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CSIR NEWS

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Team CSIR

CSIR and IL&FS sign MoU to catalyze innovation led development

The Council of Scientific & Industrial Research (CSIR) and Infrastructure Leasing and Financial Services (IL&FS) have entered into an MoU to jointly catalyze the innovation led development in the country. The MoU was signed by Dr D. Yogeswara Rao, Head, TNBD and Shri D.K. Mittal, MD, IL&FS, on 27 March 2008 in the august presence of Prof. S.K. Brahmachari, Director General, CSIR. The scientists and other personnel from CSIR Headquarters and IL&FS were also present on the occasion.

Shri D.K. Mittal, MD, IL&FS (*on left*) and Dr D. Yogeswara Rao, Head, TNBD, exchanging the MoU documents. Prof. S.K. Brahmachari, Director General, CSIR, is seen in the centre

Speaking at the MoU signing ceremony, Prof. Brahmachari said that indeed it was a unique occasion as the two organizations which excel in their respective domain of operation are joining hands, bringing in the pool their rich experience and expertise, proceeds of which would certainly benefit masses in the country. He said that research and development and commercial exploitation of the R & D output is a necessity to build robust knowledge economy in the country. For the development of innovative technologies that are beneficial to society at large, the amalgamation of technical expertise and sophisticated high tech infrastructure is required. Prof. Brahmachari said that CSIR-IL&FS endeavor would help in discovering and building techno-entrepreneurial skills as well, for successfully competing in the realm of emerging technologies and emerging market space.

Shri Mittal said that it is a moment of pride for IL&FS as it joins hands with CSIR for an endeavor which would benefit Indian masses. IL&FS and CSIR could derive synergy and put in place such projects which would not only create an Indian niche but also energize various constituents of innovation chain.

IL&FS is one of the leading infrastructure development and finance companies in India, focusing on commercialization and development of infrastructure projects and creation of value added financial services.

Prof. S.K. Brahmachari addressing the CSIR and IL&FS personnel during the MoU signing function

It is for the first time that IL&FS is joining hands with an R&D organization. CSIR and IL&FS would attempt to meet the objective of catalyzing innovation led development in the country through setting up of enabling S&T infrastructure on one hand and bringing together the innovation developers and its exploiters on the other. A cluster approach would be followed for this purpose. The aim in first phase is to set up in India and abroad:

- Science Parks at various locations
- Incubation Centres and other S&T infrastructure facilities like Instrument Centre, etc.
- Outreach Centres/S&T laboratories.

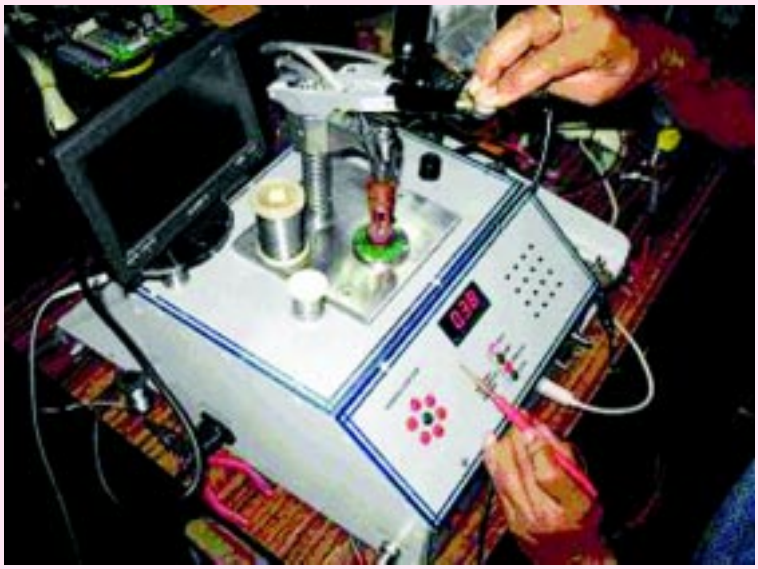
CGCRI transfers Technology of Ceramic Gas Sensor

The Sensor & Actuator Division of Central Glass & Ceramic Research Institute (CGCRI), Kolkata, has developed the technology for fabrication and packaging of LPG/CNG sensors based on semiconducting SnO_2 and transferred the know-how to M/s Indigen Technologies Pvt. Ltd, a Hyderabad based entrepreneur.

LPG/CNG Gas Leakage Alarm (Inset: Sensor Head) developed at CGCRI, Kolkata

Gas sensors are being increasingly required for industrial and domestic safety, environment monitoring, process control and in defence and strategic sectors. Infrared sensors, electrochemical sensors and semiconductor sensors hog the lion's share (~75%) of the gas sensor market. Infrared sensors are highly selective and thus attractive, but these are expensive. Electro-chemical sensors have short lifetimes. Semiconductor sensors,

based on "defect" oxides like SnO_2, WO_3 and ZnO, are widely used to detect toxic and flammable gases like LPG, CNG, CO and H_2 and have recently begun to penetrate the domestic, industrial and automobile sectors in India because they are inexpensive, rugged and have long-life. The sensing principle of semiconductor sensors is based on the dramatic lowering of sensor resistance in presence of a trace amount of a gas to be sensed.



Multi-position Semi-automatic Spot Welding Station developed at CGCRI for sensor packaging

LPG (Liquefied Petroleum Gas) is an efficient and clean medium of energy. The maximum demand of LPG is in the domestic segment as a cooking fuel. The other important application of LPG is in automobiles. CNG or compressed natural gas is another popular fuel to run vehicles. Both LPG and CNG lower exhaust emissions as compared to petrol and diesel. LPG and CNG being highly inflammable, the safety of the consumers, the safety during transportation, storage and bottling, and the safety of the vehicles running on LPG/CNG are of utmost importance. Hence, the use of sensors to detect LPG and CNG becomes of utmost importance.

The available LPG/CNG leakage detectors in India are assembled using imported semiconductor sensors. Such imported sensors are either very expensive or are of inferior quality. Hence, such gas leakage detectors have not been able to penetrate successfully into the indigenous market.

CGCRI has developed the sensor through the application of materials engineering in the form of composition modification, optimization of fabrication parameters, surface modification, etc. to get the desired sensitivity, selectivity, stability, response and recovery times. The specifications of the developed sensors (see box) are at par with the imported available in the global market. M/s Indigen Technologies Pvt. Ltd, plans to start manufacturing of the gas leakage alarms by the end of 2008 and anticipates marketing of at least thirty thousand of such units in Andhra Pradesh only in the first year. In subsequent years, the target is to escalate the production rate to meet the demand in other regions.

Specifications of the LPG/CNG leakage alarm (pocket module)

Size	**8 cm diam. & 2.5 cm width**
Weight	~ 50 g
Power consumption	1 W
Minimum detection limit	500 ppm
Sensitivity	> 85%
Response time	10 sec
Recovery time	1 min.

Inauguration of modern laboratory facilities at NGRI

Dr Anil Kakodkar, Chairman, Atomic Energy Commission; Secretary, Department of Atomic Energy, Government of India and Chairman, Research Council of National Geophysical Research Institute (NGRI), Hyderabad, inaugurated two important research facilities at NGRI, namely, the LAM-MC-ICP-MS National Facility, first of its kind in India, and a High Performance Computing (HPC) laboratory on 11 March 2008 at NGRI.

Demonstration of LAM-MC-ICP-MS National Facility following its inauguration. Seen *(from left)* are: Dr V.P. Dimri, Director, NGRI; Dr S.R. Shetye, Director, NIO; Dr Amalendu Sinha, Director, CIMFR; Dr Anil Kakodkar; Shri P.M. Tejale, DG, GSI; Dr Y.J. Bhaskar Rao, Scientist G, NGRI; Dr B. Vijaya Gopal, Scientist F, NGRI

The Multi Collector Inductively Coupled Plasma Mass Spectrometer (MC-ICP-MS, from M/s Nu Instruments, UK) with a Laser Ablation Microprobe (LAM, a 213 nm Nd-YAG UV laser microprobe system from M/s New Wave Research, USA) will be used for measurement of isotopic compositions of several analytically challenging trace elements in natural materials such as rocks, soils, water and a variety of inorganic synthetic materials such as metal alloys and ceramics. Under charge of Dr Y.J. Bhaskar Rao, Scientist-G, the facility shall support several basic and applied research projects in areas of Solid Earth, Ocean and Environmental Sciences, by providing an understanding of the systematics of isotope fractionations in nature and their precise measurement. The facility has been funded jointly by Council of Scientific & Industrial Research, New Delhi; Department of Science & Technology, New Delhi; National Geophysical Research Institute, Hyderabad and National Institute of Oceanography, Goa.

Inauguration of High Performance Computing Laboratory by Dr Anil Kakodkar. Others seen (*from left*) are: Shri P.M. Tejale, DG, GSI; Dr V.P. Dimri, Director, NGRI; and Dr Amalendu Sinha, Director, CIMFR.

The HPC laboratory facility, comprises an Alix 450 server, SG1. Under charge of Dr Ajay Manglik, Scientist-EII, this facility shall cater to resolving complex Earth processes such as the one envisaged in the Earth dynamo project. The Earth's dynamo is a manifestation of convection involving electrically conducting molten iron in the outer core, which is considered as a primary mechanism for the sustenance and reversal of the geomagnetic field. Efficient modeling techniques using fast parallel computers for solving three dimensional magneto-hydrodynamic equations are required to describe the time independent thermal convection of electrically conducting fluid in a rotating spherical shell.

New Facility at CLRI's Polymer Lab

The New Instrument Room of Polymer Lab at Central Leather Research Institute (CLRI), Chennai, was inaugurated by Dr K.V. Raghavan, Chairman, Research Council in the presence of Dr A.B. Mandal, Acting Director, CLRI. This lab has a number of sophisticated instruments such as Rheometer AR 500, Particle Size Analyzer-Microtrac S3500USA, Gel permeation chromatography with DMF and THF columns and Empower Software – Waters - India, Minilab-HAAKE - Thermo Electron Corporation, etc.

This lab has been established mainly to characterize the polymers. In addition to utilizing these equipment for the in-house R&D, CLRI will also undertake characterization of samples on fee basis for the benefit of Polymer and Allied Industries.

CLRI Industry Meet at Jalandhar

A Central Leather Research Institute (CLRI), Chennai -Industry meet was organized at Jalandhar on 12 December 2007 mainly to discuss the industry priorities in the XIth Five Year Plan and the R&D initiatives of CLRI in recent years. Dr K.V. Raghavan, Chairman, RC, Dr A.B.Mandal, Acting Director along with senior colleagues from CLRI, Chennai and RCED Jalandhar participated. The meet also had the active participation of Mr Mukhtar-ul-Amin, Chairman, CLE along with many industry representatives from Punjab and Haryana. In this meeting different issues connected with Jalandhar Leather Industry including waste water treatment, environmental policies and manpower requirements of Leather & Sports Goods Industry were discussed in detail. This meeting was coordinated by Mr S.K. Misra, Scientist incharge, RCED, Jalandhar.

Industry – Institute Interaction Meet at Kanpur

An industry interaction meeting was organized at Kanpur on 7 November 2007 with the objective to study, identify and find solutions to the regional problems of leather industry and also to discuss the XIth Five-Year Plan export targets. Dr K.V. Raghavan, Chairman, RC and Dr A.B. Mandal, Acting Director along with senior scientists from Central Leather Research Institute (CLRI), Chennai and RCED-Kanpur participated while the industry was represented by Mr Mukhtarul Amin, Chairman, CLE along with many industry representatives from Kanpur.

At the outset, Dr Raghavan briefed the participants on the major objectives of the Indian leather programme to achieve an export target of 7 million US $ by the end of the 11th Five-Year Plan. Later, senior scientists from CLRI gave presentations on latest technologies in leather processing, footwear testing, and waste-water treatment. The need for developing specialized human resource for leather sector as a whole was also emphasized. These presentations were followed by interaction with industry representatives. The following specialized areas/facilities in the Kanpur region are being identified.

- Establishment of a testing laboratory for safety footwear
- Design Fashion studio,
- Implementation of eco-friendly and water saving Leather Processing
- Technology and modernization of existing CETP at Jajamau.

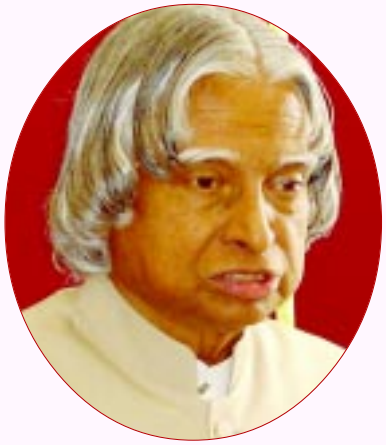
The industry representatives also requested CLRI to work closely and strengthen the existing leather technology group at HBTI, Kanpur. Dr A.B. Mandal assured the leather industry representatives of all possible technical support to develop the Kanpur based leather industry. Dr A. Garg, Scientist G & Head, RCED-Kanpur, co-ordinated this meeting

MULTI DIMENSIONS OF SCIENCE

Dr K S Krishnan Memorial Lecture by Dr A.P.J. Abdul Kalam

at National Physical Laboratory, New Delhi on 25 April 2008

"Science is borderless"



I am happy to give the 32nd Dr K S Krishnan Memorial Lecture at NPL. My association with NPL as a project engineer goes back to mid 1960's, when I worked with renowned scientist Dr Y.V. Somayajalu of NPL. He was conducting sounding rocket experiments for ionospheric studies using rocket borne radio propagation payload.

Subsequently, Dr O.P. Bahl of NPL worked with DRDL team for the development of impregnating pitch required for converting carbon preform into carbon-carbon composites which is an important requirement for our missile programme. In the recent years, NPL scientists have made excellent contribution to science and technology through the study of methane emission from paddy fields, development of magnesium rare earth alloys with very high ductility for automobiles as engine structural material and the development of fully automated load cell calibrator for 5000 kg load measurement. My greetings to all the scientists, technologists, and technology administrators participating in this function.

Dr K.S Krishnan and Indian Science

Friends, I am really honored to deliver the K.S. Krishnan memorial lecture at NPL, which is an environment of science, a great knowledge centre and where great pioneers in science lived. Dr Krishnan, the great scientist who emerges from anecdotes, reveals gentleness and humility that goes together with greatness. I congratulate the scientists and technologists both present and past who have built a robust tradition of scientific research at NPL and have made this institution into a premier research laboratory of the nation.

When I am in the midst of the scientists and technologists from NPL and students, I am reminded of the pioneering work of Dr K S. Krishnan on Quantum Condensed Matter Physics and his fundamental contribution to Raman Effect. Raman Effect has continuously impacted every field of science. Its role in spectroscopy, medical diagnostics and material characterization had been phenomenal. The Raman Effect has been used in many new areas of science and the most recent being in the development of a continuous silicon laser. Instruments and techniques based on Raman Effect make a huge industry all over the world. Dr K.S. Krishnan has indeed played a historic role. Dr Krishnan was a great populariser of science who shared his scientific insights liberally with young students from various colleges. Friends, I would like to share some random thoughts which I have come across during my visit to various scientific and technological establishments in the country and abroad.

R&D in Canada and Finland

Recently I was in Waterloo University, where I met scientists and researchers from Research In Motion (RIM) who are the inventors of Blackberry – mobile phone. Waterloo has a long tradition of innovation. When Waterloo started the "co-op" program where students work in industry and study in university in alternate semester, which was a great innovation. I saw

the demonstration of hydrogen car and Solar sports car designed and developed by the students of Waterloo University and it was operational in the roads of Canada.

At Toronto University, I met the team from Space Flight Laboratory of the university who had coordinated the development of eight nano satellites which are going to be launched by PSLV in India during the last week of April 2008, along with Indian Satellite CARTOSAT 2A for high resolution cartographic mapping and TW-SAT for imaging for third world countries. (*The ten satellites were launched successfully on 28 April 2008.)* This is an important milestone in the collaboration between ISRO and University of Toronto.

I also visited **MaRS**, a non-profit innovation centre connecting science, technology and social entrepreneurs with business skills, networks and capital to stimulate innovation and accelerate the creation and growth of successful Canadian enterprises. They took me to the incubation centre where I saw the prototype fuel cell car run by the hydrogen generated through ammonia. This happens physically through location of research labs, companies of all sizes, business advisors, investors and professional services within the MaRS Centre and more broadly through hands-on advisory services, entrepreneurial programming, our structured networks and expanding electronic community.

I visited VTT, a Technical Research Centre of Finland, an independent organization of experts for creating and applying technology, and enhancing the competitiveness of Finnish industry and business. The important aspect of VTT is it works in close coordination with Helsinki University and the Finnish funding agency for fast commercialization of the developed products.

Drug for faster cure of tuberculosis

While visiting CSIR Labs in India, I saw the development of a drug for faster cure of tuberculosis. Modern medicine has always relied on newer scientific discoveries world over. Indian scientific research starts to focus in finding solutions to our problems, which can later on be applied to the people of other countries. In this regard, India has made a very significant contribution in developing a drug uniquely suitable for Indian ambience. One of the achievements comes from a laboratory of the Council of Scientific and Industrial Research (CSIR). CSIR lab has developed a new therapeutic molecule for tuberculosis. This molecule has shown the potential to cure TB in around 2 months, as against the standard treatment of 6 to 8 months. This breakthrough is very important as we have number of TB patients. After completing the pre-clinical studies, the molecule transformed into a drug is undergoing clinical trials in humans.

It is commendable that the entire development has been done as a public-private partnership involving the Lupin, the three CSIR Laboratories, namely, Central Drug Research Institute, Indian Institute of Chemical Technology and National Chemical Laboratory, and the University of Hyderabad.

Nano tube filter – water purification

During my recent visit to Banaras Hindu University, I saw the development of a nano-tube filter. The scientists from Banaras Hindu University have devised a simple method to produce carbon nanotube filters that efficiently remove micro- to nano-scale contaminants from water and heavy hydrocarbons from petroleum. Made entirely of carbon nanotubes, the filters are easily manufactured using a novel method for controlling the cylindrical geometry of the structure. The work was supported in part by the Ministry of Human Resource Development and Department of Science and Technology in India.

The filters are hollow carbon cylinders several centimeters long and one or two centimeters wide with walls just one-third to one-half a millimeter thick. They are produced by spraying benzene into a tube-shaped quartz mold and heating the mold to 900°C. The nanotube composition makes the filters strong, reusable, and heat resistant, and they can be cleaned easily for reuse.

The carbon nanotube filters offer a level of precision suitable for different applications. The experiments demonstrated that the filters may be useful in producing high-octane gasoline. They also can remove 25-nanometer-sized polio viruses from water, as well as larger pathogens, such as *E. coli* and *Staphylococcus aaureus* bacteria. The researchers believe this could

make the filters adaptable to micro fluidics applications that separate chemicals in drug discovery.

This is a classic application of the latest in science – Nano science, to age old problem of water purification. If properly used, this can help in lessoning the burden in our drinking water missions leading to the availability of safe drinking water that will result in minimizing the water borne diseases.

Healthcare: Typhoid Detection Kit

Typhoid Detection Kit has been developed by DRDE, Gwalior, using the nano sensor developed by Prof. A.K. Sood, and his team from IISc, Bangalore. Typhoid fever caused by *Salmonella typhi* is a major health problem and an important challenge to health authorities of third world countries due to unsatisfactory water supply, poor sanitary conditions, malnutrition, emergence of antibiotic resistant strains, etc. According to an estimate the worldwide incidence to typhoid fever is 16 million cases annually and death rate is 6 lakh individuals per year worldwide. In India, the morbidity due to typhoid varies from 102 to 2219/100,000 population in different parts of the country. In some areas typhoid fever is responsible for 2-5% of all deaths.

In India for routine diagnosis for typhoid disease Widal test is performed with single serum sample which does not provide the correct diagnosis of infection. Therefore a Latex agglutination based test has been developed at DRDE, Gwalior using recombinant DNA technology and immunological technique for rapid diagnosis of typhoid infection. The test detects *S. typhi* antigen directly in patient's serum within 1-3 minutes which is very important for initiating early treatment and saving human life.

A collaborative work has been carried out with Prof. A.K. Sood of Indian Institute of Science, Bangalore, and the sensitivity of the test has been increased 30 times by applying a small electric charge (1.5 V). With this improvement, extreme low concentrations of the antigen in clinical sample can be detected. Moreover, very small quantity of clinical sample, as low as 2-3 µl (micro liter) is required to perform the above test as compared to 10-15 µl sample required for latex agglutination test.

Power: Gas flow induced generation of voltage from solids

Scientists and students of IISc have studied, experimented and found that the liquid flow in carbon nano tubes can generate electric current. One of the most exciting applications to emerge from the discovery is the possibility of a heart pacemaker – like device with nanotubes, which will sit in the human body and generate power from blood. Instead of batteries, the device will generate power by itself to regulate defective heart rhythm.

The IISc has transferred the exclusive rights of the technology to an American start-up Trident Metrologies. They will develop the prototypes and commercialize the gas flow sensors.

Drug delivery system

A research group headed by Professor A. N. Maitra of the University of Delhi's Chemistry Department has developed 11 patentable technologies for improved drug delivery systems using nanoparticles. Four of these processes have been granted U.S. patents. One of the important achievements at the initial stage of drug delivery research was development of a reverse micelles based process for the synthesis of hydrogel and 'smart' hydrogel nanoparticles for encapsulating water-soluble drugs. This method enabled one to synthesize hydrogel nanoparticles of size less than 100nm diameter. This technology has been sold to Dabur Research Foundation.

Another technology that has been transferred to industry deals with nanoparticle drug delivery for eye diseases. Traditionally, steroids have been used extensively in the treatment of ocular inflammatory disease and allergies. However, prolonged use of steroids has many side effects. The Delhi University group's process uses nanoparticles to encapsulate non-steroidal drugs. This process improves the bioavailability of the drug on the surface of the cornea. The technology has been transferred to Chandigarh-based Panacea Biotech Ltd.

CNT Production

Defence Materials and Stores, Research and Development Establishment (DMSRDE), Kanpur is synthesizing non-aligned, quasi-aligned and aligned CNT with a

batch size of 50 grammes using a fast synthesis process. It has a maximum operating temperature of 12000°C. The CNTs will have applications in EM absorbers, composites, gas sensors, flow monitors, field emission devices. Other institution that makes CNT is Tata Institute of Fundamental Research (TIFR).

Bio-pesticide development

I also would like to discuss about bio-pesticide development. Development of safe and sustainable alternatives to chemical insecticides is absolutely essential, as it has become a liability for good soil. A research mission has been taken up by International Centre for Genetic Engineering and Bio-technology to isolate a bacterium from soil dwelling nematode, which is highly pathogenic to insects. Sustained research and field trials during the last two years, at various locations in the country, of the formulation consisting of bacterium has led to successful optimized formulation resulting in a viable bio-pesticide. As reported, the formulation is effective in agricultural and horticultural insect pests like diamond back moth of cabbage and cauliflower, mealy bugs of citrus fruits and grapes and termites in teak plantation. White woolly aphid of sugar cane, which is a major factor in reducing the sugar production of Maharashtra, Karnataka and Andhra Pradesh, is effectively controlled by the bio-pesticide. Its efficacy is comparable to the chemical insecticide.

This scientific research leading to technology has been transferred to a start-up bio-tech company Nirmal Seeds Ltd and it is marketed under the brand name, BIO PRAHAR. I am sure that this work will lead to improved food productivity in a very eco-friendly way.

Detection Kit for HIV / AIDS

Next area is about the development of a detection kit, NEVA-HIV to detect HIV (AIDS) in a drop of blood within three minutes. It is a single step test in which a drop of blood is mixed with a drop of a reagent on a glass slide. If the blood sample shows clumping, it is positive for HIV. This clumping of blood can be easily seen with the naked eye; hence the test is called the Naked Eye Visible Agglutination assay or NEVA. This test uses recombinant proteins consisting of a monovalent fragment of an anti-human RBC monoclonal antibody fused to a specific protein antigen derived from HIV. These proteins cross-link RBCs in the presence of anti-HIV antibodies, which are present in the blood of HIV infected individuals. The test uses recombinant proteins consisting of NEVA-HIV. It is one of the very few tests in the world that can be performed on whole blood, even from a finger prick. Developed, keeping in mind the practical constraints of HIV testing in our country, NEVA-HIV is an instrument-free test. In addition, the simplicity and rapidity of the test, makes it suitable for use in a primary health centre of a village even in a remote part of our country.

The test has been evaluated at several national reference centers and has been found to have high sensitivity and specificity. This novel scientific development has been carried out by the faculty members of Department of Biochemistry, University of Delhi in collaboration with the Department of Bio-technology and Cadila Pharmaceuticals Ltd, Ahmedabad.

So far I have discussed my observations of growth and application of science both in India and abroad. Problems of the magnitude that would be faced in the future in Science and Technology would call for understanding and explaining Nature in her many manifestations and would require the best of minds in several continents to work together. I am aware of the work of NPL and I am sure in the years to come, NPL will create an enabling environment for scientists of many Indian institutions and international institutions to work together for solving scientific problems for societal transformation.

Conclusion

One of the very important ingredients for success of the vision of transforming India into a developed nation by 2020 is the evolution of creative leaders in every sphere of life including the scientific establishments. I have seen the connectivity between developed India, economic prosperity, competitiveness, science, technology, innovation, production, productivity, employee role and management quality, all of which are linked to the creative leader. Who is that creative leader? What are the qualities of a creative leader? The creative leadership is exercising the

task to change the traditional role from commander to coach, manager to mentor, from director to delegator and from one who demands respect to one who facilitates self-respect. The higher the proportion of creative leaders in a nation, the higher the potential of success of visions like "Developed India."

Now the question comes, in the present dynamic situation of India: Will the creators of creative leaders emerge? Poetically, I can say that when the horizon is fully red or fully green, creator of creative leaders appear in the horizon. I believe and I am sure that this is the time, creators of creative leaders will emerge for eliminating poverty and diseases and establish a peaceful nation and thereby the world through vast application of science and technology.

My best wishes to all the members of NPL for success in their missions. May God bless you.

International Conference on Nanomaterial Toxicology

Prof. A.S. Brar giving inaugural address

An International Conference on Nanomaterial Toxicology was jointly organized by the Indian Institute of Toxicology Research (formerly Industrial Toxicology Research Centre), Lucknow and Indian Nanoscience Society during 5-7 February 2008. More than 110 participants from 11 countries namely USA, Canada, UK, Italy, Germany, France, Switzerland, Belgium, Brazil, Finland and India attended the conference. Fifty-four invited presentations were delivered in six scientific sessions and 29 poster presentations were made during the conference. A brief report of deliberations held during the conference is given below:

Inaugural Session

The welcome address by Dr Ashwani Kumar, Acting Director, IITR, at the inaugural function was followed by a brief description of the genesis of ICONTOX by Dr Mukul Das, President, Indian Nanoscience Society.

The Chief Guest Prof. A.S. Brar, Vice Chancellor, University of Lucknow, while inaugurating the conference said that humans were now at greater risk of exposure to nanomaterials which could enter the biological system through different routes. He also highlighted the need for safety during synthesis of nanomaterials as well as their release into the environment. He formally released a special issue of the journal "*Nanotoxicology*" containing abstracts of the conference.

Dr Nitya Anand, former Director, Central Drug Research Institute, Lucknow during his presidential remarks said that the nanomaterials hold a tremendous prospect of use in daily life in diverse fields including delivery systems for drugs, agro-chemicals, cosmetics and for construction. He emphasized the need of proper investigations into the effects of exposure to new nanomaterials on human health.

Dr Sally S. Tinkle, Chair, NIH Nano Task Force Health Implications Working Group, NIEHS/NIH, USA. delivered the **Nanoscience Oration** on "*Harnessing the Power of Nanotechnology for Human Health*". She enlightened the audience with the integrated effort of the US-National Institutes of Health, federal agencies, industries, stakeholders, and international partners in providing a

Release of Abstracts of ICONTOX 2008 published in Nanotoxicology journal:
Seen *(from left):* Dr Alok Dhawan, Dr Mukul Das, Dr Ashwani Kumar, Dr Nitya Anand, Dr Sally S. Tinkle, Prof. James M. Tiedje and Dr Rishi Shanker

Prof. James M. Tiedje, answering the questions after his Keynote Lecture. Also seen are Dr Sally S. Tinkle, and Dr Nitya Anand

platform for exploration of the impact of engineered nanomaterials (ENM) on human physiology. She along with Dr Rishi Shanker, Vice President of the Society. also launched the website of Indian Nanoscience Society (www.nanoscience.ac.in).

Prof. James M. Tiedje, Director, Center for Microbial Ecology, Michigan State University, USA, delivered the keynote lecture entitled *"Lessons from the Microbial World for Sustainable Development and Use of Nanomaterials"*. He expressed that recent burst of activity in developing applications of nanomaterials is unprecedented. It requires both an acknowledgement of its power in all walks of life as well extraordinary care in making sure that its use is safe and sustainable. Prof. Tiedje highlighted the principles that are designed to minimize the impact of engineered nanomaterial technology on human health and the environment, with special emphasis on microbes and microbial genomics as potential markers for the purpose.

Dr Sally S. Tinkle and Dr Rishi Shanker, launching the website of the Society

Dr Ashwani Kumar, presenting a Scroll of Honour to Dr Nitya Anand. Seen in the middle is Prof. A.S. Brar

Dr Alok Dhawan, Organizing Secretary, ICONTOX 2008, proposed a vote of thanks.

Nanomaterial Synthesis and Characterization

Prof. Pancham Pramanik, Indian Institute of Technology, Kharagpur, set the tone of this session by delivering a Plenary Lecture on *Co-ordination Chemistry for Nano-material Synthesis*. He highlighted the synthesis of nanocatalysts and nanosensors for daily use through interactions between metal ions or molecules of inorganic or organic origin.

Dr Yogesh S. Shouche of National Centre for Cell Science, Pune, in his lecture entitled *Bacterial Synthesis of Nanoparticles* discussed the potential of bacterial system for synthesis of copper/ copper oxide and silver nanoparticles. He, however, cautioned that the full potential of the bacterial system for nanoparticles synthesis can only be harnessed once the mechanism of synthesis is well understood.

Dr Absar Ahmad, National Chemical Laboratory, Pune, in his talk entitled *Fungus Mediated Biosynthesis of Oxide Nanoparticles* demonstrated that biosynthesis of oxide nanoparticles can be achieved at room temperature. He gave an example of the silica nanoparticles being formed by *Fusarium oxisporum*. From the same institution, Dr B.L.V. Prasad of Materials Chemistry Division discussed the various methods to prepare stable and water dispersible metal nanoparticle such as Au/Ag, Au-Ag alloy using BSA as well as Co and Ni using core-shell/system during his talk on *Water Dispersible Biomolecule Conjugated Nanoparticles*.

Dr Rajiv Prakash from Banaras Hindu University, Varanasi, in his presentation on *A Novel and Simple Route for the Formation of Tubular Polyaniline f-CNT Nanocomposites,* described a new technique for development of tubular nanocomposite of polyaniline with functionalized carbon nanotubes using *in situ* polymerization method. He also showed that these nanocomposites have a three fold enhancement in electrical conductivity and can be exploited for various technological applications.

Dr Shailesh N. Sharma of National Physical Laboratory, New Delhi, presented a novel green synthesis approach for CdSe-ZnSe core-shell nanocrystallites in aqueous medium during his talk on *Toward Greener Nanosynthesis of Core-shell CdSe-ZnSe Quantum Dots.*

Dr Deepesh Kumar Singh, Advanced Materials and Processes Research Institute (AMPRI), Bhopal, presented a novel reverse micro-emulsion method for nano size zirconia (20-40 nm range) synthesis with specific optical, electrical properties for potential applications in transparent optical devices, electrochemical capacitor electrodes, oxygen sensors, fuel cells, catalysts and advanced ceramics.

Dr B. Mondal, Central Mechanical Engineering Research Institute, Durgapur, mentioned about his team's' development of environment-friendly gel-casting system using boiled rice extract as binder.

Dr Braja G. Bag of Vidyasagar University, West Bengal, showed that arjunolic acid, a nano-sized chiral triterpenic acid, extractable from *Terminalia arjuna*, on derivatization could immobilize varieties of organic solvents at low concentrations. An arjunolic acid derived crown ether showed efficient binding to monovalent cations including a primary ammonium ion paving the way for chiral recognition of amino acids.

Nanomaterials in Pharmaceuticals

The plenary lecture on *Nanoscience and the Design of Medicines* by Prof. Peter York of Institute of Pharmaceutical Innovations, U.K., launched the Session. He informed that the recent years have witnessed an increased frequency of new drug candidates with poor aqueous solubility. This has imposed the additional need for innovation in the design of medicines to achieve acceptable bio-performance. Nanotechnology has provided pharmaceutical scientists with an approach to resolve these issues. He also described the various methods available to generate nanoparticles of drug substances including microfluidics and sonification techniques.

This was followed by an invited lecture by Prof. Denis Labarre of Université Paris Sud, France, on *Modifying Surface Properties can Turn a Foreign Body into a Smart Nanoparticle*. He expressed

concern over drug delivery even by nanoparticulate systems. According to him modifying surface properties with polymeric compounds can turn a foreign body into smart nanoparticles.

Dr A. Sinha from National Metallurgical Laboratory, Jamshedpur, showed the recent development of nanocomposite biomimetic scaffolds and nanofluid for tissue engineering and diagnostic applications.

Prof. A. Dinda of All India Institute of Medical Sciences, New Delhi, in his talk *Exploring Nanobiocompatibility: A challenge for Nanomedicine* discussed the need for a universal prescribed format for toxicity testing of nanoparticles. He discussed his work related to the evaluation of interaction of nanomedicines with cellular and protein components of blood or body fluids, through *in vivo* and *in vitro* assays, thus taking contributory steps in exploring nanobiocompatibility as a challenge for nanomedicine.

Dr Amit Mishra of Central Drug Research Institute, Lucknow, gave a talk on *Localization of Biodegradable Nanoparticles in the Uterus following Intravaginal Instillation Suggests a Novel Mode of Contraception* and presented his work on novel mode of contraception, based on advanced techniques, on the localization of biodegradable nanoparticles, such as *poly* (lactic acid), in the uterus following its intravaginal instillation.

Dr Anita K. Verma of Delhi University in her talk on *Nano-pharmaceuticals: Pharmacokinetics and in-vivo Biodistribution of Hydrophillic Paclitaxel Loaded Biopolymeric Nanoparticles,* presented data on pharmacokinetics of the anti-cancer drug paclitaxel coated with the biopolymeric gelatin nanoparticles.

Dr V. Rajendran from K.S. Rangasamy College of Technology, Tiruchengode, highlighted the development of biocompatible nanocrystalline calcium hydroxyapatite during his presentation on *Development of Biocompatible Nanocrystalline Calcium Hydroxyapatite and its Characterization for Biomedical Application.*

Dr Rakesh Ratnam of BioPlus Life Sciences, Hosur, and Dr Stuart Wakefield of Malvern Instruments Limited, UK, gave technical lectures entitled *Dendrimers in Biomedical applications* and *The Use of Dynamic Light Scattering and Zeta Potential as Tools for the Characterisation of Nano Particles and Nano Dispersions,* respectively.

In the Poster Session a total number of 29 papers were presented in areas encompassing the use of nanomaterials, its properties, structural organization, development and synthesis, applications, biochemical alterations, and very importantly *in vitro* and *in vivo* toxicity.

Models for Nanomaterial Safety and Toxicology

Dr Ravindra Pandey, USA, in his lecture entitled *Interaction of Nanomaterials with Biological Molecules: Manganese and Silver Nanoclusters with Dopamine* discussed the toxicity studies of nanoparticles of diamond, silver, manganese, iron oxide in human lung cancer, dermal cells and growing neurons. These particles have a variety of commercial applications such as filters, catalysts, cosmetics, etc.

Dr Syed Ali, USA, in his talk on *Nanoparticles: Friend or Foe; Neurotoxicity and Neuroprotection* mentioned regarding the limited studies on the toxicity of nanoparticles and risk assessment as well as the need to do extensive research in the potential hazardous effects and possible benefit of these nanomaterials. His group has demonstrated that nanoparticles of manganese, silver and copper can be neurotoxic by generating ROS and depleting dopamine concentration in PC-12 cells. Significant changes in dopamine related genes correlated with the depletion of dopamine needing further studies to understand the mechanism of action of these nanomaterials were also discussed.

Dr Satya Prakash, Mc Gill University, Canada, delivered a talk on *In vitro Cytotoxicity of Functionalized Single Walled Carbon Nanotubes for Targeted Gene Delivery Applications*. He demonstrated that carbon nanoparticles to be used in cancer therapy can be successfully used in gene delivery applications provided their cell toxicity effects can be limited by optimizing dose levels.

Dr Diana Andersen of University of Bradford, UK, in her talk on *The Comet Assay with Photo Activation of Zinc Oxide and Titanium Dioxide Nanoparticles with UV in Human Sperm*

highlighted the need for creating more awareness on the potential genotoxic effects of UV light exposed nanoparticles, such as zinc oxide, titanium oxide, used in cosmetics. The damage, as observed by her, being very pronounced in germ cells may lead to heritable defects in offspring.

Dr Alok Dhawan, IITR, Lucknow, delivered a lecture on *Nanomaterials: A Challenge for Toxicologists*. He highlighted some of the important issues being addressed at his institute in the area of nanomaterial toxicology. He delineated the need to target hurdles encountered in carrying out toxicology studies in cells and animals that mimic human environmental exposures. He elaborated on comprehensive characterization of nanoparticles for toxicological studies, such as size, chemical composition, shape, crystal structure, surface area, surface chemistry, surface charge, solubility, state of agglomeration among others.

Prof. Marcello Lotti of Università degli Studi di Padova, Italy, in his plenary talk on *Short-term Effects of Particulate Matter: An Inflammatory Mechanism* discussed the inflammatory mechanisms induced by particulate matters (PM). He showed that data in humans indicate that short-term inflammatory responses to PM are not always detected and they are usually mild and loosely correlated with functional changes. He discussed in detail how the diversity of PM characteristics, dose metrics and endpoints hamper a clear discerning of inflammatory mechanism(s).

Dr Tobias Stoeger of GSF, Germany, in his talk *Health Effects of Engineered Nanomaterial - Lessons from Ultrafine Particulate Matter,* showed that as is the case with ultrafines, the small size of engineered nanomaterials facilitates uptake into cells and transcytosis across epithelial and endothelial cells into the blood and lymph circulation to reach potentially sensitive target sites. He suggested that an interdisciplinary team approach is mandatory for nanotoxicology research to arrive at an appropriate and responsible risk assessment.

Prof. N. Duran of Instituto de Quimica, Brazil, delivered a lecture on *Silver Nanoparticles: Control of Pathogens, Toxicity and Cytotoxicity*. He discussed the current literature on this field and potential use of silver nanoparticles to the control of pathogens with emphasis on pathogenic bacteria, their toxicity and cytotoxicity and possible mechanistic aspects acting on bacteria and virus.

Dr H. Norppa of Finnish Institute of Occupational Health, Finland, in his talk on *Genotoxicity of nanomaterials* highlighted that a great variety of new nanomaterials with many modifications are being developed. According to him, genotoxicity assessment of such materials appears to be a formidable task and attempts will be made to identify those particle characteristics that are crucial for determining possible genotoxicity should be made.

Dr Mukul Das of IITR, Lucknow, in his talk on *Emerging Trends of Nanoparticles Application in Food Technology: Safety Paradigms* highlighted the availability of limited toxicological/ safety assessments data for few nano particles and the need for studies relevant to exposure risk assessment for nanoparticles to be used in food.

Dr Iqbal Ahmad of IITR, Lucknow, in his talk on *Nanotoxicity of Talc: A Comparative Particle Size-dependent Cytotoxicity Study in Isolated Rat Hepatocytes* presented data on nanotoxicity of talc using isolated rat hepatocytes. He showed with evidences that the toxicity of talc is enhanced in nanoscale and mediated through oxidative stress. However, naturally occurring micronutrients, namely vitamin E, vitamin C and β-carotene may reduce talc nanotoxicity.

Dr Premendra D. Dwivedi, IITR, Lucknow, in the lecture on *The Potential Immuno-Toxicological Impact of Nanomaterial* discussed the strategies to assess safety of nanomaterials *vis a vis* the first line of defense in organisms.

Dr Laetitia Gonzalez of Belgium in the talk on *Dosimetry, Toxicity and Genotoxic Effects of Stöber Silica Nanoparticles in A549 Human Lung Carcinoma Cells* elegantly showed that silica nanoparticles, used in the process of polishing and as additives to drugs, food and cosmetics contribute to the cell response. He demonstrated that the small particles induce a statistically significant increase of micronuclei (MN) frequencies leading to genotoxicity.

Dr Syed A. Hashsham of Michigan, USA delivered the plenary lecture on *Emerging Genomic Tools for Nanotoxicology*

and highlighted the emerging genomic tools for nanotoxicology. He discussed the expression arrays, single cell genomics approach to measure low abundance transcripts, high throughput quantitative PCR, genotoxicity assay, and bioinformatic tools enabling enhanced capabilities for functional genomics. Using microbial systems as a model, his presentation highlighted some of the emerging genomic tools available to study the toxicity of nanomaterials.

Dr Rishi Shanker of IITR, Lucknow, delivered the lecture on *Pathogen Detection: PCR Probes to Nano-Probes!* He highlighted the use of Real-Time PCR Probes (TaqMan, Molecular Beacon and FRET) for detection of virulence and anti-microbial agent resistance genes of water and food-borne pathogens in monitoring microbiological quality of water and food. He presented exploratory data on development of gold nano particle (GNP) probes for simple and rapid detection of pathogens.

Dr Raja Roy, SGPGI, Lucknow, in his talk on *Application of MRI for in vivo Mapping of Heavy Metal Paramagnetic Nanoparticles* showed that MRI may serve as an important tool for mapping the heavy metals in nanoparticle form and discussed details of MRI, contrast agents and their possible role in toxicological application.

Dr Lalit M Bharadwaj of Central Scientific Instruments Organisation, Chandigarh, in his talk on *Biomolecular Hybrid Devices for Health Care Applications* highlighted the use of DNA nanowire for sensors and actuators, BioMEMS for micro-diagnostic kits, biomolecular motors for drug delivery and nano robotics, nanotubes for bionano-sensors and drug delivery.

Prof. Brij M. Moudgil of University of Florida, USA, in his talk *Silica-based Fluorescent Nanoparticles as Biological* Taggants and their Preliminary Biocompatibility Studies gave data demonstrating that silica nanoparticles, irrespective of the present surface modification strategies, exhibit reasonably good biocompatibility to A549 cells.

Dr Jayesh Bellare, Indian Institute of Technology, Mumbai, in his talk entitled *Cryo Electron Microscopy Techniques for Imaging Surfactant Nanosystems* showed that cryo-transmission and scanning electron microscopy can provide the clinching evidence of microstructural images that along with other techniques, may become a pre-eminent tool for determining the microstructural behaviour of nanostructured liquid systems.

Dr Satish Chandra Ogale of NCL, Pune, in his talk on *Oxide Nanoparticles for Biomedical Applications* highlighted the applicability of such oxide nanoparticles for RF hyperthermia and photo-catalytic bio-sensing.

Dr Jessica Ponti of ISPRA (VA), Italy, highlighted the *In vitro Nanotoxicology Activities at the Joint Research Centre (JRC)*. She described the *in vitro* nanotoxicology research undertaken by JRC, which is based on a multidisciplinary strategy involving the use of *in vitro* tests in combination with advanced analytical and biochemical techniques. She stressed that understanding of the mechanisms of toxicity requires proactive multidisciplinary research initiatives to address the impact of nanoparticles on human health.

Ethical and Regulatory Issues in Nanomaterial Toxicology

The session commenced with the plenary lecture *Nanomaterials – History, Hype and Hysteria* by Dr Paul Thorning of University of Bradford, UK. He opined that despite the current high profile, nanomaterials have a long history in both concept and practical use. He enlightened the audience with the major therapeutic advances with nanomaterials and nanoparticles in addressing the many challenges of poorly-soluble drugs. He pointed out the increasing level of public concern regarding the safety of the nanoparticles; their causes and manifestation, and the action required by the scientific and technological community to mitigate them.

The talk *Ethical and Regulatory Issues Related to Nanotechnology* by Prof. S. S. Aggarwal of Lucknow discussed the health risks of nanoparticles. He felt that simultaneous to systematic investigation, surveillance should be carried out about health and environmental safety aspects at all stages of the life cycle of the nano-products, from their development to disposal.

Dr K. R. Bhardwaj, former Scientist, CDRI, Lucknow, in his talk *Nanomaterial Toxicology Studies: Animal Experimentation and Ethical Issues* drew attention to the safety precautions and the

ethical requirements in the use of animals for handling and testing of nano-products.

Dr D. K. Agarwal of IITR, Lucknow, in his lecture *GLP Implementation in Nanotoxicology* emphasized on a rational scientific approach with implementation of good laboratory practice as desirable for scientific acclaim and global acceptability of studies on the safety of nanomaterials to garner the benefits of technology with minimal risk to human health and environment.

Impact of Nanomaterials on Ecosystems and Environment

Dr E. Gulari of Michigan University, USA, delivered the talk entitled *Nanomaterials: Boon or Bane for the Environment*. His presentation critically examined the potential challenges and the benefits that nanomaterials may bring to our environment and lives in the future. Keeping the scientific spirit of the conference, he projected the beneficial as well as harmful effects of several synthetic nano materials such as carbon nanotubes, cadmium selenide nanoparticles.

Dr Rajender Varma of the Environmental Protection Agency, USA, talked on *Risk Reduction in the Synthesis of Nanomaterials: Green Approach to Noble Metal Nanostructures and Nanocomposites*. He informed about the reduction in risk associated with synthesis of noble nanostructures *via* microwave (MW)-assisted spontaneous oxidations, to generate noble nanocomposites which have potential functions in catalysis, biosensors, energy storage systems, and nanodevices.

Dr B. Mahusudhan of Kuvempu University, focused on understanding the basic mechanisms such as the site of absorption, translocation, biotransformation, biocon-centration, biomagnification and bioactivation of xenobiotic nanosubstances in the biological and non-biological environment to protect ecosystems and human health from harmful particulate matter during his talk entitled *Nanotechnologies Potential Promise–Unforeseen Health and Environmental Safety Problems*.

Dr Awadesh N Jha of Plymouth University, UK, delivered the talk *Hydroxyl radicals (·OH) are associated with titanium dioxide (TiO_2) nanoparticle-induced cytotoxicity and oxidative DNA damage in fish cells under in vitro conditions.* The studies were carried out to evaluate the potential cytotoxic and genotoxic effects of TiO_2 nanoparticles on goldfish skin cells (GFSk-S1), either alone or in combination with UVA. UVA irradiation of TiO_2 treated cells caused further increases in DNA damage. ESR studies have revealed that the observed toxic effects of nanoparticulate TiO_2 were most likely due to hydroxyl radical formation.

The concluding lecture of the session was by Dr S. Ajmani, VLife Sciences Technologies, Pune, on *Understanding Toxicity Aspects of Molecules Using Novel Group Based QSTR (GQSTR) Approach*. He presented feasibility of the approach in providing models with predictive ability similar or better to conventional methods and in addition providing understanding of toxicity aspects of groups in the molecules.

Valedictory Session

The Chief Guest of the Valedictory Session was Dr Herald Krug, Switzerland, and Dr P.S. Chauhan presided over the function. Dr D.K. Saxena, Deputy Director, IITR; Dr Mukul Das, President, Indian Nanoscience Society; Dr Rishi Shanker, Chairman, Scientific Programme Committee and Dr Alok Dhawan, Organising Secretary, were also present.

Dr Chauhan lauded the efforts of Indian Nanoscience Society and IITR in organizing ICONTOX-2008, the first conference on Nanomaterial Toxicology in the country. He appreciated the efforts of INS in publication of Abstracts and subsequently, selected papers, in the Francis & Taylor Journal: *Nanotoxicology*.

Dr Harald Krug reflected and echoed the appreciation of national and international delegates on the thought provoking deliberations in the six sessions. He felt that this would evolve more collaborations and interactions for development and application of strategies for *in vitro* and *in vivo* safety and toxicity assessment of nanomaterials. Dr Mukul Das acknowledged the overwhelming response of delegates from 11 countries to INS's first event-ICONTOX-2008 in delving over the imperative issue of nanomaterial safety. Dr Rishi Shanker expressed satisfaction that

the wide range of topics covered in scientific programme led to active participation, intense discussions and provoked thinking anew the approaches for elucidating nanomaterial safety. Dr Alok Dhawan felt that the deliberations would help evolve a new thinking and scientific approach to reap the benefits of nanotechnology for the developing world. Dr Herald F. Krug and Dr P.S. Chauhan presented the **Poster Awards** to following participants - Mr Girish Gupta (CDRI, Lucknow), Mr Anurag Jyoti (IITR, Lucknow), Ms Vyom Sharma (IITR, Lucknow), Ms Virginia D'Britto (NCL, Pune) and Ms Prachi Joshi (NPL, New Delhi).

RECOMMEDNATIONS / DECLARATION OF ICONTOX 2008

A panel discussion was held on the last day under the chairmanship of **Dr P.S. Chauhan**, former Head, Department of Genetics, BARC, Bombay and Chairman, Research Council, IITR.

The panelists were: Prof. B.N. Dhawan, former Director, CDRI, Lucknow; Dr R.C. Srimal, former Director, IITR, Lucknow; Dr John D. Fortner, Center for Biological and Environmental Nanotechnology, Rice University, USA; Prof. Dennis Labarre, Universite Paris Sud, France; Prof. Herald Krug, Institute of Toxicology and Genetics, Hermann-von-Helmholtz Platz, Germany; Dr U.S. Tandon, Joint Adviser, International S&T Affairs Division, CSIR; Dr Mukul Das, President, Indian Nanoscience Society & Co-Chairman, ICONTOX 2008, IITR; Dr Rishi Shanker, Scientist, IITR and Chairman, Scientific Programme Committee, ICONTOX 2008; Dr Paul Thorning, Director, Institute of Pharmaceutical Innovation, University of Bradford, UK; Prof. Hannu Norppa, Finish Institute of Occupational Health, Finland; and Dr Alok Dhawan, Organizing Secretary, ICONTOX 2008, IITR.

The recommendations made after deliberations were formulated as a declaration.

ICONTOX 2008 Poster Awardees with Dr Alok Dhawan, Dr D.K. Saxena, Dr P.S. Chauhan, Prof. Herald F. Krug, Dr Rishi Shanker and Dr Mukul Das

The Declaration

This declaration is issued for the attention of the scientific community with interest in nanomaterials and nanotechnology, manufacturers of nanotechnology-enabled products, policymakers and regulatory agencies, and the general public. After two days of deliberations and a panel discussion among nearly two hundred researchers from multidisciplinary fields, it is sincerely felt that the time has come to pay due attention to the demands of ensuring and documenting that nanomaterials prepared by new and existing processes are safe for human use and benign towards the environment. The possibility of unforeseen hazards accompanying the use of nanometer-size material in a vast variety of consumer products must be investigated, contained, monitored and ameliorated by joint and responsible action by all sections of the society.

Observations/ Recommendations

There is a general consensus among the scientific community that:

1. 'Nanomaterials' and 'nanotechnology' are by now

umbrella terms, and refer to materials ranging from 1 to 1000 nm in nominal size. The emphasis on size alone in defining nanomaterials is misplaced, and tends to trivialise the challenges and opportunities of nanotechnology.

2. The plethora of differences that exist between materials of different physico-chemical nature are far more likely to manifest themselves in chemical reactivity, biodegradability, safety or toxicity than the single common parameter of nanometer-range size. Thus, wherever possible, safety/ toxicity investigations should be conducted concurrently on materials in the nanometer as well as the micrometer or millimeter size range.

3. With regard to evaluating the safety and toxicity of nanomaterials, the first step would definitely involve tracing the pattern of distribution of the material once it is released into the environment or within an organism. These investigations may be carried out by actual experiments or with the aid of computation. Thus, establishment of biodistribution on intended or accidental exposure, as well as study of environmental dispersal of different nanomaterials is a priority area.

4. It is equally important to establish quantitative analytical methods for dosimetry in order to know the amounts of a given nanomaterial that has been released into the environment and/or to which a person or test animal has been exposed. Methods are required to investigate whether nanomaterial retains its size and surface properties in the environment or in the biophase, and the duration for which it does so. Different approaches would obviously be called for in case of solid, particulate nanomaterial and nanomaterial contained in a solid, semi-solid or liquid matrix.

5. Nanotoxicity screening should include physicochemical characterization of nanomaterial, either being assessed *in vitro* or *in vivo* assays.

6. The areas of nanomaterial safety evaluation, containment and monitoring have much to learn from the existing expertise and experience in the safety of radioactive substances, carcinogens, pathogens and biomaterials. New recommendations, however, need to be drawn up with due thought to the special properties of nanomaterials, to enable a rational regulatory environment as well as to harmonize experimental procedures across different laboratories worldwide.

7. Formalization of recommendations offered by the scientific community to regulatory authorities should continue to distinguish between nanomaterials in an industry-wise classification (metallurgy and mining, pesticides, consumer products, cosmetics, drugs, etc.) while retaining commonalities of across-industry concerns. Thus, for instance, long-term unintended environmental or occupational exposure to small doses of nanomaterials should be distinguished from intended, occasional administration of a large dose of nanometer-sized drug delivery system.

8. The terms 'nanotechnology' and 'nanomaterials' should be used responsibly, particularly by marketing professionals and those in the communication media. Science, technology and biomedicine researchers should rigorously self-regulate their own claims and those of their peers in presenting and communicating their research results pertaining to the use of nanomaterial and nanotechnology. Every attempt should be made to distinguish between phenomena that emerge by virtue of a given material being fabricated on a nanometer scale, and other phenomena associated with nanometer-scale materials that can be explained on the basis of what is known about the material present in larger sizes.

9. Historically, toxicology has lagged behind technology, but nanotechnology is an exception where toxicology concerns can keep in step with emerging technology. However,

nanotechnology is also expected to progress faster than previous technological initiatives. There is thus need for greater vigilance, scientific rigour, curiosity-driven research and mechanism-based explication of nano-toxicological observations.

10. The nanoscale materials, which do not exist in nature, should be regarded as a new compound and should be handled with care.

11. Physicochemical characteri-zation of inorganic nanoparticles have been carried out extensively, however, there is need to characterize organic nanoparticles, along with their properties in comparison to their macro structural particle.

12. There is urgent need to develop infrastructure and human resources to undertake research in nanotoxicology. Governments and funding agencies throughout the world need to strengthen this area through the following initiatives:

    i. Creation of laboratory/facilities for characterization and investigation of nanomaterials for their safety/toxicity and funding of research proposals and multi-disciplinary interactions in this area. At least 3% of the annual research budget should be allocated to nanotoxicology research.

    ii. Building up a priority list of nanomaterials to be studied for potential toxicity.

    iii. Setting up "libraries" or repositories or collections of well-characterized nanomaterials used in different applications, for use as standards as well as experimental material.

    iv. Coordination and funding of monitoring studies on persons already exposed to nanomaterials of various kinds as workers in nano-technology-enabled industries or consumers of nano-technology products.

    v. Adoption of informed regulatory guidelines to govern the use of nanotechnology and nanomaterials in different areas of application.

Delegation from Honeywell visits NAL

A delegation from Honeywell visited National Aerospace Laboratories (NAL), Bangalore, on 3 April 2008. Dr A. R. Upadhya, Director, NAL welcomed the delegation and gave a presentation on NAL activities.

Mr Larry Eugene Kittelberger, Senior Vice President, Honeywell, USA, expressed his happiness regarding the partnership with NAL, especially in SARAS auto pilot and software development programmes and appreciated NAL capabilities. He thanked the Director and NAL team for the cooperation and commitment. Dr T. S. Prahlad briefed about the progress made on the project. Dr M. K. Prasad, Vice President, Honeywell, appreciated the efforts made by the NAL team for the joint development of software programs, and also briefly explained the present activities of Honeywell, Bangalore. He said that working with NAL has helped HTSL to develop strengths in new areas of importance to aerospace.

Mr Kittelberger and Dr Prasad desired to continue the partnership by taking up a few more projects in the field of aerospace operations, controls, software testing and development of new products. He also mentioned that they are looking at Bangalore and Hyderabad for joint collaborations and mentioned that working with NAL is very exciting. The team also visited the Advanced Composites Division.

Dr Dinesh Mohan receives the Scopus Young Scientist Award

Dr Dinesh Mohan, Scientist, Environmental Chemistry Division, Indian Institute of Toxicology Research (IITR), Lucknow, has been honoured with the prestigious Scopus Young Scientist Award in Environmental Sciences for the Year 2007 in recognition of his outstanding achievements in the areas of remediation and encapsulation of priority pollutants from water/wastewater, tailoring of activated carbons and/or environmentally benign adsorbents, biomass pyrolysis for the development of bio-fuels (bio-oils), development of environment-friendly wood preservatives and biorefineries. The award consists of Rs 50,000 and a citation.

Scopus Young Scientist awards were instituted by Elsevier — the world's largest publisher in Science, Technology & Medicine to honour and propel India's young research minds towards furthering Indian Science in different branches of science and technology including biological sciences, chemistry, engineering, environmental sciences, material sciences, mathematics, medicine and physics.

Dr Dinesh Mohan, has published over 60 research papers in peer-reviewed journals of international repute. A number of his articles have been selected in the top 25 hottest articles. One, published in *Energy and Fuels*, was highlighted in a *Newsletter for Contributors to the ACS Cycle of Excellence*, 1(2) 2007. He has also published chapters in various books including two in the *Encyclopedia of Water* published by Wiley, NY. He has also filed a patent and presented a number of papers at international and national conferences and meetings.

Earlier, he was awarded a research funding under prestigious Young Scientist Scheme of Department of Science and Technology, Government of India in 2003.

Dr S. Chandrasekhar gets AP Scientist Award

Dr S Chandrasekhar, Scientist, Indian Institute of Chemical Technology (IICT), Hyderabad, has been selected for the prestigious Andhra Pradesh Scientist Award 2008 in recognition of his dedication to quality research and successful achievement in the area of "Chemical Sciences". This award is conferred by the A P State Council of Science & Technology, Government of AP, and the award carries Rs 25,000 and a citation.

Dr Chandrasekhar has made original and productive contributions to the field of Organic Synthesis. These include total syntheses of several bioactive natural products with correct stereochemical orientations of diverse scaffolds. The introduction of polyethylene glycol as a solvent for organic and organo-metallic reactions has opened up new vistas in the domain of green chemistry. His enthusiasm to perform collaborative research has led to initiation of several intellectually challenging projects with researchers from France, Germany, Korea, China, Switzerland and USA. Introduction of automation in organic synthesis is yet another challenge he has taken up more recently. His contributions to unraveling economically viable processes for drugs such as Misoprostol (anti-ulcer), Carboprost (oxytocic), Fondaparinux (anti-coagulant) and Taxol (anti-cancer) have made him a well recognized researcher in the field of industrial/process chemistry as well. Dr Chandrasekhar has published more than 160 papers in well reputed international and national journals. He has filed four patents and guided more than 12 students for their doctorate degrees.

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