



Custom designed and indigenously developed FCVA system for deposition of tetrahedral amorphous carbon films at NPL

A physical vapor deposition facility called the 'filtered cathodic vacuum arc' (FCVA) has been set up and a reactor for the same has been custom designed and indigenously developed at the National Physical Laboratory (NPL), New Delhi, under a Department of Science and Technology (DST) sponsored project.

The system consists of: (a) water cooled cathode and anode, (b) S bend magnetic filter on 6 inch duct to remove the macro particles and neutrals generated in the arc and (c) an 8 inch S.S. cross deposition chamber with a provision of biasing the substrate. The system has two turbo molecular pumps backed by two rotary pumps that enable to achieve a base pressure of $\sim 1 \times 10^{-6}$ m bar. One turbo molecular pump is connected to the deposition chamber and the other, near to the cathode-anode assembly. Three different DC power supplies energize the magnetic filters and a magnetic field of ~ 350 Gauss is achieved inside the duct. A mechanical striker that uses a DC arc supply of 0-30V and is capable of delivering 100 A current initiates the arc.



A view of the custom designed and indigenously developed S bend FCVA system at NPL





In this technique, a film is deposited by condensation of highly ionized plasma on any substrate, including low melting point plastic, at room temperature. Commercially viable coatings of TiN, ZrN and other tribological coating for cutting tools and decorative applications are normally deposited by this technique. The cathodic vacuum arc offers the unique opportunity of growing various forms of carbon, ranging from highly diamond-like to graphite-like and various intermediate materials like tetrahedral amorphous carbon (ta-C), hydrogen and nitrogen incorporated tetrahedral amorphous carbon (ta-C:H and ta-C:N), nanoclustered carbon, nanocomposite and carbon nano tubes.

The system developed has been used so far to grow (i) ta-C films, (ii) hydrogen and nitrogen incorporated ta-C films and (iii) boron and phosphorous incorporated ta-C films.

The above work has been carried out by Dr O.S. Panwar, Scientist F and Mohd. Alim Khan, SRF-CSIR. The latter has submitted the work for his Ph.D. thesis. Dr P. N. Dixit, Dr R. Bhattacharyya and Dr B. S. Satyanarayana also contributed.

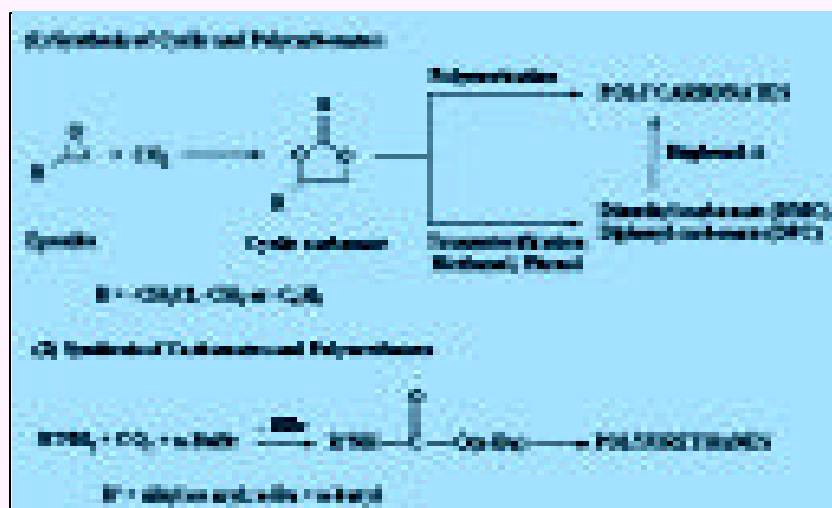
CO₂ as novel, cheaper and eco-friendly, raw material for manufacture of chemicals

POLYCARBONATES and polyurethanes (two important classes of engineering plastics and polymers) are conventionally manufactured using toxic chemicals like phosgene (COCl₂) and carbon monoxide (CO). Apart from the toxicity of the raw materials used, the conventional manufacturing processes generate significant amounts of inorganic waste by-products, disposal of which is an issue of great environmental concern. Their synthesis utilizing a 'greenhouse gas', carbon dioxide (CO₂), is an eco-friendly, greener approach. BASF, Ashahi Keisai Corp. (Taiwan) and a few other companies have, in the recent past, put the CO₂-based approach into commercial practice for the synthesis of cyclic carbonate precursors of polycarbonates. In this novel process, an epoxide (ethylene oxide, for example) is reacted with CO₂ over a catalyst producing selectively cyclic carbonates (Scheme 1). The latter can be polymerized by known methods into biodegradable, aliphatic polycarbonates or alternatively,

transesterified with methanol producing dimethyl carbonate (DMC) and valuable co-generated product monoethylene glycol (MEG). DMC is an important raw material in the manufacture of aromatic bis-phenol polycarbonates (BPC) (Scheme 1).

Most of the known catalysts for this reaction are homogeneous and require high temperatures/pressures (30 – 80 bar, for example) for high product yields. In some cases, a co-catalyst/promoter and solvent are also essential for high carbonate selectivity. Recently, Rajendra Srivastava, D. Srinivas and Paul Ratnasamy of National Chemical Laboratory (NCL), Pune, in their research paper, published in *Journal of Catalysis*, **233**, (1) 1–15 (2005) have discovered a highly, efficient, solid, bi-functional catalyst, adenine modified mesoporous Ti-SBA-15, for the synthesis of cyclic carbonates from epoxides and CO₂ at mild conditions (120°C, 6.9 bar, 4 – 6 h reaction time). The catalyst is reusable in recycling experiments with little loss in activity/selectivity. By using this solid

catalyst, a variety of cyclic carbonates could be synthesized with no additional solvents and co-catalysts/promoters. This solid catalyst is highly active also for the synthe-



Scheme 1: Chemicals Synthesis Utilizing CO₂ as Raw Material Instead of Phosgene



sis of alkyl/aryl carbamate precursors of polyurethanes. The carbamates are synthesized at 80°C and 3.4 bar pressure by reacting alkyl/aryl amines, CO₂ and n-butyl bromide (Scheme 1). Yields of the products are greater than 90%.

It is an interesting feature that in the synthesis of both carbonates and carbamates, CO₂ is used as raw material replacement for toxic phosgene. Replacement of homogeneous catalyst by solid, reusable, heterogeneous catalyst leads to an economic advantage, avoiding catalyst separation and purification operations in the manufacturing process. Srivastava *et al.*, disclosed that the novelty of the catalyst is its bi-functionality that is introduced by basic adenine and Lewis acidic Ti sites. Detailed physico-chemical characterization studies revealed that while the Ti ions increase catalytic activity by enhancing the adsorption of the epoxides or alkyl/aryl amine substrates, basic nitrogen groups of adenine facilitate activation of CO₂ molecules. Co-existence of basic adenine and Lewis acidic Ti sites in the catalyst system facilitates higher surface concentrations of activated reactant molecules and synergic enhancement in catalytic activity for carbonates and carbamates synthesis. In the context of increasing levels of CO₂ in the atmosphere and the Kyoto protocol, this method of polymers synthesis utilizing CO₂ and solid, reusable catalysts is an environment-friendly, greener approach.

Studies Relating to Silicon CMOS Device Design and Optimization

Shanti Swarup Bhatnagar Prize-winner

Dr Valipe Ramgopal Rao's work

DR Valipe Ramgopal Rao, Professor, at the Indian Institute of Technology, Mumbai, has been awarded, along with Dr Kalyanmoy Deb of the Indian Institute of Technology, Kanpur, the



Shanti Swarup Bhatnagar Prize in Engineering Sciences for the year 2005 for his research contributions to the area of silicon CMOS device design and optimization, using single halo (SH) or lateral asymmetric channel (LAC) technologies, and their impact on analog/RF circuits [CSIR News 55 (2005), 342]

For the past few decades, CMOS technologies have been aggressively scaled to increase the performance of microprocessors and improve the memory density. However, modern ICs such as those used in wireless communication products require the integration of analog as well as digital circuits on the same chip. A typical system-on-chip (SoC) therefore consists of memory, logic, signal conditioning and signal processing circuits on the same die. Since the performance requirements of devices for all these circuits are different, and in some cases even conflicting, the implementation of SoC becomes quite challenging in CMOS technologies. Also, CMOS technologies optimized for digital

applications are not always suitable for analog applications. For digital circuits, the scaling of the device is motivated mainly by the performance improvement (for example, I_D varies in proportion with $1/L$

according to long channel theory). This scaled device however shows a reduced output resistance (R_{out} varies in proportion with L^2) thus leading to a degradation in voltage gain, which is an important parameter for analog applications. Further, substrate coupling influences the performance of analog circuits, if they are integrated on the same chip along with high-speed digital circuits. Typically analog circuit design is a trade-off between performance, speed, noise, linearity, signal swings and many others. Implementation of analog circuits in deep sub-micron technologies further complicates this trade-off due to various scaling induced second order effects. All these issues necessitated the researchers to look for alternative device designs to improve the analog performance of conventionally scaled CMOS devices. Further, as the CMOS devices are scaled, novel materials need to be integrated which necessitates understanding and optimization of the device behavior with these new materials.



Prof. V. Ramgopal Rao has made significant contributions to the area of Silicon CMOS devices and device optimization for the mixed signal CMOS device design. Through a series of publications in leading IEEE journals, his group has demonstrated the effect of fringing fields in high-K dielectric MOSFETs, and its impact on the device/circuit performance. For the first time, a semi-analytical model has been proposed which takes into account the fringing fields in analyzing the circuit performance. His work has provided a good understanding for the design of high performance devices for the sub 45 nm node CMOS technologies, where high-K gate dielectrics are expected to be integrated. Prof. Rao's contributions for device design and optimization for system on chip (SoC) applications have been very well recognized and appreciated by the peers. His work has shown the advantages of single halo (SH or lateral asymmetric channel - LAC) technologies and their impact on the analog/RF circuit performance. The proposed technology is helpful in achieving improved performance from SoC designs, without increasing the chip cost and the complexity. His contributions brought out succinctly the device optimization issues with single halo technologies and quantified the performance improvements in terms of chip area, frequency of operation, and the amplifier gain in comparison with the existing technologies. Some of his specific contributions to the mixed signal technologies are: understanding the velocity overshoot effects and their optimization in single halo technologies, reliability characterization

and improvement in mixed signal applications, suppression of parasitic bipolar effects in SOI technologies by channel engineering, novel interface characterization techniques, suppression of short channel effects and reduction in parasitic capacitances in scaled technologies with channel engineering understanding the implications of negative-bias-temperature-instability mechanisms in mixed signal designs, etc. His work during the last few years has established a methodology for study of novel technologies and their impact on the circuit performance. This technology-circuit interaction is a unique characteristic of some of his papers, which has been very well recognized.

Some of his more recent research interests span multiple disciplines and his group is actively involved in micro-fabricated bio-sensors for cardiac applications and molecular electronics. For example, he is leading an effort at IIT-Bombay for the development of an integrated system to provide point-of-care diagnostic support for cardiovascular diseases. The system under development monitors the molecular markers to detect cardiac attacks, especially incipient cardiac attacks that go undetected before major/fatal attacks occur. The system comprises 'infarcSens' or 'iSens', which is a cantilever and molecular FET based affinity biosensor array for sensing myocardial infarction and subsequent cardiac status prognosis, using a suite of molecular markers. The sensing electronics and the associated data management software for tracking the markers with time required for

creating an epidemiological database, is also currently being developed. A multidisciplinary team at IIT-Bombay from the departments of Electrical, Bioengineering, Chemistry, Material Science and Mechanical Engineering is currently involved in this project.

Prof. V. Ramgopal Rao obtained his M.Tech from IIT-Bombay in 1991 and Dr Ingenieur degree from the Faculty of Electrical Engineering, Universitaet der Bundeswehr Munich, Germany in 1997. During 1997-98 and again in 2001, he was a visiting scholar with the EE Department, University of California, Los Angeles. He is currently a Professor in the Department of Electrical Engineering and Head, Centre for Research in Nanotechnology & Science, IIT-Bombay.

Prof. Rao's areas of interest include Physics, Technology and Characterization of Silicon CMOS devices for logic and mixed-signal applications, Bio-MEMS, and Nanoelectronics. He has over 150 publications in these areas in refereed international journals and conference proceedings and holds two patents. He is the chief investigator for several ongoing sponsored projects funded by various multinational industries and government agencies including the Nanoelectronics centre project at IIT-Bombay.

Prof. Rao is an Editor for the IEEE Transactions on Electron Devices in the CMOS Devices and Technology area and is a Distinguished Lecturer (DL), IEEE Electron Devices Society. He is a Fellow of the Indian National Academy

of Engineering (INAE) and a Fellow, IETE. Dr Rao received the Swarnajayanti Fellowship award for 2003-2004, instituted by the Department of Science and Technology, Government of India. He is also a working group member setup by the Government of India, on Nanotechnology. He was the organizing committee chair for the 17th International Conference on VLSI Design, and was Chairman, IEEE AP/ED Bombay Chapter during 2002-2003. He is currently a member of the executive committee, IEEE Bombay Section. He serves on the organizing committees of many international conferences in India and abroad.

National Seminar on Crop Disease Management at RRL, Jorhat

THE Regional Research Laboratory (RRL), Jorhat, organized a two-day national seminar on 'Current Trends in Crop Disease Management for Improving Productivity, under the aegis of Eastern Zonal Chapter of Indian Phytopathological Society (IPS), New Delhi. The inaugural function of the event was attended by Prof. G. D. Sharma, Vice Chancellor, Nagaland University, Kohima, as the Chief Guest. Notable among others who participated in the function are: Dr P. G. Rao, Director, RRL, Jorhat and Chairman, Organisation Committee; Dr Y. P. Sharma, ICAR, Barapani, Meghalaya; Dr K. P. Singh, G B Pant University of Agriculture and Technology, Hill Campus, Panichauri, Uttaranchal; Dr D. K. Jha, Gauhati University; and Prof. U. Chakravarti of North Bengal University. More than 200 delegates and experts from all over the country participated in the event besides the scientific community of RRL.

Dr P. G. Rao, in his address thanked IPS for selecting RRL as the venue for holding this seminar of great national importance. He mentioned that NE crops have peculiar phytopathological problems which only expert handling can deal effectively to contain the situation. He sincerely hoped that the deliberations of the seminar would be fruitful.

Earlier, Dr Paran Baruah, President of IPS, Eastern Zone & Convenor of the seminar, briefly spoke about the activities and objectives of the IPS and pointed out that the seminar bore a special significance as it coincided with the centenary celebration year of the Indian Phytopathology which had just dawned in the country. He mentioned that in view of the country's population explosion, the crop productivity has not been

able to keep pace with ever increasing demand. Farmers use chemicals and pesticides to combat the diseases and pests, which often lead to deterioration of soil fertility and thereby reduction in the crop productivity. The seminar had been designed to throw insights into the various bottlenecks for increasing the crop productivity, he added.

Delivering the speech as the Chief Guest, Prof G. D. Sharma touched upon the various aspects of crop disease management and stressed that the disease management should be necessarily integrated with the total crop management. He congratulated RRL for taking the lead to organize such an important seminar.

Prof. Sharma said that the country is in need of a second green revolution. The first green revolution made the country self sufficient in food production, raising its total output from 50 million tonnes to over 200 million tonnes over the years and making the country a major exporter of food in the world. But despite this fact, the agricultural growth has remained almost stagnant during the last few years. Therefore, in order to ensure sustainability, a second green revolution is a must for India, particularly in the area of Horticultural crops. Concerted efforts are needed for evolving crops tolerant to flood, drought, heat and cold. Aspects such as nutrition, fibre, etc. are to be accorded due importance. Energy has been a major requirement for human health. Explaining how to achieve all these, he mentioned that the commercial crop management must be sufficient for which the technological evolution provides a major opportunity for the agricultural scientists. It can help in transplantation of genes to produce disease-resistant varieties. Varieties of



mutations occur in wild plants. The scientists can integrate those in crop plants for producing new crops varieties, he opined.

The Chief Guest also released a souvenir brought out on the occasion.

The seminar was mainly divided into two technical sessions in which a total of 31 papers were presented. Besides the technical sessions, two other sessions were also held: i.e. one poster session in which 15 papers were presented on different subjects from all over the country and another Prof. M. J. Narasimhan Merit Academic Award session for the authors below the age of 35 years for encouraging research, in which a total of 4 papers were presented. An exhibition was also organized for the viewers and participants in which five different organizations displayed their products.

At the valedictory function, Dr M. Hazarika, Director, Tea Research Association, Tocklai and Prof. A. K. Pathak, Director of Research, AAU, Jorhat, were respectively the Chief Guest and the Guest of Honour. The meeting was presided over by Dr D. C. Goswami, Director Grade Scientist, RRL, Jorhat. In the meeting the winners of the various competitions were awarded and the certificates of appreciation were presented to the participants. In a gesture quite befitting to the occasion, the meeting felicitated two of the renown phytopathologists of the region, namely Dr D.N. Bordoloi, former scientist of RRL and Prof. A. K. Roy, former Head, Department of Plant Pathology, AAU, Jorhat, for their exceptional contributions to the field.

Seminar on Innovative Technologies for Rural Development



'All India Seminar on Innovative Technologies for Rural Development' in progress

A two-day All India Seminar on Innovative Technologies for Rural Development was organized jointly by the Institution of Engineers (India), M.P. State Centre and the Regional Research Laboratory (RRL), Bhopal, in the recent past. The seminar was inaugurated by Smt. I.M. Chahal, IAS, Principal Secretary, Department of Rural Industries, Government of M.P. Dr S.C. Soni, Director, University Institute of Technology, Barkatullah University, Bhopal, presided over the function. The technical deliberations took place during technical sessions on Use of Innovative Technologies for Rural Development, Watershed Development and Management Technology, Initiatives for Rural Development and Innovations in Rural Technology Development. The discussions during the seminar were centered around creating awareness about the importance of rural technologies for nation building and for improving the socio-economic condition of the rural masses. The seminar was attended by more than one hundred delegates drawn from a gamut of academic institutions, R&D organizations, defence establishments, universities and private and government organizations and industries engaged in providing developmental initiatives to the Indian rural scenario. The deliberations and discussions of the Technical sessions were followed by Panel Discussions. Dr G. Singh, Vice Chancellor, Mahatma Gandhi Chitrakoot, Gramodaya Vishwavidyalaya, Chitrakoot, was the Chief Guest at the valedictory function.

National Symposium and Training Course on Coordinate Metrology

THE National Physical Laboratory (NPL), New Delhi, organized, in the recent past, a national symposium and training course in collaboration with Metrology Society of India, on Coordinate Metrology.

Coordinate Metrology is a very specialized area in Dimension and Form Measurement. A coordinate measuring machine (CMM) is a versatile tool with multitasking capabilities. CMMs are used in various sectors right from defense, medicine, automotive and mechanical manufacturing. The field is developing fast and more versatile and specialized CMMs are coming up with contact probes, optical probes, video imaging and combination of these. Optical and nano CMMs have been also developed and are in use at some places.

The symposium emphasized the importance of SI units, trace-



Dr K. P. Chaudhary, Scientist F, demonstrating measurements on CMM to the participants

ability fundamental constants, and precision measurements and provided a glimpse of pioneering work in the field of precision measurement for materials and crystal structure.

The symposium brought experts, academicians, industry and users at a common platform to discuss the available technology, future trends and applications in the field of coordinate metrology. The symposium had seven invited talks followed

by 18 technical papers by various experts. The practical training course was aimed at creating awareness about working principles, calibration procedures and measurements with CMM, factors affecting uncertainty in measurements and evaluation of uncertainty. Various Industrial units exhibited their latest products related to metrology on the occasion.



Participants of the National Symposium and Training Course on Coordinate Metrology



International Workshop on Emerging Areas of Fibre Optics and Future Applications

A three-day International Workshop on 'Emerging Areas of Fibre Optics and Future Applications (IWOP-2005)' was held at the Central Glass & Ceramic Research Institute (CGCRI), Kolkata, recently. This was for the first time that such a high profile international workshop in the area of photonics was held in India. It covered some of the frontline topics in the advanced area of optical communication. Some of the leading experts from abroad while discussing the future advancement in the areas presented a detailed analyses of the respective topics with basic understanding of fibre optics.

The speakers included Professor David Payne, FRS, Director, Optoelectronic Research Centre, Southampton University, UK; Professor Phillip Russell, FRS, Director, Max Planck Research Group for Optics, University of Erlangen-Nuremberg, Germany; Professor John Canning, Optical Fiber Technology Centre (OFTC), University of Sydney, Australia; Professor Ajoy Ghatak, Emeritus Professor, IIT-Delhi; Professor Karsten Rottwitt, Technical University, Denmark; Dr Atul Srivastava, Bookham Inc., USA; Dr Marc



Prof. David Payne, FRS, Director, Optoelectronic Research Centre, Southampton University, UK, delivering his talk in a tutorial session

Besserer, EXFO, Singapore; and Professor Raman Kashyap, Professor, Departments of Engineering Physics and Electronic Engineering at Ecole Polytechnique de Montreal, Canada. The workshop was aimed at promoting research-industry interaction, and to facilitate the industries and researchers acquaint themselves with the latest developments in fibre optics.

Shri Bhagwan D. Khurana, Group President, Global Fiber Optics Network, Reliance Infocom Ltd, Mumbai, inaugurated the workshop. In his inaugural address, Shri Khurana gave a lucid presentation on the present S&T scenario on ap-

plications of optical fiber based devices in telecommunication network and the future possibilities of R&D and its applications. He elaborated the present status of Indian Telecom Network and particularly emphasized the need for strong R & D base in India to meet the future challenges in this fast changing technological front.

Earlier, Dr H. S. Maiti, Director, CGCRI, welcomed the faculty members of the workshop, the participants, and the invited guests, and explained the various programmes related to fibre optics where CGCRI



Prof. Phillip Russell, FRS, Director, Max Planck Research Group for Optics, University of Erlangen-Nuremberg, Germany, delivering a talk in a tutorial session



had made a considerable impact in the country. Prof. Ajoy Ghatak in his deliberations mentioned the need of such a workshop and advocated for more of such international meets in India to make progress in the emerging areas of photonics.

In his presentation Prof. David Payne, FRS, first highlighted the operation of high power cladding-pumped fiber laser, pulsed 1550 nm EYDF and erbium doped holey fiber amplifier and then explained the functioning of 10 kW fibre laser for various industrial applications. Incidentally, Prof. Payne is the inventor of the optical fiber amplifier.

Prof. Phillip Russell, FRS, inventor of Photonic Crystal Fiber, explained in detail the principle of photonic band-gap and photonic crystal fibers and their future applications. Other speakers dwelt on various aspects of the theme of workshop and interacted actively with the participants.

An exhibition arranged during the programme attracted some of the leading industries from India as well as abroad who displayed their products. Their representatives interacted with the participants during the business session. The exhibition was inaugurated by Prof. David Payne.

The novelty of the workshop was that instead of

presenting technical papers within a limited time, a time of three hours was allotted for each lecture so that the speakers could include detailed discourses. This benefited particularly the young and budding researchers attending the workshop. The workshop attracted 100 delegates. Among the participants 12 were from the overseas.

The Indian participants were mostly from Indian Institute of Technology (IIT)-Delhi, IIT-Madras, IIT-Bombay, IIT-Kharagpur, IIT-Roorkee, Indian Institute of Science (IISc)-Bangalore, Laboratories under Defence Research Development Organization (DRDO), Indian Space Research Organization (ISRO), Department of Atomic Energy (DAE), Department of Information Technology (DIT) and the various universities. Thirty participants were from industries such as Sterlite Optical Technology, Bharat Sanchar Nigam Limited (BSNL), and Videsh Sanchar Nigam Limited (VSNL).

The workshop was symptomatic of the progress that CGCRI has made on optical fiber based research and technology as the nodal laboratory in the task force for photonics and optoelectronics in CSIR's Network Programme under the Tenth Five Year Plan of Government of India.

NPL Short-term Course on Radio Meteorology and Radio Wave Propagation Over Sea

THE National Physical Laboratory (NPL), New Delhi, organized a short-term second course for the Indian Naval Officers on the topic 'Radio Meteorology and Radio Wave Propagation Over Sea' on the request from Directorate of Naval Oceanology and Meteorology (DNOM), in the recent past. Fourteen senior naval officers attended the course. The participants were mostly meteorologists and communication engineers.

The course focused on the refractive structure of the lower atmosphere up to one km or so over the sea-surface, with special emphasis on Evaporation Ducts. These ducts are formed due to the sharp gradient in the refractive index above the sea-surface. These ducts trap microwaves and affect the performance of a radar system. Consequently, they assume considerable strategic importance. NPL has carried out a one-year project on 'Evaporation Ducts' for the Indian Navy.

The lectures were delivered by NPL scientists, experts from National Institute of Ocean Technology, Chennai and India Meteorological Department, New Delhi. Computer-based tutorials on topics related to data buoy, radar and satellite meteorology were used for demonstration.

National Science Day Celebrations at CSIR Laboratories/Institutes

THE National Science Day (NSD) is celebrated at the various CSIR laboratories and institutes every year to commemorate the anniversary of the discovery of 'Raman Effect' by Sir C.V. Raman, Nobel Laureate.

Highlights of celebrations at NAL, NCL, NEERI and RRL-Jorhat, this year:

National Aerospace Laboratories (NAL), Bangalore

NAL organized, a lecture by Professor Raghavendra Gadagkar on 'Units of Darwinian Natural Selection — When should players sacrifice themselves for the sake of the team?'

The talk started with a homage to Darwin. Prof. Gadagkar then moved on to conflicts in the animal kingdom: why do they fight out there, and why do they stop fighting? What was the survival value of fighting? "They used Darwin to explain everything. In many cases something attributed to Darwin wasn't what Darwin said; it was

what people thought he said," Gadagkar suggested that biologists like Konrad Lorenz and Vero C Wynne-Edwards got their Darwin completely wrong. "They both made the same errors, but Wynne-Edwards at least made these errors very precisely!". In Prof. Gadagkar's view, errors could persist in biology for a hundred years (1859-1959) because the language that biologists employed was "extraordinarily vague". It was only after the 1960's that one realised that Darwin's original theories required modifications or extensions. We needed new theories, for example,

to understand when and why were species altruistic or selfish. He talked about his experiments at IISc for two decades, involving the social behaviour of wasps, based on what Hamilton wrote in 1964.

Dr A. R. Upadhyya, Director, NAL, thanked Prof Gadagkar for his delightfully precise lecture and for shattering the myth that "nature is not always right". He also talked of how the National Science Day is an occasion to restore scientific temper. Dr M. R. Nayak welcomed the gathering and Dr M. N. Sathyanarayana proposed the vote of thanks.

National Chemical Laboratory (NCL), Pune

NCL organized a two-day event to celebrate the National Science Day. The event started with the exhibition of posters wherein about one hundred forty posters from the areas of biochemical sciences, catalysis, chemical engineering science, organic chemistry, physical and materials chemistry and polymer science and engineering were displayed by NCL research students.

Prof. Partha Majumder, Head, Anthropology and Human Genetics Unit, Indian Statistical Institute,



Dr Sivaram giving introductory remarks

Kolkata, delivered the Science Day Lecture on "Where do we come from? A statistical – genetic traceback".

Dr S. Sivaram, Director, NCL, in his introductory remarks said that the science is extremely broad and borderless, and although it focused at times on very narrow disciplines, a scientist must expand his horizons and thinking to understand, and be aware of developments in other fields of science. Today, if you are interested in



Prof. Partha Majumder delivering Science Day Lecture

diseases or pharmaceutical chemistry or interactions of organic molecules with biological systems, understanding of human genetics is crucial.

Prof. Majumder said that the question he wished to discuss “Where do we come from? A statistical – genetic traceback”, has been addressed by different people from different walks of life — people who are religious leaders, anthropologists and paleobotanists, and so on. He indicated that the latest tool to look for an answer to this question “Where do we come from” is molecular genetics, which has the advantage of its theoretical foundation in terms of population genetics. He mentioned that India has made major contributions to the foundations of molecular genetics through “Kosambi Map Function”, the work of Prof. D.D. Kosambi. Referring to the subtitle of his talk, ‘a statistical genetic traceback’, Prof. Majumder elaborated, “we look at present day populations and go on to look backwards in time, and hence, the term,

‘traceback’. We use data from molecular genetics and apply statistical approaches to infer, and thus the phrase, statistical genetics.”

About eight million years ago, a group of African apes split into two distinct species: one leading to gorillas and chimpanzees, and the other leading to modern humans, called the *hominid* line. Prof. Majumder said that we, of course are *Homo sapiens*, and spoke primarily on *Homo sapiens sapiens*, a sub-species of *Homo sapiens*. So the genus *Homo* evolved about two million years ago and they were *bipedal*. At least one of these *Homo* groups — evolved from the *Australopithecus* — spread out from Africa to Asia and India. Hence, most of the development of this kind of *Australopithecus* took place in Africa and humankind also arose in Africa. He also said that there are fossil evidences to support this view. We find *Homo erectus* species in Indonesia dated about one million years ago, much earlier than the Neanderthal man in Europe, etc. This way different species of the genus *Homo* moved out of Africa to populate other regions of the world. Anatomically, modern humans evolved in Africa about a hundred and thirty thousand years ago.

Prof. Majumder said that we are a relatively new species on the time-scale evolution. Most of the genetic variations observed so far, are primarily found “*within*” groups as opposed to “*between*” groups. If you look at the entire genetic variation across the groups,

one finds that 85% of the variation is “*within*” the groups, and the remaining 15%, “*between*” groups. He concluded his talk with an apt quote from the Maya Angelou’s book, “Would not take nothing for my journey now”:

“It is time for the preachers, the rabbis, the priests and pundits, and the professors to believe in the awesome wonder of diversity so that they can teach those who follow them. It is time for parents to teach young people early on that in diversity there is beauty and there is strength. We all should know that diversity makes for a rich tapestry, and we must understand that all the threads of the tapestry are equal in value no matter their color; equal in importance no matter their texture.”

In the morning session, there were lectures by Dr V.R. Pedireddi, Scientist, Organic Chemistry Synthesis Division, and by research students. In the Award presentation ceremony, Prof. Majumder presented the NCL Research Foundation Scientist award of the Year to Dr V.R. Pedireddi; Kirti Sangoram Memorial Award for the Best Research Scholars in Physical & Materials Science, Chemical Sci



Dr Pedireddi giving Scientist of the Year award lecture



ences, and Biological Sciences; Dr Rajappa Prizes for the best research paper and the best poster awards

(among research scholars) in organic chemistry. Dr Sourav Pal, Chairman, Students Academic

Committee, and Head, Physical and Materials Chemistry Division proposed the vote of thanks.

National Environmental Engineering Research Institute (NEERI), Nagpur

Prof. S. S. Gokhale, Director, Visvesvaraya National Institute of Technology (VNIT), Nagpur, was the Chief Guest on the occasion. Dr J. Mukhopadhyay, Director, Jawaharlal Nehru Aluminium Research Development and Design Centre, Nagpur, presided as the Guest of Honour.

While addressing the audience, Prof. S. S.

Gokhale expressed concern over space pollution. He briefed about the phenomenon of space pollution, technologies counteracting the space pollution and air traffic management. Prof. Gokhale said that the space has become crowded owing to unlimited launches of remote sensing satellites, communication satellites, weather satellites, increasing air traffic and various space missions. This situation has created the space pollution posing impacts on our environment. He emphasized on the need for setting up an effective action plan for various launches so as to minimize the space pollution. He urged the scientists to advance science and technology to combat the space pollution. In this context, he suggested to develop spacecraft that use hydrogen as the fuel, which would be effective in reducing the space pollution. The exhaust gases released by present



Dr S. Devotta, Director, NEERI, delivering the welcome address. Seated on dais (from left) are: Dr S.P. Pande; Dr J. Mukhopadhyay; Dr S.S. Gokhale and Dr J.S. Pande

day spacecraft may cause hazards to the earth; even leading to acid rain, after reacting with water vapour. This kind of pollution has not been frequently noticed in our country, since there have been very few launches and take-offs here as compared to the developed countries, he added. To save the ozone layer, Prof. Gokhale laid stress on the development of such eco-friendly combustion devices for spacecraft as is done in automobiles to reduce the pollution level. He further said that the particulate matter present in the exhausts of spacecrafts can interact with the passage of sunlight and promote cloud formation. To resolve this problem, scientists are making efforts to develop eco-friendly propellents that will be able to reduce the particulate matter in the exhausts of spacecraft, he said. Prof. Gokhale advocated that noise pollution related to the space activi-

ties should also be minimized by using appropriate technologies in the spacecraft. He pointed out that certain ecological indicators, e.g. population, flora and fauna should be taken into consideration while launching the space missions. It should be ensured that the space mission gets capsized in the sea in case of an accident, Prof. Gokhale

added.

Dr J. Mukhopadhyay spoke on the importance of aluminium and briefed about its eco-friendly properties. He compared India with the other developing countries in terms of aluminium production and pointed out that our country is lagging behind in per capita consumption of aluminium. In our country a large quantity of aluminium is being used in the land transportation area, particularly in railways and automobiles due to its significant properties – fuel economy, safety and environment-friendliness. He emphasized on the need to reuse and recycle aluminium to the maximum extent as this process in the developed countries is producing 70% of the aluminium. He urged that all automobile manufacturers in our country should adopt the process of reuse and recycling of aluminium.



He cautioned that after 15 years there will be increase in CO₂ emissions by 35% due to automobiles. This can be reduced by the maximum use of aluminium in automobile industry.

Earlier, Dr Sukumar Devotta, Director, NEERI, in his welcome address briefed about the Millennium Development Goals and how NEERI can achieve these goals in the coming years. Elaborating the Millennium Development Goal No.

7, which is related to environmental sustainability, Dr Devotta said that the serious issues before India and NEERI are degradation of land and forest cover. Dr Devotta expressed concern over the climate change, which need counteraction according to the Millennium Development Goal. In the Indian perspective, he drew attention towards safe drinking water and basic sanitation. He said that appropriate efforts should be made to ensure safe drinking water and basic sanitation to the

people by 2020. He informed that this year the institute has been granted two International patents, published more than 65 research papers in SCI journals and earned more than 10.5 crores.

Dr S. P. Pande, Scientist & Head, Research & Development Planning Unit, introduced the dignitaries and Dr J. S. Pande, Science Secretary proposed the vote of thanks. The programme was compered by Dr (Smt) Atya Kapley.

Natinoal Geophysical Research Institute (NGRI), Hyderabad

At NGRI, Dr D.K. Pande, Director (Exploration), ONGC Ltd, New Delhi, delivered the National Science Day lecture on 'Scientific innovativeness —A step towards energy security of the country'.

In his lecture, Dr Pande spoke about the various options, like gas hydrates, nuclear, CBM, bio-diesel, available in the energy sector for meeting the future energy needs of the country. He dwelt on these supplementary sources at length.

He expressed his anguish on the present energy scenario as discoveries are declining and demand is outpacing the reserves growth. The domestic production of oil is only 27% and at current rate of produc-



Dr V.P. Dimri, Director, NGRI presenting a memento to Dr D.K. Pande

tion, the oil reserves will last for just 55 years.

He described that the gas hydrate exploration is "real game for us today", pointing out that a fraction of this resource can supply

energy for 100 years. But the technologies for exploitation of this vast resource are still at R&D stage.

He referred India as "Soudi for thorium" since India has good reserves of thorium hence depending on nuclear energy would be a more useful option in future. He informed that the ONGC was planning to start CBM production by March 2007 from Jharia area. He emphasized the need for "strategy partnership" between R&D organizations like NGRI and oil companies and

they "should work hand in hand" in this challenging field.

Earlier, Dr V. P. Dimri, Director, NGRI, introduced the Chief Guest. Dr S.N. Prasad, Scientist, proposed a vote of thanks.



Regional Research Laboratory(RRL), Jorhat

At RRL-Jorhat, Prof Subhas Chandra Saha, Vice Chancellor of the Assam Central University, Silchar, was the Chief Guest while Dr P. G. Rao, Director, RRL-Jorhat presided over the function held on National Science Day. The function was graced by invited guests, eminent scientists, entrepreneurs, media persons, students and teachers besides the scientific brethren of RRL both, old and new. Dr B. K. Gogoi, Scientist 'F' and Co-ordinator of the celebration committee, welcomed the audience.

Delivering a talk on a very thought provoking topic 'Science, Technology & Society – A North Eastern Perspective', the Chief Guest Prof. Saha said that although he is not a man of science, he tries to view the entire scenario of the problems and science and technology of the region from an entirely different angle. Unlike rest of the country, the North Eastern region has a very peculiar problem and the science and technology of the region as a subject requires 100% attention of all concerned. He said that NE and its people are all the time struggling to survive. The

society in the context of NE has all the time protect and defend itself from being exposed to the nature – the nature appears here to be in all its crudest form and there is no other choice than to surrender to the mercy of nature. The region has quite a good number of reputed scientific institutions, centers of excellence and universities, etc. wherein lots of very vital and valuable work has been carried out for solving the problems of the society. But the benefits of these S&T pursuits have hardly been applied for finding solutions to these problems. Communication gap, transportation and management are such other problems which have badly affected the region. In other words, the fruits of science and technology have still not been available to the people of the region. Today the situation is



Sitting on dais during NSD Celebration at RRL-Jorhat (from left) are: Prof. S.C. Saha, Vice Chancellor of the Assam Central University, and Dr P. G. Rao, Director, RRL-Jorhat

the man on the street plays total ignorance not only about the works, but also about such institutions. To reverse this situation a massive science literacy campaigning needs to be undertaken by all, primarily to make children curious about science so that they can make a career in science. For this, connectivity amongst the people is required which too can be achieved with the help of science only, he opined. He particularly emphasized on the need for tapping the young people for such scientific pursuits.

Dr P.G. Rao, Director, RRL, Jorhat, in his Presidential remark briefly mentioned about the purpose behind the celebration and spoke about the role played by RRL for the industrial, economic, societal and human resource development of the region. The meeting ended with a vote of thanks by Dr B.G. Unni, a senior scientist of the laboratory. The day was declared as 'Open Day' for enabling the school students, teachers and other public to visit the laboratory.



A scientist briefing the student visitors during open day on the occasion of NSD celebration at RRL-Jorhat

such that people of Assam University hardly know what is going on in RRL and vice versa. So much of important scientific works are being done in the scientific institutions of the region, yet



International Conference 'Ad Met-06' Asia Pacific Metrology Programme (APMP) 2006

THE National Physical Laboratory, India (NPLI) (www.nplindia.org) and Metrology Society of India (MSI) (www.metrologyindia.org) have been organizing the International Conference on Advances in Metrology (Ad Met) once every two years. The first such conference was organized in 1996, and the 5th was held in 2005. The next conference is scheduled in 2007. NPLI is organizing the 22nd Asia Pacific Metrology Programme (APMP) 2006 General Assembly and Related Meetings from 11-16 December 2006 for the first time in India at India Habitat Centre, New Delhi. NPLI will also celebrate 60 years of its establishment in 2006-07. This year NPLI with MSI have decided to organize the AdMet-06 preceding 22nd APMP General Assembly so that the metrologists, young researchers and experts from APMP member countries and other NMI's in the world can present their work, interact with each other for the advancement of knowledge and exchange of information related to Science of Metrology.

APMP is primarily responsible for developing international recognition of the measurement capabilities of the region's national and territorial measurement laboratories. APMP has been operating in the Asia-Pacific region since its inception as a Commonwealth Science Council initiative in 1977. It is the oldest continually operating metrological grouping in the world.

AdMet-06 will consist of four parallel sessions covering various aspects of Metrology:

(A) Physical, Electrical, Environmental and Other Issues:

- Latest trends in measurement standards, instruments and techniques
- Physical, electrical, clinical and environmental issues
- Nano metrology
- Development of sensors and actuators and

- their application to metrology
- Metrology for precision measurement, inspection and quality control in manufacturing sectors
- Social role of measurement and emerging areas of measurement science
- Regional cooperation in metrology and mutual recognition of all measurements
- Biomedical measurement to improve quality of life
- Benefits of MRA to Economy and Society

(B) Pressure and Vacuum:

- Instrumentation and techniques employed in pressure and vacuum metrology
- Scientific advancement of pressure and vacuum metrology
- Regional and supplementary key comparisons
- Traceability, dissemination, accreditation issues and BIPM MRA
- Presentation of country report
- Applications of pressure and vacuum metrology and interaction with industry

(C) Time and Frequency - ATF-2006:

- Presentation of reports of NMI's
- Advances in atomic standards
- Time scale
- Time transfer

(D) Chemical:

- Traceability in chemical measurements
- Recent scientific/technical advancements to realize the SI unit 'mole'
- Certified Reference Materials
- Regional and national inter-comparison program

For further details please visit www.apmpweb.org



Training Programmes at CRRI: 2006-2007

THE Central Road Research Institute (CRRI), New Delhi, will be holding the following programmes during May 2006 to February 2007:

Name of Training Programme	Duration with Dates	Course Fee	Course Coordinator
A. PAVEMENT ENGINEERING & MATERIAL			
• Rigid and Composite Pavements: Design, Construction & Quality Control Aspects	5 days 6-12 Sept., 2006	Rs. 6000/-	Shri G.K. Tike
• Design, Construction and Maintenance of Flexible Pavements including Quality Aspects and Techniques of Hot Mix Asphalt (HMA) Placement	5 days 23-29 Aug., 2006	Rs. 6000/-	Dr Sunil Bose
• Pavement Evaluation Techniques and their Applications for Maintenance & Rehabilitation	5 days 8-14 Nov., 2006	Rs 6000/-	Shri B.M. Sharma
B. PLANNING & MANAGEMENT			
• GIS Application in Planning and Management of Rural Road Network	5 days 17-23 Jan., 2007	Rs. 6000/-	Dr B.K. Durai
• International Course on Dissemination of HDM-4	10 days 4-17 Oct., 2006	Rs. 20,000/-	Dr P.K. Kanchan
C. GEOTECHNICAL ENGINEERING			
• Geotechnical and Landslide Investigations for Highway Projects	5 days 13-19 Dec., 2006	Rs. 6000/-	Shri Sudhir Mathur
D. BRIDGES & STRUCTURE			
• Bridge Diagnostics, Performance Evaluation and Rehabilitation	5 days 12-18 July , 2006	Rs. 6000/-	Dr Ram Kumar
E. TRAFFIC & TRANSPORTATION			
• Traffic Management and Safety	5 days 17-23 May, 2006	Rs. 6000/-	Dr T.S. Reddy
• Aspects of Transportation Planning and Environmental Impact Assessment Studies for Roads	5 days 14-20 Feb., 2007	Rs. 6000/-	Dr S. Gangopadhyay

Customized Tailor Made Programmes: In addition to the above, CRRI also organises customized tailor made programmes as per the clients requirements.

Course Fee: The course fee as indicated above is payable in advance by crossed bank Draft in favour of Central Road Research Institute, New Delhi.

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Printed and Published by V.K. Gupta on behalf of National Institute of Science Communication and Information Resources (CSIR),

Dr K.S. Krishnan Marg, New Delhi -110 012 and printed at NISCAIR Press, Dr K.S. Krishnan Marg, New Delhi -110 012

Editor: Dr B.C.Kashyap; Associate Editors: Meenakshi; Vineeta Singhal; Editorial Assistant: Neelima Handoo;

Design: Pradip Banerjee; Sarla Dutta; Production: Kaushal Kishore

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