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Team CSIR



RRL-Thiruvananthapuram transfers Environment-friendly Synthetic Rutile Technology to CMRL

THE Regional Research Laboratory (RRL), Thiruvananthapuram, has entered into an agreement with M/s Cochin Minerals and Rutile Ltd, Kochi, for transfer of a new environment-friendly technology developed by RRL for synthetic rutile from ilmenite. Synthetic rutile is starting material for the production of titanium tetrachloride, titanium metal and titanium dioxide.

The presently used CMRL technology employs the highly polluting partial reduction of ilmenite followed by conc. hydrochloric acid digestion, where all the iron values present in ilmenite are removed as acidic ferrous chloride, disposal of which is a major problem owing to its limited use. CMRL is modernizing their production through the state-of-art technology for high-grade synthetic rutile.



Signing of agreement for transfer of environment-friendly synthetic rutile technology to CMRL



The new process involves essentially three steps, namely:

- (i) Solid state reduction of ilmenite using coal;
- (ii) Aeration rusting of reduced ilmenite using environmentally benign catalyst where the metallic iron is converted to solid iron oxide; and
- (iii) Chemical beneficiation to remove the remaining small quantities of iron.

In the new process all the byproducts are recovered as salable byproducts, thereby making the process pollution free. Synthetic rutile of 96-97% TiO_2 with radioactivity acceptable to international clients is produced.

The process patented by RRL has been further modified to meet the requirements of CMRL and pollution control board norms.

The new process has been proved by RRL and CMRL jointly through a pilot plant where tonnage quantities of high-grade synthetic rutile have been produced, which has been evaluated and accepted by international customers. Many new innovations have been incorporated in the process to make it environment friendly and economically viable to the Indian conditions. The technology is globally competitive in terms of cost of production, quality of synthetic rutile and conversion of byproducts into salable commodities.

Under the present agreement CMRL would put up a commercial plant of capacity 24,000 tonnes/annum synthetic rutile of 96-97% TiO_2 with low radioactivity using the new modified RRL technology. The commercial plant is expected to be ready within two years and RRL would continue to be associated with CMRL in the implementation of the technology.

This is one of the major technology transfers not only in the history of RRL but also in CSIR. It is also a major milestone in the laboratory's priorities for developing and transferring technologies suitable for regional development.

CGCRI develops Solid Oxide Fuel Cell Technology

ALL over the world, including India, the need for finding alternative energy options is assuming increasing importance. It is not only with a view to lowering the dependence on rapidly exhausting fossil fuels, but also owing to increasing global concern about the environmental consequences of fossil fuel use in production of electricity and for the propulsion of vehicles. Fuel cells are promising alternatives to solve these problems.

Compared to other types of fuel cells, Solid Oxide Fuel Cell (SOFC) characteristically has all solid state components providing compactness and flexibility to design. In addition, high operating temperature ($> 700^\circ\text{C}$) causes electrode reactions to occur faster without the use of expensive metal catalysts. The exhaust heat from SOFC is useful for cogeneration or bottoming cycle leading to further increase in efficiency of the system. Another important feature of SOFC is its multi-fuel capability. Besides hydrogen, it can accept natural gas, biogas and other light hydrocarbons. Considering all such multivariate advantages, SOFCs are emerging as one of the most promising distributed power generating system (watt to kilowatt-level) for the future.

In India the Central Glass & Ceramic Research Institute (CGCRI), Kolkata, is the pioneering institute for the development of SOFC. Under the current CSIR-NMITLI programme, CGCRI is the lead institute responsible for development of indigenous SOFC technology in multi-kilowatt range which is based on the state-of-the-art anode-supported planar design. Under this project, large numbers of single cells of dimension $5\text{ cm} \times 5\text{ cm} \times 1.5\text{ mm}$ have been fabricated (Fig. 1) by using simple, inexpensive and up-scalable fabrication techniques such as tape casting and screen printing. The developed cells have the right kind of microstructure (Fig. 2) with a $20\text{ }\mu\text{m}$



thin, gas-tight 8 mole% yttria stabilized zirconia (YSZ) electrolyte sandwiched between a porous anode (NiO-YSZ) support (1.5 mm thick) on one side and a 50 μm thick porous Sr-doped LaMnO₃ (LSM) cathode layer on the other side. Recently, electrochemical performances of these cells have been tested at Forschungszentrum Jülich (FZJ), Germany. The performance of the cells has been found to be excellent and a current density as high as 1.3 A/cm² under a cell voltage of 0.7 V at 800°C (Fig. 3). Various cells from different batches have been tested and the results are quite reproducible. The performances of CGCRI's cells are quite comparable with other international leading SOFC stack developers (Table on next page). Currently, cells of dimensions 10 cm \times 10 cm \times 1.5 mm are under development. The institute is now engaged in demonstrating a 250 watt SOFC stack using ferritic steel as interconnect and gas-manifolding. CGCRI has also developed suitable glass-based sealant for its in-house stack development. Shortly BHEL and CGCRI are going to sign an MoU to carry out a much bigger programme on SOFC Technology development to deliver a SOFC power pack with balance of plant. Forschungszentrum Jülich, Germany is also keen to start collaborative research work with CGCRI in this area.

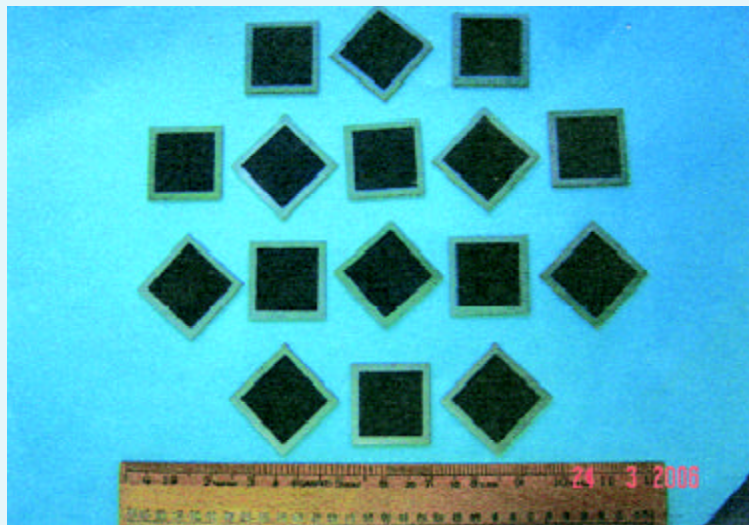


Fig. 1 : Planar anode-supported SOFC single cells (5cm \times 5 cm \times 1.5 mm) developed at CGCRI, Kolkata

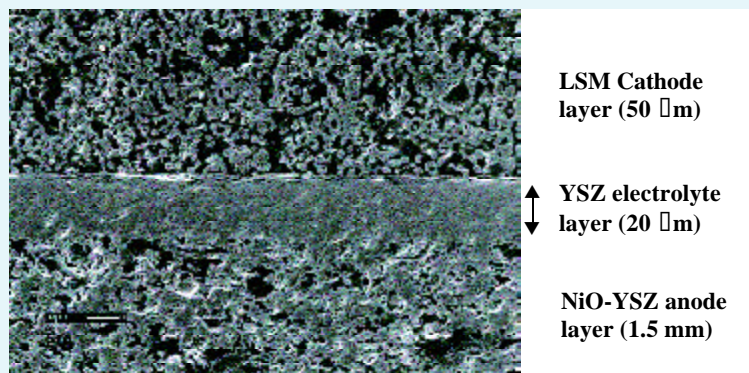


Fig. 2 : SEM micrograph of a typical SOFC single cell (as shown in Fig. 1)

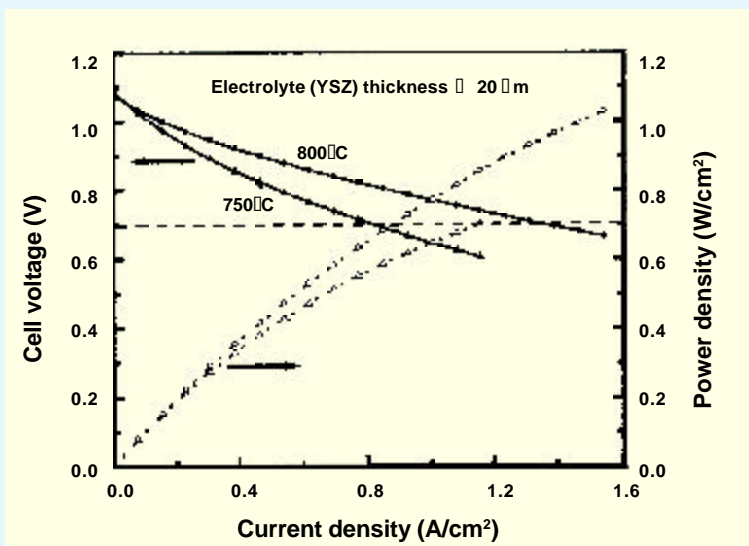


Fig. 3 : Electrochemical performance of CGCRI developed 5 \times 5 SOFC single cells



Comparison of cell performance of CGCRI developed and anode-supported planar SOFC single cell with some leading international SOFC developers

| SOFC Developer | Cell Size | Performance |
|---|--------------------------|--|
| GE Hybrid Power Generation Systems (USA) | 4 cm □ 4 cm | At 800°C, 0.7V, < 1.0 A/cm ² |
| Forschungszentrum Jülich (Germany) | 5 cm □ 5 cm □ 1.5 mm | At 800°C, 0.7V, > 1.0 A/cm ² |
| PNNL (USA) | Coin cell (dia. – 25 mm) | At 750°C, 0.7V, < 1.0 A/cm ² Natural gas / Gasoline |
| H.C. Starck Ceramics (In DEC, spin off Company of ECN, Netherlands) | Up to 20 cm □ 20 cm | At 750°C, 0.85V, 0.5 A/cm ² |
| CGCRI (Kolkata) | 5 cm □ 5 cm □ 1.5 mm | At 800°C, 0.7V, 1.35 A/cm ² |

New CFTRI Processes Released

THE processes released by the Central Food Technological Research Institute (CFTRI), Mysore, recently, include:

Shelf stable *kabab* mix with chicken meat

Kabab is a popular snack food product and different varieties of *kababs* are available in the market, based on meat and vegetable. The shelf stable *kabab* mix with chicken meat is a convenient product that can be easily reconstituted to make *kababs* of different shapes. The product can be consumed by frying / baking / toasting.

The *kabab* mix with chicken meat developed by CFTRI is a ready-to-use kind with an acceptable taste and meat flavour. The incorporation of onion, garlic and pepper enables the product to be shelf stable up to six months under ambient conditions. The product is free from added chemicals and preservatives.

The deboned chicken meat with skin, corn starch, wheat flour, garlic and onion powder, skimmed milk powder and spices are the major raw materials used for the product. The meat is washed, cooked, minced and after adding other ingredients, dried and packed. Meat mincer, dry grinder, autoclave, steam generator, hot air drier and mixer are the equipment required. This product is an innovative one in the hygienic processing of comminuted meat.

Ready-to-eat amla products — candy and osmo air-dried segments

The Indian Goose-berry (*Emblica officinalis*) is rich

in vitamin 'C' and pectin and is valued for its medicinal properties. It is widely used in Ayurvedic preparations in view of its ability to inhibit platelet aggregation and cholesterol lowering properties.

Amla fruit is also used as an astringent and mouth freshener as the fruit is rich in polyphenols. Amla products have very good internal and export market potential. The amla fruit is seasonal and it is available during October - January months. Processing of the amla fruit is essential in order to make the product available throughout the year.

CFTRI has developed amla candy, osmo air-dried amla-sweet and osmo air-dried amla-salty ready-to-eat products with a shelf life of eight to ten months under ambient conditions. These concentrated amla products have good taste, texture and nutritive value. The raw materials required include amla fruit, sugar, salt and permitted preservatives.

The processing comprises washing, cutting, syruping, osmotic treatment, drying and packing. Fruit washer, tray drier and boiler are the equipment required for a production unit.

The left over syrup can be flavored and profitably utilized for preparing ready-to-serve beverages.



CFTRI Processes granted US Patents

Process for obtaining a bound - phenolic acid rich dietary fibre

(US Patent No. 7037537)

Phenolic acids such as ferulic and coumaric acids are covalently linked to mainly dietary fibre components such as arabinoxylans and pectins and influence their physicochemical properties in various food preparations.

Besides acting as flavour components, phenolic acids are known to possess anticarcinogenic, antimutagenic and antioxidant properties.

The presence of phenolic acid in dietary fibre components is very vital in the preparation of cereal-based health foods targeting geriatrics and infants.

Phenolic acids are also present as free acids in very small amounts in cereals and malts.

However, they undergo decarboxylation, leading to decrease in their utility value. Hence, the bound phenolic acid is very important for the positive health benefits of dietary fibre components. Removal of the starch by specific enzymatic treatments is a prerequisite to prepare bound phenolic acid dietary fibre rich from cereals and their malts.

The Central Food Technological Research Institute (CFTRI), Mysore, has developed an economic and efficient process for obtaining the bound - phenolic acid rich dietary fibre from cereal malts. Compared to the existing process, the present one eliminates the usage/addition of exogenous enzymes.

Process for the preparation of high arginine peptides

(US Patent No. 7091001)

Arginine is present in most of the proteins including meats, nuts, milk, cheese and eggs. Arginine is essential for the removal of ammonia that is generated from protein breakdown. It is also needed to transport the nitrogen used in muscle metabolism. Arginine is one of the body building amino acids and influences several hormone functions. L-arginine is shown to influence the liver functions to lower cholesterol levels and to inhibit the growth of certain type of tumours in animal system. It is a precursor for potent blood vessel expander and main blood pressure regulator of the body.

A low lysine: arginine ratio in protein has been shown to reduce serum and aortic cholesterol. CFTRI has developed a novel process for the preparation of high arginine peptides.

The advantages of this process are:

- It is a single step process with high yield of hydrolysates.
- The process provides enriched fraction of peptides with high arginine to lysine ratio of at least 5 times.
- The preparation can be used as an ingredient in health foods for treating cardio-vascular diseases.

SARAS Nacelle and Engine Installation

THE current activity under the SARAS project of the National Aerospace Laboratories (NAL), Bangalore, at the SARAS hangar is centered around the nacelle and engine installation on the aircraft. The nacelle on the aircraft is attached to the stub wing through the L and M inboard frames. An integral part of the stub wing. Inboard L frame is attached to the root rib at #3, front spar, skins and tie rod brackets. Inboard M frame is attached to End Rib at #3, machined spacers and the skins. The L and M inboard frames are attached to the O/B and bottom L and M frames of the nacelle through the longerons and splice boxes.

The SARAS PT-II is now powered by two 'PT6-67A' engines. These are attached to the engine mount yoke I/B and O/B through shock mounts mounted on engine mounting pads. The shock mounts are attached to the yoke cup brackets by bolts and self locking nuts. The engine is also attached to the stub wing tie rod bracket by tie rods attached to the top and bottom ends of the inboard yoke. Engine installation is definitely a delicate process involving deft maneuvering. It is first maneuvered in position to the inboard yoke and then the outboard yoke is locked to the inboard yoke with 10 mm diameter bolts and nuts at the top and bottom flanges. In its installed condition, it has a pitch up of 2 deg and a toe-in of 1.5 deg with respect to the aircraft axis.

The tasks that have been completed on the integration and equipping side, include: the assembly of the wind shields-front and side and the assembly of the pax cabin windows. Fitment of antennas atop the top skin of the fuselage and Swaging and load testing of all the FCS cables.

NIO signs MoU with ENSIL for Cooperation in the Areas of Environmental Pollution and Ecotoxicology



Dr S.R. Shetye, Director, NIO and Prof. Patrick Leprat, Director, ENSIL, exchanging the MoU documents

THE National Institute of Oceanography (NIO), Goa, signed a Memorandum of Understanding (MoU) with Ecole Nationale Supérieure d'Ingenieurs de Limoges (ENSIL), University of Limoges, France, on 27 October 2006 for research cooperation in the areas of Environmental Pollution and Ecotoxicology. Under this MoU exchange of students, scientists and scientific information between these two organizations would take place. The use of facilities and equipment at both the laboratories would also be made available to the individuals working under the cooperative research programmes. Dr Anupam Sarkar from NIO and Prof. Guy Matejka from ENSIL would coordinate the activities. The MoU will remain in force initially for a period of six years. The documents were exchanged between Dr S.R. Shetye, Director, NIO and Prof. Patrick Leprat, Director, ENSIL in a meeting held at NIO.

FINER, Guwahati, CFTRI and RRL, Jorhat tie-up

A joint meeting to discuss the possibility of setting up of food-based industries in Assam and other states of North Eastern region, was held at the Regional Research Laboratory (RRL), Jorhat, on 13 October, 2006. Directors of RRL, Jorhat, Central Food Technological Research Institute (CFTRI), Mysore and Federation of Industries for North Eastern Region (FINER), Guwahati, participated in the meeting. The members of the Research Council, scientists of RRL, Jorhat and members of FINER also took part in the discussion. The specific purpose of the meeting was to initiate dialogue with CFTRI for exploring possibilities of setting up of food based industries and more specifically the horticulture products based processing industries. The FINER and RRL, Jorhat had signed an MoU for working jointly in the areas of mutual interest for industrial and socio-economic development of the region. The present meeting was the second of its kind. Shri S. K. Jain, President, FINER, briefed about the initiatives taken by FINER for facilitating small and medium scale industries in the region and in that connection he also informed that a group of entrepreneurs would be deputed to CFTRI for undertaking higher training in food processing.

Earlier, Dr P. G. Rao, Director, RRL, Jorhat, welcomed the participants and spoke about the objectives of the meeting, Dr V. Prakash, Director, CFTRI, spoke on the experiences of CFTRI technology for pineapple processing industry commissioned successfully at Ukhrul, Manipur. He emphasized the need for taking special care in selection and supply of raw materials in the food processing sector and gave an example of PPO Model, i.e. Passion Fruit, Pineapple and Orange where steady supply of raw materials would be available throughout the year in the region. He also stressed for setting up of processing units nearer to the cultivation area to minimize transportation cost and damages in handling. The marketing of the produce seemed to be a deciding factor in the region as the road is the only mode of transportation of the finished products to the market, he opined. He mentioned that market tie-up with establishments like Army Cantonment of the region might be a better solution. On the security of

agri-products and preventing biopiracy, Dr Prakash emphasized the need for DNA finger printing of the fruit and vegetables of the region. Dr G. Thyagarajan, Chairman, RC, RRL, Jorhat, suggested that only the public-private partnership could bring rapid industrial development in the region and mentioned that environmentally viable technologies are the need of the day. He mentioned that the region could bring about horticultural revolution in the country and the time has come for value addition to vegetables for export. But at the same time, he cautioned not to export vegetables as such. The horticultural revolution could generate employment avenues to millions in the region, he commented. The meeting ended with the resolution that CFTRI, Mysore, RRL, Jorhat and FINER, Guwahati would work together under a tripartite agreement to address many of such problems for bringing about industrial and socio-economic development of the N E region.

NPL-Industry Meet

THE National Physical Laboratory and Metrology Society of India organized an NPL-Industry Meet on 7 November, 2006 jointly at NPL, New Delhi. The aim of this Meet was to provide a forum for interaction between scientists, metrologists and technocrats in the industry with a view to understanding their problems in metrology, technology incubation and provide the viable solution. The deliberations were focused on how NPL could help the industry. Twenty-six participants from different industrial units and over 20 senior scientists of NPL attended this meet. M/s Mahindra & Mahindra Ltd, M/s Crompton Greaves Ltd, M/s Maruti Udyog Ltd, M/s Honda and several other industries located in different parts of the country were represented by their senior officials.

The forenoon session was dedicated to the NPL contributions to inductees,

including presentation on the importance of measurement, calibration and testing in improving the quality of products. In addition, the presentation on various techniques and technologies developed by NPL, e.g. those pertaining to noise pollution, development of metallic components, teleclocks, antiglare coatings, luminescence materials, conducting polymers, smart windows, chemical analysis and much more was given by senior scientists of NPL.

In the afternoon session, industry representatives gave their views regarding the contribution of NPL. While complimenting NPL for its contributions, some delegates from industries desired improvement in procedures for public dealings. Director, NPL while attending to their queries assured them for better contact between industry and NPL scientists in future.



Views of NPL-Industry Meet. Dr Vikram Kumar, Director, NPL, giving the welcome address (top right), and Dr R.K. Garg, Scientist F and General Secretary, MSI, giving introductory remarks (right above)



Studies on Microstructure of Polymeric Materials

Shanti Swarup Bhatnagar Prize-winner

Dr Ashish K. Lele's work

DR Ashish K. Lele, Scientist at the National Chemical Laboratory (NCL), Pune, has been awarded, along with Dr Sanjay Mittal of the Indian Institute of Technology, Kanpur, the Shanti Swarup Bhatnagar Prize in Engineering Sciences for the year 2006 "for making pioneering contributions by probing micro and mesostructure of polymeric materials and relating it to the macroscopic dynamical and equilibrium properties using a combination of theory and experiments" [*CSIR News*, 56 (2006), 296].

Dr Lele has particularly worked on smart gels, influence of molecular topology on the dynamics, and polymer-nanoclay composites. Smart gels have been shown in the past to demonstrate sensitivity, selectivity, mobility, shape memory and enzyme catalysis. Dr Lele's group demonstrated for the first time two additional life-mimicking features namely, macroscopic self-organization and healing in hydrogels. The discovery of these two novel phenomena was hinged on understanding the metal ion complexation with specific functional groups attached to the polymer chains. The theoretical basis of this work was provided by Dr Lele by developing a mean field equilibrium model that specifically accounted for hydrogen bonding and



dispersive interactions in hydrogels. Dr Lele's work highlighted the link between the macroscopic swelling-collapse transition phenomenon and molecular events.

The understanding of how topology governs the dynamics of macromolecules is extremely important for polymers of different architectures such as linear, branched, ring, star and combs. Such polymers are expected to have novel applications in adhesives, gels, processing aids, bio-medical devices, etc. Dr Lele has been exploring the roles of intrinsic and extrinsic constraints on the dynamics of polymer molecules. His group has investigated the role of constrained dynamics of grafted macromolecular brush in wall-slip, a phenomenon which is of substantial fundamental as well as applied interests. On the one hand it questions the basic assumption of the 'no-slip' boundary condition in

fluid mechanics of macromolecular fluids and on the other hand it is highly relevant to the polymer processing industry. Dr Lele's group has developed a coarse grained but rigorous molecular model describing the coupling between the dynamics of tethered chains and the bulk chains. The model unearthed for the first time the crucial role of the convective constrained release process as being the root cause of the stick-slip instability. Recently, he has investigated the dynamics of endless flexible ring polymers. The key question to answer is whether such polymers, when constrained, can reptate at all; knowing well the critical role played chain ends in the reptation mechanism. Recently, theoretical research from his group resulted in the formulation of the first coarse grained mean model that rigorously predicts the dynamical parameters of thermal motions for ideal flexible ring polymers in fixed as well as moving obstacles.

Recently, organo-nanoclays have attracted attention in industry and academia alike owing to the substantial improvement they impart to thermo-mechanical and barrier properties of polymeric resins for a relatively small incorporation into the matrix. Dr Lele's group illustrated crucial structure-property relations in these nanocomposites. They were the first to show that polymer nanoclay



composite melts exhibit an apparent yield phenomenon in which the viscosity of the melt precipitously drops from a very high value (due to hydrodynamically percolating network of the highly asymmetric nanoclay tactoids) to a much smaller polymer melt-like value (due to flow induced orientation and breakage of the network) on application of a shear yield stress. Dr Lele demonstrated the usefulness of rheology as a tool that should be used together with other techniques such as x-ray scattering and electron microscopy to elucidate the dispersion of nanoclays in polymers. Further, he quantitatively established through the use of a novel *in situ* rheo-x-ray technique the effect of shear on the orientation of the clay and the kinetics of partial disorientation on cessation of shear.

Dr Lele leads 'Complex Fluids and Polymer Engineering' group at NCL. He has been earlier awarded the CSIR Young Scientist Award (1996), Indian National Science Academy Young Scientist Award (1998), and UICT Alumni Young Scientist Award (2003). He is a fellow of the Indian National Academy of Engineering (2004). He has to his credit thirty-eight papers published in international peer reviewed journals, eleven conference papers and one US patent.

Uhlenbeck-Yau Compactification of the Moduli Spaces of μ -Semistable Bundles

Shanti Swarup Bhatnagar Prize-winner

Dr Vikraman Balaji's Work



DR Vikraman Balaji of Chennai Mathematical Institute, Siruseri, has been awarded along with Dr Indranil Biswas of Tata Institute of Fundamental Research, Mumbai, the Shanti Swarup Bhatnagar Prize in Mathematical Sciences for the year 2006 for his outstanding contributions to moduli problems of principal bundles over algebraic varieties, in particular on the Uhlenbeck-Yau compactification of the Moduli Spaces of μ -semistable bundles. Further his work on holonomy groups for stable bundles on surfaces is significant [*CSIR News*, 56 (2006), 297].

Dr V. Balaji's contribution in the past several years has been to the

geometry of principal bundles as well as issues related to vector bundles over higher dimensional varieties. His initial motivation was to understand principal bundles and the related moduli problems from a Tannakian perspective. With this in mind, in collaboration with C. S. Seshadri, he worked out a new approach for the study of principal bundles on curves. As in many of these moduli problems it was realized early that the key issue which needs to be addressed is the so called "semistable reduction theorem". In the mid seventies, after GIT construction of the moduli of principal bundles on curves, he approached the problem from what may now be termed as the "stacky" point of view. In the mid-nineties,



semistable reduction was proved but unknowingly he gave an approach for the semistable reduction theorem which was group-theoretic rather than Lie theoretic.

He (in collaboration with A. J. Parameswaran) generalised it to large positive characteristics and solved the moduli problem (the existence and projectivity) for principal bundles over curves. The problem was open since the mid-seventies. For principal $GL(n)$ -bundles, as is well-known, this is classical and due to Seshadri. More precisely, H to be a semisimple algebraic group and assuming X , a smooth projective curve defined over an algebraically closed field k . He proved the existence and the projectivity of the moduli spaces of principal H -bundles on X for fields k of characteristic $p > 0$ with precise bounds on the prime p , the restrictions being imposed by the representation theory of H .

Carrying on the work on principal bundles on curves, he addressed the problem of semistable reduction for principle bundles over higher dimensional varieties. This together with the construction of the Donaldson-Uhlenbeck compactification of the moduli space of stable principal bundles on surfaces is his next goal. The purpose of this work is two-fold: its first aim

is to prove the semistable reduction theorem for the isomorphism classes of μ -semistable principal bundles (in the sense of Ramanathan-Mumford) with a semisimple structure group H over smooth projective varieties X defined over C . In fact, he proved the semistable reduction theorem for classes of μ -semistable quasibundles. This theorem generalizes, in its entirety, the basic theorem of Langton for the functor of isomorphism classes of μ -semistable torsion-free sheaves. It involves new ingredients such as the notion of "quasibundles" which extends the notion of principal bundles. This plays the role of μ -semistable torsion-free sheaf so as to realize the boundary points.

The final theorem is concluded with the key input from Bruhat-Tits theory. The second aim is to give an algebro-geometric construction of the compactification of the moduli space of μ -semistable principal bundles over smooth projective surfaces. By the theorem of Ramanathan and Subramaniam (generalising Donaldson-Uhlenbeck-Yau theorem to the case of principal bundles), this enables one to give a projective scheme structure to the Donaldson-Uhlenbeck compactification of the moduli space of antiselfdual (ASD) Yang-Mills bundles over X with general structure groups. In the vector

bundle case the algebro-geometric construction was independently given by J.Li and J.Morgan. Dr Balaji then proved (generalising a result of Taubes) that the moduli space $M_s H$ of μ -stable principal H -bundles on the surface X is non-empty for large characteristic classes c where "largeness" is suitably interpreted for principal bundles.

Dr Balaji did his B.A. (Hons) in Mathematics and M.A. from St Stephen's College, New Delhi. In 1984, he joined the Institute of Mathematical Sciences as a doctoral student of Prof C.S. Seshadri. His doctoral work was on the theme of geometry and topology of certain moduli spaces of vector bundles. In 1991, after a post-doctoral period, he joined the faculty of the then formed School of Mathematics, SPIC Science Foundation which has since become the Chennai Mathematical Institute. He is a faculty member here ever since. He has visited a number of centres the world over such as Oxford University, Cambridge University, University of Paris-VII, University of Liverpool, etc. where he did collaborative research. He was an Associate Member of the ICTP, Trieste till 2002. He has given invited talks in many international centres such as Oberwolfach (Germany), Durham (UK), Porto (Portugal) and also at the TIFR (Mumbai).



CSIR Foundation Day Celebrations at Laboratories/Institutes

THE highlights of CSIR Foundation Day celebrations at some of the laboratories/institutes were covered in 15 December 2006 issue of *CSIR News*. Highlighted here are the programmes held at CGCRI, CMERI, IICB, RRL-Jorhat and SERC, on the occasion:

Central Glass & Ceramic Research Institute (CGCRI), Kolkata

At CGCRI, Shri B. Bhattacharjee, Chairman, Research Council of the institute, was the Chief Guest. Speaking on the occasion, Shri Bhattacharjee, reminded the gathering that the best way to offer homage to the founders of the Council was to cultivate the spirit of collective responsibility by the staff and inculcating innovativeness in the work place. Every person should possess a sense of pride in being associated with CSIR, and assure himself that he or she was up to the meaningful standards of duty expected from the system.

Earlier, welcoming the chief guest and the gathering, the CGCRI Director Dr H.S. Maiti gave an overview of the achievements of the institute and its future plans. The institute has been consistently contributing to the three sectors – strategic, general industrial and societal. In the strategic sector– one of the most important examples was the development of special glasses like radiation resistant, ultra-low expansion, and the laser glass. The institute

had also shown significant progress in the CSIR network projects especially in the areas of photonics and custom-tailored special materials where CGCRI was the nodal laboratory. He also explained the achievements and the possibilities of the on-going New Millennium Indian Technology Leadership Initiative (NMITLI) project on fuel cell. He referred to the encouraging results obtained on the Single Solid Oxide Fuel Cell (SSOFC) which could be stacked to produce 250W-1kW power packs. The results of the activities in the other NMITLI project on bioceramics implants were also encouraging, he informed.

Among the examples of R&D accomplishments of CGCRI, Dr

Maiti mentioned about development of erbium-doped fibre, a key component of EDFA (Erbium doped Fibre Amplifier). Under an MoU with Network Systems Technology (NeST), Cochin, the fibres are being regularly supplied by CGCRI to the company for commercial use in the amplifier in the national and the international markets. He also discussed the development in Fibre Brag Grating (FBG) sensors which could be advantageously used for on-line temperature and strain sensing where other techniques were difficult or impossible to use. He also informed about the work done regarding non-linear with non-linear glasses with non-linear optical properties. While discussing the development of special coating on glasses by sol gel techniques, he informed that an MoU was signed between CGCRI and Tata Chemicals Innovation Centre, Pune, on the exploitation of gold nano-triangle incorporated glasses which were expected to have special optical properties. A special mention was



School students being told about the Specialty Glass Blocks during the Open Day session observed at CGCRI



CSIR Foundation Day Celebrations

made of the work done on synthesis of zeolite nano particles for gas separation membrane. The recent CGCRI contributions to the area of engineering ceramics for the strategic sector have been: hall effect thrusters, ceramic materials for electron tubes, jet vanes and armours. Dr Maiti also mentioned the achievements regarding biomorphic

silicon carbide materials using the fibre structures available in woods. Among the contributions in the societal sector, special mention was made of the arsenic and iron removal plants, the achievement of the Naroda and the Khurja Centres on traditional ceramics. The bone china plant in a rural setting in Bankura, West Bengal has been a good commercial success. In an important development, a two-year Diploma course on 'Designing in ceramics and glazed pottery' has been started through an interactive programme between CGCRI and the University of Burdwan (one of the main universities in West Bengal), informed Dr Maiti.

Dr Sandip Chatterjee, the Convenor of the Foundation Day programme, proposed vote of thanks.

In the afternoon, the fifth Atma Ram Memorial Lecture was delivered by Dr Tridibesh



Dr T. Mukherjee (left), who delivered the fifth Atma Ram Memorial Lecture, being presented a plaque by the Chief Guest Shri B. Bhattacharjee (right)

Mukherjee, Deputy Managing Director (Steel), as part of the Foundation Day programme. Dr Atma Ram, was the founder Director of this institute and he later became Director General of the CSIR. The topic of this year's lecture was 'Technology and Growth: The Link'.

Dr Mukherjee divided his lecture into three parts (i) Per capita income and Technology — possible connection, (ii) History of technology development and (iii) Spark of ideas on technology development. He reminded the audience that the economic development was not a zero sum game; this game was one that everybody could win if appropriate technology was identified and applied. The major developments take place by "discontinuous" development aided by innovativeness in the idea and the approach, making a departure from the slow pace of growth sustained by improvements in the prevailing

approach. One example was the introduction of steam engine in UK during the industrial revolution. Dr Mukerjee pointed out that UK could attain higher economic development through the industrial revolution because of open society, individual initiative, speculative scientific thinking, geographical advantage, and the fact that Britain was rich in coal and other natural resources.

Talking of prompt technology development, he discussed how circumstances trigger a technology development, and cited the example of Japan's economic rise from the ravages of war. On the indigenous application of appropriate technology, Dr Mukherjee gave the example of India achieving green revolution in the 1960s and 1970s. He also discussed the present status of the indigenous technology and economy. He concluded that the per capita income implied standard of living and the latter was the indicator of a country's state of technology. For technological success, the technological ambience and focus should be the basic attribute, he concluded.

The institute was kept open to the school students, family members of the staff members and the interested general public for viewing its facilities and knowing its R&D activities.



Central Mechanical Engineering Research Institute (CMERI), Durgapur

Apart from the usual observances that mark this day, the highlight of the Foundation Day celebrations at CMERI were three illuminating lectures by — Dr P.S. Goel, Secretary, Ministry of Earth Sciences; Shri S.P. Gon Chaudhary, Director, West Bengal Renewable Energy Development Agency (WBREDA) and Dr A. Chatterjee, Advisor to the Managing Director, Tata Steel.

Shri Partha Sarathi Banerjee, Scientist, CMERI, welcomed the gathering and introduced the speakers to the audience.

In his inaugural Speech, Dr G.P. Sinha, Director, CMERI, extended a hearty and warm welcome to the dignitaries and the personnel of the institute. He spoke about the efforts of CMERI towards propelling the nation forward. He mentioned *Krishishakti* – the latest of the offerings of CMERI for empowerment of the small Indian farmers. *Krishishakti* is an economy tractor that retains all the important features and functions of its higher horsepower counterparts but which has been designed with the sole objective of helping a common farmer. Dr Sinha then outlined the efforts of CMERI towards the design and development of the Automated Underwater Vehicle (AUV). Another first in India, the technology for the development of an AUV for operating at a depth of 500m is in progress. Dr Sinha concluded by focusing on ten new advanced technologies on which

CMERI is working on under the CSIR Network Project to render the Indian manufacturing sector globally competitive. He dwelt on the challenges CMERI has undertaken in addressing NNS manufacturing and for introduction of automation in manufacturing. He also spoke about the ambitious projects CMERI has proposed for adoption under the Eleventh Five Year Plan. These include micro systems development like micro machine tools, micro robots, etc. so that the indigenous manufacturing sector can benefit from machines having better capabilities, less bulk or mass and less energy requirement.

Dr P.S. Goel, who was the Chief Guest on the occasion, delivered the Foundation Day Lecture. In his illuminating and thought provoking address, Dr Goel deliberated on the future of science in this country and sounded a timely alarm that the best talent is drifting away from science owing to the uncertainty in finding a rewarding career in science. He stressed that India needed to generate scientific jobs. He also reminded that scientists have the duty of providing scientific solutions to realize this and stop the drift to the best talent away from careers in science.

Subsequently, Dr Goel spoke about the various issues that are confronting the country today, viz. energy consumption, global warming, depletion of the ozone layer, shrinkage of cultivable land,

water consumption, etc. He added that in addition to separately addressing the challenges being confronted in the various disciplines related to earth sciences, the Ministry of Earth Sciences today is essentially addressing the ways and means of integrating these aspects into a combined model. He illustrated this by commenting that in today's world if one is looking for better, more precise, accurate and dependable weather forecasting, this cannot be done by considering the aspects of atmospheric science alone. For this, one needs to integrate the inputs coming from the ocean to the atmosphere and move back to the ocean which also gets affected by the atmosphere.

Dr Goel then mentioned about the CMERI's participation in developing appropriate technologies for sub-sea exploration. Recently, CMERI has developed a Remotely Operated Vehicle, which is to be tested soon by NIOT. CMERI is also working on the development of Autonomous Underwater Vehicle and other submersible vehicles jointly with IIT, Kharagpur. Appreciating this activity, he felt that such cooperative ventures were a logical conclusion of the ongoing activities. The Ministry of Earth Sciences, Dr Goel said, had much more ambitious plans for fostering such developments in a phased manner. He opined that in the first place, one should look for solutions to pertinent problems. Secondly, such programmes must relate to the



CSIR Foundation Day Celebrations

wider context so that tangible benefits can accrue for the society in general.

Shri S.P. Gon Chaudhary, who was the Guest of Honour, delivered his lecture on 'Energy Security'. Beginning his speech with a succinct account of the energy status of the country, where half a billion people are denied of energy for consumption, livelihood and sustainable development and where 126,000 MW power being generated in the country is utilized by only 50% of the population. Shri Gon Choudhury concluded that to realize the government's mandate of providing energy to all by 2010 and access to electricity to all by 2012, a tremendous technological challenge has to be taken up by the scientists and technologists of the country. He opined, "I don't think that only coal-based, or gas-based or nuclear power-based conventional sources can solve the problem. We must think about distributed power generation, power from alternative energy sources, alternative technologies." Shri Gon Choudhury further consolidated the case for renewables by pointing out that the extension of grid line to provide electrical power from conventional concentrated utilities to half a billion people may not be always a good option. The setting up of long and costly transmission and

distribution lines, coupled with high transmission and distribution losses, the increasing price of fossil fuels, and the high cost of centralized management systems make this programme unattractive in many places, and in some cases, almost impossible. He then underlined some of the existing renewable technologies related to solar photovoltaics, solar thermal, wind, biomass and biogas utilization, microturbines, etc. He concluded by reiterating that a tremendous challenge lies ahead in the field of energy in general and renewables in particular and exhorted the technologists at CMERI to undertake meaningful research in New Renewables like Fuel Cell, Organic Solar Cell, Hydrogen, Biofuel, BIPV in urban areas, etc. He opined that it is clear that there will be no single solution for providing electricity to billions of people and energy switching from conventional to renewable is inevitable.

The third lecture of the day was delivered by Dr A. Chatterjee, who led the captive audience to introspect whether we as Indians have actually delivered what we are capable of. He began his speech by drawing attention to the rich spiritual and cultural heritage of India and by recalling the achievements of the country in the

ancient times, which included the invention of the 'zero', the formulation of algebraic and trigonometric equations, the establishment of the first ever university in the world, etc. He also quoted copiously from the speeches of great men of letters who spoke warmly about the potential of India. He then went on to highlight some of the more recent achievements by outstanding Indians in the fields of science, technology and entrepreneurship, which underlined the immense pride in this country and its people. Thereafter, he went on to elaborate the competitive advantages of India and concluded by providing a road map to excel as a country in the global scenario.

The programme concluded with vote of thanks proposed by Shri S.N. Shome, Chairman of CSIR Foundation Day Committee.

Certificates of appreciation and mementoes were then handed over to the CMERI employees who had superannuated during the year. Dr P.S. Goel, Secretary, Ministry of Earth Sciences, gave away the mementoes.

During the afternoon session, prizes were handed over by Dr G.P. Sinha to the winners of the various competitions arranged for the staff members and their children on the occasion of the CSIR Foundation Day.

Indian Institute of Chemical Biology (IICB), Kolkata

At IICB, Dr Sushanta Duttgupta, Director, Indian Institute of Science Education and

Research (IISER), Kolkata, was the Guest-in-Chief. Dr J. Gowrishankar, Director, Centre for DNA

Fingerprinting and Diagnostics (CDFD), Hyderabad, delivered the Foundation Day Lecture. Prof.



Siddhartha Roy, Director, IICB, presided over the function.

Dr Duttgupta, in his address mentioned how IICB and CSIR are dedicated to serve the nation. He also highlighted the endeavour, activity and glory of CSIR. He emphasized on human resource development and importance of breaking artificial barriers among different disciplines of science.

Dr J. Gowrishankar, in his

Foundation Day Lecture discussed about "R-loops in Transcription".

Prof. Roy, Director, IICB, in his welcome address, briefly discussed the purpose of the celebration. He also mentioned the future programmes of CSIR and IICB to provide more benefits of science to the common people of India. Dr H. K. Majumdar, Scientist G, IICB in his introductory lecture discussed the history of CSIR, its vision,

structure and function and mentioned recent scientific developments and achievements of IICB, its past contributions and future programmes to develop the nation and to build stronger scientific base. The institute observed 'Open House' on the previous day, when a large number of students from different schools and colleges and their teachers visited the institute.

Regional Research Laboratory (RRL), Jorhat

At RRL, Jorhat, Prof. S K Joshi, former Director General of CSIR and presently the Vikram Sarabhai Professor at the JNCASR, delivered the Foundation Day Lecture on 'Nanoscience & Nanotechnology'. Prof. Joshi mentioned that nanoscience and nanotechnology is entirely a new concept and one of the most exciting branches of physical research. It started taking shape as subject of study and research in 1980 and has soon developed into a full-fledged discipline. He briefly described the advances in the area and its immense potential, e.g. in the development of powerful computers, mobile phones, appliances for medical research, drugs for treatment of complicated diseases, perfumeries, etc. He was hopeful that nanoscience will bring about a new revolution in the industrial sector for improving the quality of human life. Prof. Joshi profusely lauded the accomplishments of RRL-Jorhat.

Dr P. G. Rao, Director, RRL, Jorhat, in his speech accorded a warm welcome to the august gathering and spoke briefly about the genesis of CSIR and the contributions it has made over the years for the development of the country. In the meeting, retired

employees of RRL as well as those who had completed 25 years of service in CSIR were given mementoes in recognition to their contributions towards the growth and development of the institute. Meritorious students belonging to SC/ST category were given cash



Prof. S.K. Joshi delivering the CSIR Foundation Day Lecture at RRL-Jorhat

awards for scoring highest marks in science subjects in the last matriculation examinations held under various school boards. Prizes were also awarded to the winners of essay competition organized on the occasion. The day was observed as 'Open Day'.



CSIR Foundation Day Celebrations/Honours

Structural Engineering Research Centre (SERC), Chennai

The event was celebrated jointly by SERC and Regional Units of CECRI, CEERI, CSIO, NEERI and NML.

Open Day was observed in the morning when college students and faculty, students of higher secondary schools, entrepreneurs and general public, totalling nearly a thousand, visited the campus. Multifarious and multi-disciplinary R & D programmes and projects carried out for government, public and private sector industrial organizations / agencies, providing solutions to their current problems, were explained and demonstrated. A multimedia video documentary prepared by SERC, highlighting the principal R&D expertise, facilities and achievements of the Research Centre was projected.

In the afternoon, a special lecture was delivered by the Chief Guest, Shri R.K. Celly, Executive Director, Building Materials and Technology Promotion Council, New Delhi.

SERC Director, Dr N. Lakshmanan, in his brief welcome speech, emphasized the national need to identify, nurture and support the scientifically bent youth to take up careers in the core science and engineering disciplines.

Shri Celly, in his lecture, laid stress on the need for recycling of industrial wastes and innovative technologies for minimizing the energy demand. Citing the contemporary concern on the disaster-proneness of the Indian subcontinent, he advocated more focus on disaster prevention technologies. He also dwelt on the importance of taking up technology diffusion and technology transfer on a 'Mission Mode'. He welcomed efforts and ideas to bring about and strengthen 'Synergy' among CSIR - BMTPC - Industry. He also gave away the Dr M. Ramaiah Prize for the best technical paper and certificates of merit, to the scientists of SERC.

Later, Dr C.V. Vaidyanathan, Director-Grade Scientist and Advisor (Management), SERC, gave away prizes to the winners of various Science competitions conducted for the children. Director Dr Lakshmanan honoured the retirees and those who had completed 25 years' service in CSIR.

Dr G. Parthasarathy selected for MRSI Medal

DR G. Parthasarathy, Scientist F, Geological Studies Division, National Geophysical Research Institute, Hyderabad, has been selected by the Materials Research Society of India (MRSI) to receive the MRSI Medal for 2007. The medal will be presented to him during the Annual General Meeting of MRSI to be held at NPL, New Delhi, on 12-14 February 2007. Dr Parthasarathy is a Ph.D from Indian Institute of Science, Bangalore and has over 130 research papers in peer reviewed SCI journals to his credit. He has filed five international patents.



Dr S.S.C. Shenoi elected Fellow of IAS

Dr S.S.C. Shenoi, a Senior Scientist of the National Institute of Oceanography (NIO), Goa, has been elected a Fellow of the Indian Academy of Sciences, Bangalore. Dr Shenoi has contributed significantly to the understanding of physical oceanography of the waters around India during the last two decades. His work particularly stands out in the areas of study of processes internal to the ocean that influence Sea Surface Temperature (SST) and hence to coupling between the monsoon and the ocean, development and validation of SST retrieval algorithms using satellite data and description of the system of coastal circulation around India. He has 50 research publications in various journals to his credit.



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