness Week Inauguration lecture by Shri. Ramesh Chandra Bhanu, IPS, Transport Commissioner, Govt. of Kerala



Vigilance Awareness Week Valedictory Function Shri. Radhakrishnan Nair, Former Director, CBI delivering valedictory lecture



संस्थान में 14-20 सितंबर 2007 के दौरान हिंदी दिवस/हिंदी सप्ताह मनाया गया

हर साल की तरह राष्ट्रीय अर्तविषयी विज्ञान तथा प्रौद्योगिकी संस्थान, तिरुवनंतपुरम् में 14 सितंबर को हिंदी दिवस के रूप में तथा बाद के एक सप्ताह तक हिंदी सप्ताह के रूप में समुचित ढंग से मनाया गया। पूरे सप्ताह के दौरान राजभाषा के प्रचार प्रसार के लिए परियोजना स्टाफ, अनुसंधान छात्र आदि सहित संस्थान के संपूर्ण स्टाफ सदस्यों के लिए तथा उनके स्कूली छात्रा केलिए निम्नलिखित प्रतियोगिताएं आयोजित की गयी।

1. हिंदी निबंध लेखन

2. हिंदी टिप्पण/आलेखन

3. हिंदी पठन

4. हिंदी प्रश्नोत्तरी

5. हिंदी गीत

इन सभी प्रतियोगिताओं में कर्मचारियों एवं उनके बच्चों ने बडी संख्या में भाग लिया।

हिंदी दिवस का औपचारिक उद्घाटन 14 सितंबर 2007 को प्रातः 10.00 बजे संपन्न हुआ। डॉ. एन. के. गुप्ता, उपनिदेशक, द्रव नोदन प्रणाली केंद्र, भारतीय अंतरिक्ष अनुसंधान संगठन, तिरुवनंतपुरम ने कार्यक्रम का औपचारिक उद्घाटन किया। उन्होंने अपने भाषण में राजभाषा के रूप में हिंदी भाषा के महत्व पर प्रकाश डाला और सूचित किया कि अब संयुक्त राष्ट्र संघ हिंदी भाषा को भी मान्यता देने के सिलसिले में विचार किया जा रहा है। उन्होंने बताया कि 13-15 जुलाई 2007 के दौरान न्यूयार्क में आठवें विश्व हिंदी सम्मेलन का आयोजन किया गया, जिसका विषय था - 'विश्व मंच पर हिंदी'। इस प्रकार हमारी राजभाषा हिंदी को विश्व मंच पर स्थान प्राप्त होते हुए भी भारत में उसके प्रचार प्रसार में अब भी बाधा है। प्रो. टी. के. चन्द्रशेकर, निदेशक, एन आई आई एस टी, तिरुवनंतपुरम ने समारोह की अध्यक्षता की। उन्होंने अपनी अध्यक्षीय भाषण में बताया कि संस्थान में प्रशासनिक कार्यों में राजभाषा हिंदी का उपयोग बढ़ रहा है, किन्तु विज्ञान तथा प्रौद्योगिकी के क्षेत्र में इसका ज़्यादा प्रयोग नहीं होता है। उन्होंने अपने भाषण में यह सूचित किया कि सूचना प्रौद्योगिकी के बदलते परिवेश में हिंदी भाषा ने अपना स्थान प्राप्त कर लिया है। अपने भाषण में उन्होंने सी- डाक, पुणे द्वारा हिंदी साफ्टवेयर निर्माण का प्रारंभ, हिंदी के प्रशिक्षण में कम्प्यूटर तथा मल्टीमीडिया तकनॉलजी का विकास, राजभाषा विभाग के हिंदी पोर्टल, राजभाषा विभाग द्वारा घोषित विभिन्न पुरस्कार योजनाएं आदि का संक्षिप्त विवरण प्रस्तुत किया।

उद्घाटन सत्र के बाद स्टाफ सदस्यों के लिए हिंदी निबंध लेखन प्रतियोगिता आयोजित की गई। प्रतियोगिता का विषय था- "विज्ञान तथा प्रौद्योगिकी के विकास में सी एस आई आर का योगदान"

तारीख 17 सितंबर 2007 को कर्मचारियों केलिए हिंदी में टिप्पण/आलेखन प्रतियोगिता तथा कर्मचारियों के स्कूली छात्रों केलिए निबंध लेखन प्रतियोगिता चलाई गई। तारीख 18 सितंबर 2007 को कर्मचारियों तथा कर्मचारियों के स्कूली छात्रों केलिए हिंदी गीत प्रतियोगिता तथा हिंदी पठन प्रतियोगिता चलाई गई।



तारीख 19 सितंबर 2007 को हिंदी प्रश्नोत्तरी आयोजित की गई। डॉ. सुधीर कुमार सिंह, वैज्ञानिक, जैव प्रौद्योगिकी प्रभाग ने प्रतियोगिता का सफलतापूर्वक संचालन किया। सभी प्रतियोगिताओं में स्टाफ सदस्यों ने बड़े उत्साह से भाग लिए।



समापन समारोह में अध्यक्षीय भाषण देते हुए निदेशक प्रो. टी. के. चन्द्रशेखर

20 सितंबर 2007 को अपराह्न 4.00 बजे आयोजित समापन समारोह में स्टेट बैंक आफ त्रावणकोर, प्रधान कार्यालय, तिरुवनंतपुरम के राजभाषा प्रबंधक डॉ. कुलदिप सिंह चौहान मुख्य अतिथि थे। प्रो. टी.के. चन्द्रशेखर, निदेशक एन आई आई एस टी, तिरुवनंतपुरम् ने समारोह की अध्यक्षता की। अपने अध्यक्षीय भाषण में उन्होंने हिंदी सप्ताह समारोह को सार्थक एवं सफल बना देने के लिए सभी का साधुवाद किया। मुख्य अतिथि द्वारा विभिन्न प्रतियोगिताओं के विजेताओं को पुरस्कार वितरित किया गया।



समापन समारोह में पुरस्कार वितरित करते हुए मुख्य अतिथि स्टेट बैंक आफ त्रावणकोर, प्रधान कार्यालय, तिरुवनंतपुरम् के राजभाषा प्रबंधक डॉ. कुलदिप सिंह चौहान