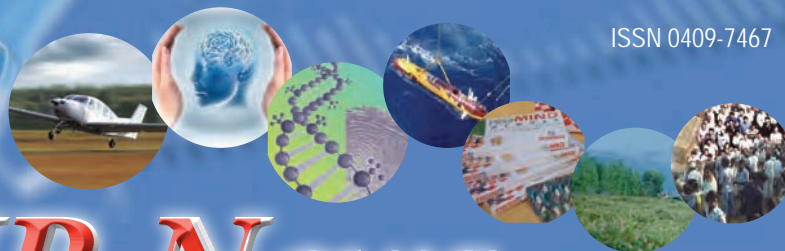




ISSN 0409-7467



# CSIR News

NEWSLETTER OF THE COUNCIL OF SCIENTIFIC &amp; INDUSTRIAL RESEARCH

Volume 64 No. 1 &amp; 2

website: <http://www.csir.res.in>

January 2014

## In This Issue

- 1** In The News
  - Prof. Samir Kumar Brahmachari Retires as DG-CSIR
  - Interview with Prof. Samir Kumar Brahmachari
- 13** R&D Highlights
  - Molecular Basis of Pathogenesis in Glaucoma Caused by Mutations in Optineurin
  - Ti and Ni-ti foams for Biomedical Applications
- 17** Technology Transfer MoUs
- 18** Workshops
- 19** Training Programmes
- 20** Foundation Day Celebrations
- 21** Lectures
- 22** Visits
- 23** Honours & Awards
- 24** Appointments

### In The News

## Prof. Samir Kumar Brahmachari Retires as Director General of the Council of Scientific and Industrial Research



Prof. Samir Kumar Brahmachari, Director General of the Council of Scientific and Industrial Research (CSIR), laid down office on 31 December 2013 after a distinguished tenure of seven years at the helm.

Leading the largest publicly funded R&D organization of India – the Council of Scientific and Industrial Research (CSIR) – he steered the strategic transformation of CSIR to champion inclusive innovation in India.

His vision was repositioning of CSIR with the focus on remaining strategically important for the nation; to have excellent scientists who are happy and proud to be in CSIR; to create large public good to remain relevant; and to become a unique organization for

achieving knowledge business the world over. Under his leadership, a road map for 2022 was prepared – **CSIR@80: Vision and Strategy – A New CSIR For New India.** This unique effort received appreciation from the Prime Minister of India and President, CSIR.

Prof. Brahmachari’s tenure was marked by several initiatives that are expected to yield fruitful results in the years to come.

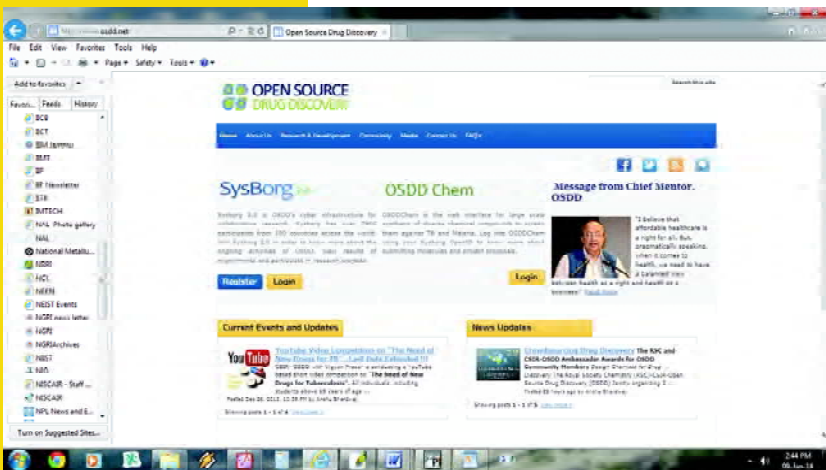
He was instrumental in the creation of the Academy of Scientific and Innovative Research (AcSIR) to generate human resource for transdisciplinary research by leveraging the infrastructure and scientific strength of CSIR. The academy, meant for promoting inter-disciplinary and



trans-disciplinary research that is ordinarily not offered in regular universities, seeks to increase the number of high quality PhDs in the country who can productively contribute to the growth of the nation.

Open Source Drug Discovery (OSDD) initiative was Prof. Brahmachari’s brainchild, and is considered perhaps CSIR’s boldest and most path breaking initiative in its seventy years plus history. Prof. Brahmachari was even bestowed with the title of “Open Source Guru” for conceptualizing and mentoring India’s first crowd-sourcing initiative.

The goal of OSDD is to enable open, collaborative scientific research that will make possible the discovery and development of new drugs. Its aim is to provide extremely affordable healthcare for the resource poor people across the world by creating ultra-low-cost drugs. This CSIR led team India consortium with global partnerships (over 7900 registered participants across 130 countries), provides a platform where the best minds can collaborate and collectively endeavour to solve the complex problems associated with discovering novel therapies for neglected tropical diseases like Tuberculosis, Malaria, Leishmaniasis, and so on. The acclaimed success of this philosophy has culminated into CSIR collaboration with organizations like TB alliance ([www.tb Alliance.org](http://www.tb Alliance.org)) and Mayo clinic, USA ([www.mayoclinic.org](http://www.mayoclinic.org)).



Prof. Brahmachari also pioneered open access of a new kind – open access to technology, knowledge, and information to enable inclusive economic development. The CSIR-800 programme initiative aims to reach affordable technologies and information to the 800 million people of the country at the bottom of the pyramid to bring about socio-economic transformation. The programme would strive to enhance incomes, increase agricultural yields, create wealth from waste, and provide low-cost housing, transportation, potable water and sustainable energy to some of the most backward areas in the country.

With the philosophy – “from creating wealth for a few big industries to creating wealth for many” – Prof. Brahmachari led CSIR to foster a major strategic partnership with the National Innovation Council (NInC). The alliance will particularly focus on setting Cluster Innovation Centres to promote innovation at grassroots level particularly the Micro, Small and Medium Enterprises (MSMEs) sector. The alliance will seek to enhance the innovation capability and capacity of 26 million MSMEs spread throughout the length and breadth of the country. Through the establishment of Cluster Innovation Centres at identified MSME clusters, CSIR expects to create enabling frameworks for technological interventions/innovations, which will contribute to enhanced productivity and competitiveness of MSMEs.

Prof. Brahmachari also formulated the policy for Scientific Entrepreneurship. This national effort pioneered and led by CSIR/DSIR has helped government to give nod for researchers to have an equity stake in scientific enterprises and spin-offs while still being employed in their organizations. This policy decision is to enable Indian scientists like their peers in all developed countries, to enjoy the commercial benefits of their inventions and patents.

Further, to enhance the innovation capacity of CSIR, and pursue technology commercialization and entrepreneurship of processes, products and services, Prof. Brahmachari laid the foundation of CSIR Tech Private Limited (CTPL). This independent company aids in the exploration



of newer models of technology transfer to the markets, and leveraging of private investments.

Prof. Brahmachari also conceptualized a mega project TAPSUN (Technologies and Products for Solar energy utilization through Networks) in partnership with MNRE.

Under his leadership, CSIR also bagged the much acclaimed Thomson and Reuters Innovation Award 2010 and 2013 for being

the most innovative hi-tech academic institution in the country.

It was during Prof. Brahmachari's tenure that the first *CSIR Techno Fest* was organized in 2010 to showcase the contributions of CSIR in driving forward the competitive industrial growth coupled with sustainable inclusive growth towards improving the quality of living of the common masses. As this fair highlighted the potpourri of the industrial competence and cultural diversity of India, it attracted a large number of

people including the important stakeholders of CSIR.

For the first time ever in the history of CSIR, the Republic Day parade in 2011



featured a science tableau of the Council of Scientific and Industrial Research showcasing the journey of drug development from generic to genomic medicines (personalized medicines which can be designed according to the gene patterns of an individual).

Curtains came down on the visionary scientific career of Prof. Samir Kumar Brahmachari as DG-CSIR, but not before he shared his experiences with the CSIR family.



*Before laying down office as the Director General of the Council of Scientific and Industrial Research, Prof. Samir Kumar Brahmachari talked to CSIR News about his eventful scientific journey, his quest to transform CSIR into a goal-driven forceful entity, and his vision for the future of CSIR.*

**CSIR News:** CSIR completed 70 years of its existence under your tenure. How would you define CSIR's role now, compared to when it was founded?

**S.K. BRAHMACHARI:** CSIR was established in the newly independent India. In the closed economy just after independence, when there was a shortage of funds and a very small industrial base, the country needed self-reliance. CSIR played a very important role and survived to the open market economy of today. Today, CSIR has a very different role to play. It has to catalyze innovation in the industry and take up high-end science to bring in industries of tomorrow. It has to create transdisciplinary human resource to make industries competitive and it should play a very important role in meeting societal needs for S&T innovation, especially in MSMEs and the rural sector.

**CSIR News:** What's the value that CSIR creates for India? What has been the economic impact of CSIR's research?

**S.K. BRAHMACHARI:** CSIR creates value at three levels. Firstly, CSIR S&T creates human resource, then it brings economic returns for the functioning of its laboratories, and thirdly its knowledge brings in more projects. But this is just a small component, may be just 25% of the total budget of CSIR laboratories.

A maximum of more than Rs 1000 cores is what CSIR spends from its internal budget and its extra planned budgetary expenses whereas non planned expenditure is probably Rs 3000 crores. But the economic impact of CSIR comes in the form of the technologies it transfers to Indian industries, which make money, for example, the generic drug industry, leather industry, metallurgy, polymer and material industry, TATA and several others which used CSIR technologies and created wealth.

In their hands the money then multiplied by a factor of hundred. Lastly, the benefit that flows to the public, for example, CSIR's role in generic drug industry like streptokinase and other biopharma-ceuticals.

Recently, we carried out an economic impact assessment of CSIR technologies and it has been shown that just two technologies, namely, the tractors Sonalika and Swaraj and biopharmaceutical streptokinase alone have generated Rs 28,000 crores worth economic return when the entire CSIR budget has been Rs 24,000 crores for the last 20 years.

We have also carried out economic impact assessment of another set of four technologies, namely, the rice bran oil, water filter of IMMT Bhubaneswar, the coke oven and the spartak tiles of Gujarat. It is clear that one of the highest economic returns comes from investments in these sectors. We all know that CSIR has been valued as the most innovative organization of 2013 by Thomson and Reuters and it is



more innovative than the major Indian industries in various sectors.

**CSIR News: When you were Director of the Centre for Biochemical Technology, what was your vision that spurred you on to transform the Centre into a national institute focusing on genomics?**



**S.K. BRAHMACHARI:** I came to the center realising that it had the potential tools for genomics research and dreamt of building a full-fledged genomics institute. My vision was to make India a global player in genomics and to mark its presence in the genomics map of the world. This was the mission which I was driven by and which allowed me to transform CBT into the Institute of Genomics and Integrative Biology (IGIB). The idea was that our large population with various disease profiles and

the large pool of Indian computational talent was a unique resource. I was very sure that when the human genome data becomes public, these two resources will play a key role in making functional genomics discoveries. The institute was built to realize this potential.

**CSIR News: Were there any takeaways from your stint as Director of IGIB that stood you in good stead when you took over the reins of the CSIR as its Director-General?**

**S.K. BRAHMACHARI:** As Director of IGIB, I transformed an institution. I learned how to use existing resources and how to use resources frugally to come up with globally competitive scientific performance. I learnt human resource handling, how to reorient scientists in the newest spheres of sciences and as a leader how to sell dreams and attract the best talents. I learned how to nurture young people who have never seen these facilities but could perform using those facilities as well as any experienced researcher of the world.

Hence, the journey from being the Director of IGIB to the Director General of CSIR was only a matter of scale-up. I had already operated at 1% scale and what had to be done was hundred times bigger. Even when I lived in the DG-CSIR bungalow as Director, IGIB, I felt obligated to spend 20% of my time worrying about CSIR. During Dr. Mashelkar's tenure as DG-CSIR, I had the privilege to be a member of the Governing Body, the CSIR society and in numerous policy decision making committees including the Vijay Kelkar Committee.

I spent at least 2000-3000 hours knowing about CSIR before I became DG-CSIR. I visited at least 22 out of 37 CSIR laboratories prior to becoming DG-CSIR. I had to spend about 7000 hours to know CSIR fully during my first two years of tenure as DG-CSIR in order to complete the required limit of at least 10,000 hours of learning about CSIR. I have visited all the CSIR centres and labs more than once during my tenure interacting with researchers and staff, except CSIR-CSMCRI, Bhavnagar where I have been





only once. I have visited some laboratories as many as 24 times to push projects.

So, my training as IGIB director and learning how to transform a small organization gave me the courage to make the elephant dance. All I can say is that reorganizing IGIB was like handling a motor boat and reorganizing CSIR was like handling a gigantic oil tanker. To turn it around needs enormous energy and effort. But once it is turned around and put on course, it is very difficult to change it. So, I believe what CSIR is today, it may slowly drift but will never undergo a metamorphosis into a new direction and lose its focus.

**CSIR News: What would you describe as some of the most significant initiatives that have been taken during your tenure of seven years as DG-CSIR?**

**S.K. BRAHMACHARI:** I think realizing the creation of transdisciplinary human resource as most important element and that research without teaching is sterile. It is a two-way loop that works. Students are the main force which eventually energizes and motivates the elderly talented workforce of an organization. In this context, what I count as a major achievement is the formation of AcSIR and the PGRPE programme that has completely transformed the engineering laboratories, which were in near coma state because of shortage of PhD in engineering in Indian institutions. I am sure, with the formation of AcSIR, in the next decade there will be a top-class brand of CSIR PhDs floating around. The programme has brought much enthusiasm and dignity to researchers and CSIR scientists across the laboratories are brushing up their basics to take up new roles.

The second accomplishment according to me is empowering scientists to spin-off companies through enactment of a law approved by the cabinet. The third accomplishment is to synergize CSIR laboratories to worry about 800 million Indians who need S&T intervention the most – the CSIR-800 programme.

Last, but not the least, is the formation of CSIR Tech thereby empowering scientists to drive innovation in CSIR, conceptualizing

innovation complexes and finally the OSDD project which has the potential to transform the entire health sector scenario by developing affordable drugs for neglected diseases.

But nothing would have been possible if the scientists of CSIR were not made happy through better assessed promotions, technical support staff and encouraged to take up more challenges by creating administrative structures that are nimble and



less bureaucratic. We also worked on bringing procedures for procurement and resource management, creating IT connectivity across the CSIR system to enable better interactions between scientists, establishing ERP across CSIR system as indigenously-built enterprise solution and designing 160 new projects over two years of debate involving all CSIR labs.

A little effort that has brought a large

All I can say is that reorganizing IGIB was like handling a motor boat and reorganizing CSIR was like handling a gigantic oil tanker.

**Prof. Samir Kumar Brahmachari**



**CSIR News:** The Open Source Drug Discovery initiative by you has been in the news in recent years. How did you come up with this idea and why do you think this is the right approach for drug development in the country?

**S.K. BRAHMACHARI:** OSDD initiative came as an idea in 2006, while formulating the Eleventh Five Year Plan. The idea of OSDD was driven by the dearth of drugs for neglected diseases. Big pharma companies are uninterested in manufacturing drugs for tropical infections like tuberculosis due to lack of market incentives. It was observed that they were not even interested in taking up technologies from CSIR laboratories, wherein we had developed some universal drug targets for broad spectrum antibiotics.

Thus, realizing that this activity has to be undertaken using public funding and we cannot have the market-driven business model as the only model, we developed a model called incentive mode through prize, rather than the incentive model through royalty and IPR. Following the success of the Human Genome Project and Linux, we also realized that we could accelerate the process of drug discovery in an open source mode by bringing in more expertise on a common platform.

Today, I am glad to say that we have been successful in achieving this goal. Today OSDD portal has the participation of over 7900 participants across 130 countries, we have been able to identify

outcome is the creation of OASIS which is the indigenous online portal to access S&T information. With CSIR's own YouTube, CSIR's own blog and Facebook today CSIR is a socially connected organization and has a new brand name which associates with youth. CSIR has been encouraging young scientists to take up leadership positions, bringing the best scientific talents to lead the CSIR labs through transparent procedures and to upgrade the positions of directors and distinguished scientists in the CSIR system. We have been able to bring in NRI researchers, STIO's (scientists and technologists of Indian origin) and international expertise to participate. For the first time in the history of the organization there is international expertise on the advisory board and in the CSIR academy board to benchmark CSIR globally and take it to the select group of the top 100 institutions of the world.



many non-toxic targets and small drug-like molecules and currently we are taking a new combination of molecules to phase-2 clinical trials in India.

**CSIR News: Are there any challenges to this model of drug discovery?**

**S.K. BRAHMACHARI:** Yes, the biggest challenge that is faced while propagating Open Source Drug Discovery is the mindset of the people. It is extremely difficult to bring people to accept the fact that we are paying too much for healthcare because we are still using the old conventional methods of drug discovery. While processes like designing a car or aircraft or launching a satellite are today done with high mathematical precision using computational simulations, drug discovery is still a trial and error process, like the Wright brothers' way of flying an aircraft in the 1900s. So, the two biggest questions here are whether we can change the existing mindset and secondly how to take the OSDD model beyond neglected diseases.

**CSIR News: Over the past couple of years CSIR seems to have taken up the cause of MSMEs and rural development with renewed vigour. Could you tell us something about that?**

**S.K. BRAHMACHARI:** CSIR has always been industry focused. It is important to realize that today's giant industries were yesterday's small industries and today's small and medium industries were yesterday's micro industries. Biocon grew from being a very small enterprise to a very large enterprise. Over the years, CSIR has been focusing on medium, small and micro enterprises which eventually became larger enterprises. So, CSIR's relation with large industries has grown with years and CSIR was fully absorbed in working with large industries. However, in sectors like biotech and drug pharmaceuticals CSIR has been responsible for the creation of many small industries. The pharma sector is today a 100-million dollar industry if not a billion dollar industry.

Also, we realize today that there are MSME clusters where CSIR can contribute in the way of improved processes, energy

efficient technologies, waste matter utilization and reduction of wastes. It has also been realized in the last few years that MSMEs form the backbone of 40-45% export of this country and engage nearly 300 million people providing them livelihood. Hence, it is clear that focusing on this sector means focusing on overall improvement of the economic condition of the country. So, CSIR has refocused itself on cluster-specific technology transfer rather than individual industry-based technologies. We are also using crowd sourcing and open innovation space to bring together people who can replicate, propagate and scale-up some of the technologies we have developed. Electric rickshaw developed by CSIR is one such example which eventually got modified, adopted and scaled up in cities like Delhi.



**CSIR News:** CSIR is setting up a 100-crore Innovation Complex close to Kolkata. How do you perceive this complex giving a push to innovations in the country?

**S.K. BRAHMACHARI:** CSIR is not only setting up an Innovation Complex in Kolkata, but also in Chennai and Mumbai to start with and has got approval for eight other locations. The idea is to create a space that facilitates interactions between researchers and entrepreneurs to generate multi-disciplinary inputs for the creation of prototypes, products and small spin-off companies. It is perceived to be a hub for open innovation and also as a site that provides the required knowledge support



to MSMEs. We hope that these centers will boost the innovation space of India and give a large impetus to MSMEs to take up new technologies for upgrading their products and improving their economy.

**CSIR News:** Has any conscious effort been made over the past few years to strengthen the CSIR-Industry linkage?

**S.K. BRAHMACHARI:** CSIR has always been actively interacting with the industries. However, in recent years public-private partnerships have faced several criticisms and unsympathetic support from the stakeholders. Therefore, CSIR has gone very cautious in its public-private partnership programmes and in many sectors it is focused more on MSME sectors rather than large industries.

**CSIR News:** What was the vision behind setting up of the CSIR-Tech?

**S.K. BRAHMACHARI:** We realized that Indian industries don't have the appetite to take up high risk technology projects whereas young entrepreneurs are willing to do so. But young researchers may not have the resources to take CSIR technologies. So we decided to consider knowledge as equity. CSIR can then spin-off companies with whom it can license its technologies and hold equity and thereby convert cash into equity and eventually in future lead to larger wealth generation than just technology transfer fee or royalty. This is also likely to generate job opportunities. Hence, CSIR-Tech is an enabling instrument for CSIR scientists to spin-off companies and for those companies to create new employment opportunities.

**CSIR News:** There is this inevitable comparison with China vis-à-vis scientific progress. What is it that China has done to surge ahead? And what is it that we should be doing?

**S.K. BRAHMACHARI:** I think speed matters.... China's biggest strength is the speed of implementation from decision to policy while in the democratic system of India, we are too slow to implement many of the decisions we take and I think that is what differentiates the growth in China versus the growth in India, especially in the scientific sector. It is unfortunate that we don't value time so we need a time audit as much as we require a performance audit or finance audit. If we can speed up our implementation as we plan and provide appropriate economic resources to implement, I think technology will take the Indian economy much further than it is today.

**CSIR News:** The spending on science in the country is still too low as compared to China. Do you think there is a direct linkage of scientific output with budget allocation?

**S.K. BRAHMACHARI:** China is committed to expansion and the number of universities and institutions that it has created in the last 10-15 years is very very



large compared to India. So it won't be appropriate to compare us with China in this sense. It is important to note that China focused on skill development, while India focused on higher education. Although we had Polytechnics, the Chinese succeeded because of their skill development programmes and today China has far more number of skilled individuals than India. Therefore, the scientific output or industrial productivity is very much linked, not only to the financial resources available, but also to the trained human resource available. As I said, China's biggest strength is the speed of implementation and I think that is what differentiates the growth in China from the growth in India, especially in the scientific sector.

**CSIR News: Has the functioning of CSIR ever been cramped due to budget constraints?**

**S.K. BRAHMACHARI:** The answer is both Yes and No. Many times, many expansion and scale up programmes have got curtailed because of budgetary constraints. However, CSIR's internal strength has often raised resources internally. The administrative bureaucracy and finance often hold back the activities of CSIR in the fear that there will be a shortage of resources and there is no guarantee that the resources will be available in future. But as we all know that in a Government system risk taking is not encouraged whereas all entrepreneurship is driven by the risk that you take. People borrow money and create wealth. In CSIR, very often restraints have come with the belief that we may not be able to raise funds. But I have always seen that if one has a dream and chases the dream with a single minded focus, resource is never a limitation. But convincing the machinery, including finance, is often difficult.

**CSIR News: Some feel that the largest network of scientific laboratories has today turned into a lumbering giant and needs to be downsized and reoriented for it to really become effective. What do you say?**

**S.K. BRAHMACHARI:** No, actually I

would say it is the other way. The large size helps in the impact of a body, so that even when the velocity is low it has a huge momentum. I think the strength of CSIR lies in its diversity and its size along with scientific acumen. All the CSIR national laboratories combined together make up may be 25% more than the size of institutions like Oak Ridge National Laboratory, which is one of the biggest in the US. Hence, I think, we need more scale-up operations. Our institutions are too small compared to the requirements of our population and we need to expand our activities in order to fulfill them. So, I don't find any reasons why CSIR should be further downsized when it is already downsized with respect to administrative and support staff. You can't have an oil tanker of the size of a boat because obviously it doesn't serve the purpose. The advantage of such a large organization is that when even 20% of the laboratories perform they yield 80% results and we all know that not all the laboratories perform all the time in a similar manner. CSIR has been relevant from what can be called the import-substituted economy to the technology-driven era and the open market space and continues to play a vital role even during these times of changing market demands, industrial profile and economic policies of the country. I would say, this has happened because the diversity and size of CSIR has allowed it to happen.

**CSIR News: At the Mail Today Education Conclave 2012, you said that India needs a new crop of scientists and technologists who are trained in a multi-disciplinary fashion. What did you really mean?**



**S.K. BRAHMACHARI:** What I meant was that in the coming times, we are going to see a strong integration of various scientific disciplines. All the new developments will happen at the interface of disciplines. At this interface, we require hybrid manpower who love Biology along with understanding Mathematics. We are



aware that the Indian education system is highly segregated. Those who like and study Biology become doctors and those who like Mathematics become engineers. It is time we realize the importance of trans-disciplinary education considering the need of hybrid knowledgebase. I believe that the CSIR Academy if successfully handled will be able to implement this vision of creating a national pool of hybrid manpower.

**CSIR News: Do you look back at your stint as DG-CSIR with satisfaction? Are there any regrets, any failures?**

**S.K. BRAHMACHARI:** Six years back, when Dr. Mashelkar relinquished his office, I was not a candidate for the office of DG-CSIR, as I felt that I could contribute much more as a scientist than as a science manager. I was aware that CSIR had to be re-engineered to face the challenges of new India but was doubtful whether such a feat was possible. However, when I look back six years down the memory lane, I have great satisfaction to see that while I accepted the challenge under very different circumstances, today CSIR is a unified organization ready to face the challenges of the future. Today we have a new CSIR for new India. This is quite satisfying.

However, the regret I have is that I have not been able to make CSIR a complaint-free organization. Although there has been a major reduction in the number of complaints, it is not yet complaint-free. The regret I have is that I am not aware of any mechanism with which an organization of this size can be made completely complaint-free.

**CSIR News: How do you visualise the future of CSIR say 10 years from now? What do you think would be the major areas where CSIR is expected to make its mark in the coming years?**

**S.K. BRAHMACHARI:** If CSIR continues to use the existing set up and the Twelfth Five Year Plan is successfully implemented, it is very clear that CSIR will lead the Indian S&T into a new horizon in the coming years. It is also evident that in the next 10 years, life sciences will get integrated with physical, chemical and engineering sciences. At this interface of scientific disciplines, students of CSIR academy will have a pivotal role to play and will be able to contribute towards generating affordable solutions in the areas of next-generation healthcare devices, energy saving devices, and environment friendly technologies.

**CSIR News: Finally, after stepping down as DG-CSIR, what do you plan to do professionally as well as on the personal front?**

**S.K. BRAHMACHARI:** I would like to spend time mentoring young researchers and interacting with and motivating the younger generation. I plan to pursue the scientific activities of my Open Source Drug Discovery as a global effort. I am also keen on working towards taking CSIR-800 technologies to rural India.

On the personal front, I am looking forward to getting rid of my watch that reins my time and lead an unshackled life, not dominated by busy schedules or controlled by a personal secretary.

*(Prof. Samir Kumar Brahmachari was interviewed by Hasan Jawaid Khan and Geetha Sugumaran)*



# Molecular Basis of Pathogenesis in Glaucoma Caused by Mutations in Optineurin

Genetic as well as environmental factors lead to glaucoma – a complex eye disease resulting in blindness. Loss of vision in glaucoma is progressive and is due to death of retinal ganglion cells in the optic nerve head. It is the second leading cause of blindness worldwide and in India it is the fourth leading cause of blindness.

While cataract, which is the most common cause of blindness, can be treated by surgical replacement of eye lens, loss of vision in glaucoma cannot be regained by

therapeutic intervention. Therefore, it is important to understand the molecular mechanisms involved in the pathogenesis of glaucoma so that strategies for prevention and treatment can be devised.

Mutations in certain genes are often primarily responsible for glaucoma. One of the genes mutated in glaucoma patients is *OPTN*, which codes for the protein optineurin. An alteration in this gene (M98K) was earlier shown to be associated with glaucoma only in South Asian populations.

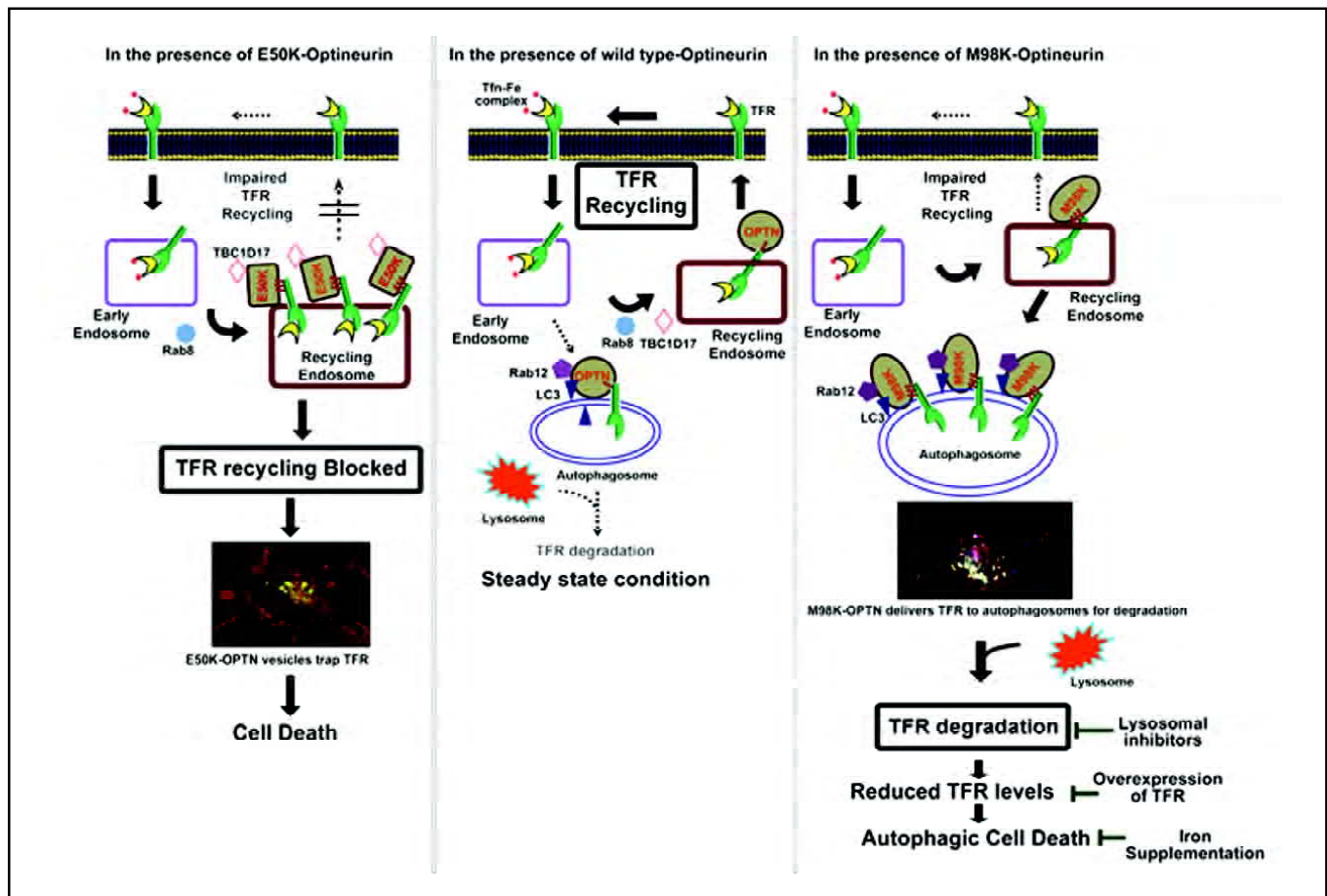


Fig. 1. Model depicting how E50K and M98K variants of optineurin (OPTN) cause cell death in retinal ganglion cells by altering dynamics of transferrin receptor (TFR). In normal cells expressing wild type optineurin, TFR bound to transferrin-iron complex is internalized by endocytosis and recycled back to plasma membrane after releasing iron in the cell. In M98K expressing cells, TFR is degraded by enhanced autophagy leading to cell death. The microscopic image shows M98K sequestering TFR in autophagosomes. However, in E50K expressing cells, TFR is not degraded but its cycling is blocked due to altered molecular interactions, leading to accumulation of TFR in large vesicular structures (shown in yellow in microscopic image) and cell death

Our work has therefore shown that M98K and E50K mutations induce death of retinal ganglion cells by engaging two different mechanisms. This work is being carried out in collaboration with L.V. Prasad Eye Institute, Hyderabad.

Our work at CSIR-CCMB has shown that M98K variant of optineurin induces death of retinal ganglion cells in culture (RGC-5 cell line) but not of other neuronal or non-neuronal cells [1].

This cell death involves enhanced autophagy, a process that removes damaged proteins and organelles in the cells by degradation in lysosomes. Blocking of this enhanced autophagy by chemical inhibitors or knocking down genes required for autophagy can prevent cell death induced by the mutant protein. Enhanced autophagy induced by M98K-optineurin leads to degradation of transferrin receptor, a protein involved in iron uptake and in maintaining iron homeostasis in the cell.

Degradation of transferrin receptor (TfR) is crucial in inducing cell death by M98K-optineurin, because death could be prevented by blocking transferrin receptor degradation or by exogenous expression of the transferrin receptor.

The molecular determinants of autophagy, essential for cell and tissue homeostasis, are presently poorly understood. Our work has identified a regulator of autophagy, Rab12, which is a GTPase involved in controlling membrane-vesicle trafficking. Rab12 is essential for M98K-optineurin induced autophagy, transferrin receptor degradation and cell death in retinal ganglion cells. This work also showed that Rab12 is involved in autophagy induced by amino acid starvation.

Studying another glaucoma associated mutant of optineurin, E50K, we showed that its expression induces death selectively in RGC cells. The mutant caused defective TfR cycling resulting in reduced transferrin uptake [2,3]. Our work also showed that cellular optineurin functions to regulate endocytic recycling of transferrin receptor, a fundamental process involved in uptake of iron by cells. Optineurin regulates activity of Rab8, a GTPase controlling endocytic trafficking of transferrin receptor. Optineurin binds to the activated, GTP-bound form of Rab8 and then recruits TBC1D17, a GTPase activating protein that inactivates activated Rab8. Thus, optineurin regulates Rab

8-mediated endocytic recycling of transferrin receptor by controlling the activity of Rab8 through TBC1D17 [2].

The E50K mutation in optineurin shows altered interaction with Rab8 and causes a defect in TfR recycling leading to insufficiency of transferrin uptake by cells. Unlike M98K, which induces autophagy and transferrin receptor degradation, the E50K mutation does not induce transferrin receptor degradation, but results in accumulation of TfR in large vesicles containing mutant OPTN.

Our work has therefore shown that M98K and E50K mutations induce death of retinal ganglion cells by engaging two different mechanisms (Fig. 1). This work is being carried out in collaboration with L.V. Prasad Eye Institute, Hyderabad and currently we are exploring the role of optineurin in autophagy, membrane vesicle trafficking and signalling involved in gene expression.

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*Dr Ghanshyam Swarup from  
CSIR-CCMB*

# Ti and Ni-Ti foams for Biomedical Applications



Titanium and its alloys are biocompatible to human bodies. Therefore, these materials are being extensively used for joint replacements. However, their mechanical properties as well as microarchitectural structure should also be compatible with bones for much faster recovery and effective performance. Otherwise, there may be possibility of stress concentration at the interface which will lead to infection and loosening of the joint.

In this direction, it is aimed to make bioactive Ti-foams from pure Ti and/or its alloys. The cellular structure of these foam materials can be tailor-made by varying the cell size and cell volume fraction with the variation of size of space holders and their volume fraction. In addition, the foam structure can be made into a functionally graded structure according to the bone structure with variation of size and concentration of space holder from surface to the centre while making these foam-using space holders.

CSIR-Advanced Materials and Processes Research Institute (CSIR-AMPR), Bhopal has initiated work on bio-compatible materials like bio-active Ti-foams of varying cell sizes and porosities for bone-implants and bone regeneration as a part of the 12<sup>th</sup> Five year plan project (BIOCERAM) ESC 0103 under the nodal laboratory CSIR-CGCRI, Kolkata. CSIR-AMPR scientists have successfully made Ti-foams using different space holders through powder metallurgy route which has been made bio-active with a coating of HAP.

## Open Cell Ti-foams with Unimodal Cell

Open cell Ti-foam with average cell size up to 500  $\mu\text{m}$  was made using different space holders such as NaCl, Amonium Bicarbonate and Acrowax. These space holders either get evaporated during drying and sintering or get dissolved out in water after sintering leaving behind a cellular structure. The size of these space holders and their amounts were varied to get varying cell size and density in the foam materials. In initial attempts, open cell Ti-foams with porosity up to 80% and cell size up to 500  $\mu\text{m}$  were made (Fig. 1). The foams also contain very fine porosity in the cell wall which will allow easy flow of bio-

fluid and make the tissue growth easier and faster. Thus the recovery could be faster.

The strength and modulus of these foams as a function of relative density (density of foam/density of dense Ti) showed that the strength of foams varies with

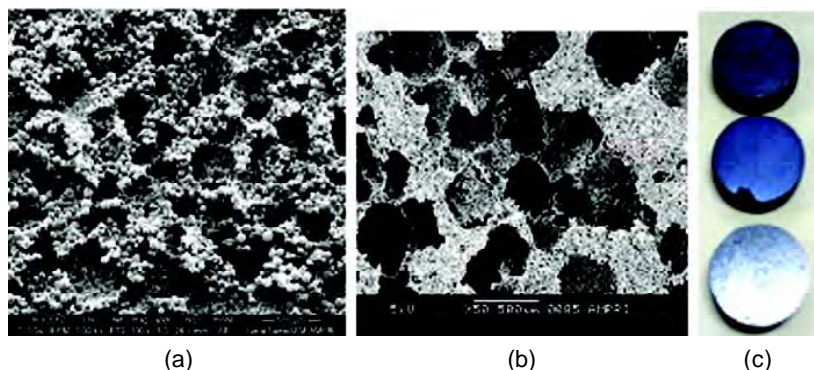


Fig. 1. Open Cell Ti-foams made with (a) NACL as space holder and (b) ammonium bicarbonate as space holder and (c) Ti-foam pellets

relative density. In case of pure Ti-foams, a strength of 35 to 40 MPa can be achieved when its relative density increased to 0.35 (porosity = 65%) (Fig. 2). Under such conditions the modulus of these foams is observed to be 15 to 18 GPa (Fig. 3). It is noted that for getting higher strength and modulus, either the porosity of the foams should be reduced or the strength of the matrix be improved through alloying.

## Open Cell Ti-foams with Bimodal Cell

In order to get easier flow of biofluid and also for faster tissue growth, it is thought

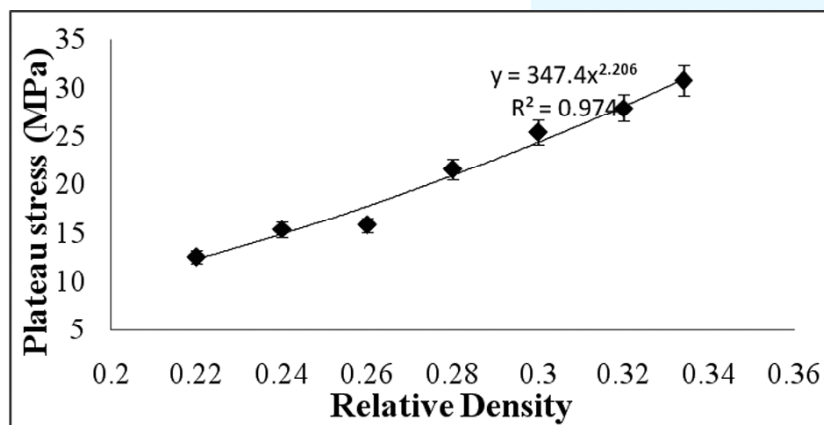


Fig. 2. Plateau stress of open cell Ti-foam as a function of Relative Density

that Ti-foams with bi-modal cell size distribution could be better options. Therefore, space holder of bi-modal size distribution was used, wherein average size of 500  $\mu\text{m}$  and 50  $\mu\text{m}$  are used together in the ratio 2:1. The foam produced through this technique clearly showed coarser cells of

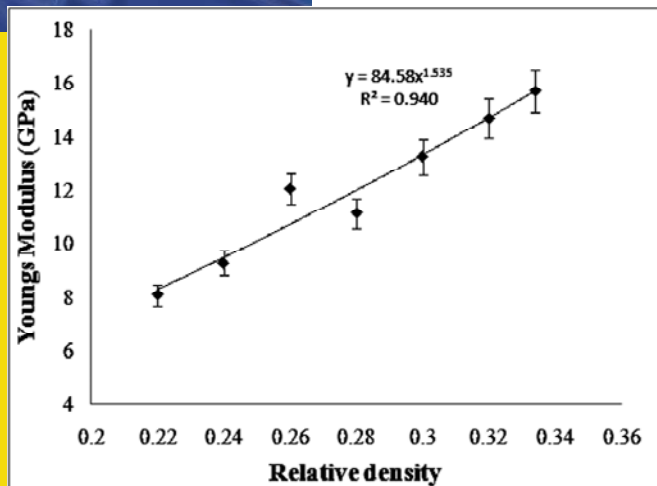


Fig. 3. Young's modulus of open cell Ti-foam as a function of relative density

500  $\mu\text{m}$  and finer cells of 50  $\mu\text{m}$  at the cell wall of coarser cell (Fig. 4). The strength of these foams (relative density = 0.30) is also noted to be  $\sim 30$  MPa and its modulus was noted to be  $\sim 15$  GPa.

### HAP Coated Ti-foams

Ti-foams were coated with suspended HAP particles (2 to 5  $\mu\text{m}$ ) through spin coater. The coating duration was varied between 2 to 4 hours. After coating, the foams were dried and sintered to make the coating strongly adhered with the cell wall of the foam. It is noted that a considerable amount of cell wall is coated with HAP. The strength of these foams was then noted to be improved significantly. The HAP coated Ti-foam with 0.35 relative density exhibited strength of  $\sim 50$  MPa and modulus of  $\sim 20$  GPa signifying that the strength and stiffness of foams could be improved through such type of coating. As HAP is bio-active, these Ti-foams can also be made bio-active. It is thought that Ti-foams can be made cost effective and user friendly for bone scaffold applications.

CSIR-Advanced Materials and Processes Research Institute, Bhopal is now attempting their in-vitro analysis with collaboration of other CSIR Laboratories and local institutes like Peoples University Bhopal, IISER Bhopal and AIIMS Bhopal.

*Dr B.K. Prasad, Dr. D. P. Mondal & Dr. J.P. Chaurasia from CSIR-AMPRI*

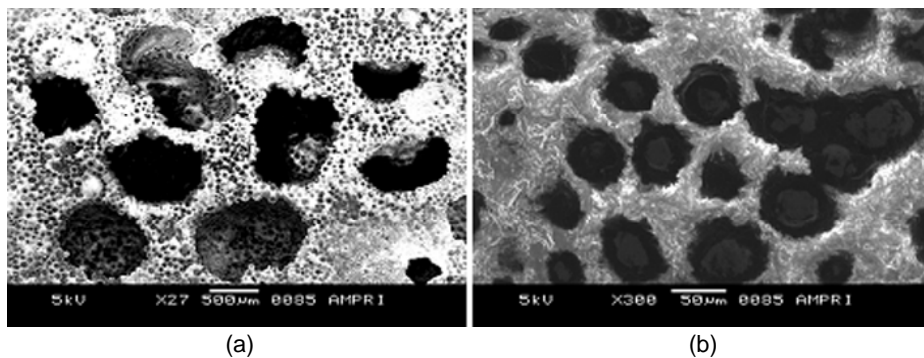


Fig. 4. Microstructure of open cell Ti-foam with bi-modal cell size (a) overall microstructure and (b) microstructure of cell wall

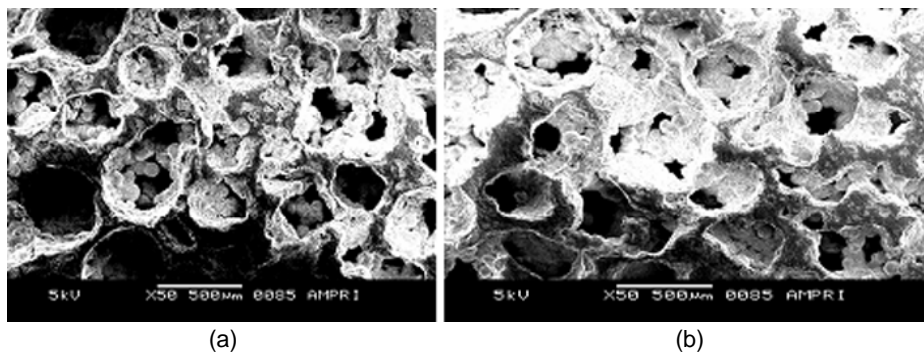


Fig. 5. Microstructure of HAP coated Ti-foams (a) Coating for 2 hrs and (b) Coating for 4 hrs

## Transfer of Technology by CSIR-AMPRI



Signing of agreement between CSIR-AMPRI and Jindal Steel and Powers Ltd (JSPL)

CSIR-Advanced Materials and Processes Research Institute (CSIR-AMPRI) has signed Technology Transfer Documents with Jindal Steel and Powers Ltd (JSPL), Raigarh for licencing of the process for making fly ash based cementitious materials useful for making Cement-free Concrete of varying grades, depending on the characteristics of fly ashes and aggregates for non-structural applications. The process has been licenced to JSPL on non-exclusive basis for their internal use.

The process is useful for making concrete suitable for road laying, repair and other applications and completely obviates

the use of cement and also does not require water during the curing process needed in the conventional concrete. The avoidance of cement in the concrete has further advantage of reducing the carbon dioxide load on the environment – each ton of cement production leads to the generation of one tone of carbon dioxide.

The team responsible for this Technology Transfer includes Dr. S.S. Amritphale, Chief Scientist, Dr. Navin Chandra, Acting Director, Dr. Deepti Mishra, Shri R.K. Chouhan, Dr. Manish Mudgal, Shri Mohd. Akram Khan and Dr. Swati Lahiri.

### MoUs

## CSIR-CRRI signs MoU with Delhi Technological University



The CSIR-Central Road Research Institute (CRRI) signed an MoU with the Delhi Technological University on 12 September 2013 at New Delhi. The purpose of this MoU is to create a framework for collaboration between CSIR-CRRI and DELTECH with the following objectives:

1. To establish close linkage and functional coordination between CSIR-CRRI and DELTECH.

2. To consider the qualified scientists, scholars and professional of CSIR-CRRI as an accredited faculty/guide for different research, teaching programmes of DELTECH and vice versa.
3. To facilitate joint seeking of funds and conduct of research, submission of project for research and development, training and consultancy with university/institutions in India and abroad.
4. To deploy students as trainees on industry interested projects, initiated by DELTECH but supported for technical domain from CSIR-CRRI.
5. To mentor DELTECH students for innovation management.
6. To share resources for taking R&D output forward.
7. To trace entrepreneurial possibilities through students on road and transportation technologies.
8. To co-supervise meritorious students for their higher education on innovation projects.
9. To bridge the connection between innovative pursuits and acceptance of the industry.
10. To organize joint conferences and seminars.
11. To jointly supervise students for their project/thesis work.

### Workshops

## 5<sup>th</sup> India-Korea Joint Workshop on Bioenergy Incorporating Biofuels and Biorefineries



Dignitaries on the dais

The 5<sup>th</sup> India-Korea Joint Workshop on Bioenergy Incorporating Biofuels and Biorefineries was held at CSIR-National Institute for Interdisciplinary Science and Technology (NIIST), Trivandrum during 9-10 September 2013. It was organized and supported by the Department of Science and Technology (MoST), Govt. of India, Ministry of Science, ICT and Future Planning (MSIP), Govt. of Korea, Asian Research Network, Seoul, Korea Institute of Science and Technology, Seoul and hosted by the CSIR-NIIST.

There were about 90 delegates from Korea and India who attended the workshop. The scientific programme of the

workshop was divided into five technical sessions, *viz.* Algal Biofuels & biorefinery, Microbial fuel cells, Biohydrogen, Biomass to fuels and Lignocellulosic biomass conversion and value addition, and Advanced biofuels and chemicals.

The workshop aimed to improve relations in science and technology between the two countries through their mutual interest in chosen themes such as bioenergy. This workshop was not only envisioned to make a win-win model based on the exchange of ideas and human resource but also expected to proceed to an economic partnership between India and Korea.

The workshop was inaugurated by Prof. Haiwon Lee, Hanyang University, Seoul, Korea and Dr. Suresh Das, Director, CSIR-NIIST on 9 September 2013. In his welcome remarks, Dr. Das emphasised the need for advanced research in the area of energy. Prof. Lee mentioned the importance of collaborative research between the two countries, which have identical situations in many terms.

Dr. Sanjay Bajpai, DST, Govt. of India outlined various collaboration opportunities

offered by the DST in various fields of science and technology. Dr. Rajeev Kumar, DST Coordinator talked about the past and on-going collaboration with Korea, including the details of ministerial level meetings held in New Delhi in November 2012 and recommendations and expressed the hope that the current workshop would be a grand success opening up opportunities for joint projects in the area of bioenergy.

Prof. Ashok Pandey, Coordinator (India) addressed the audience informing the specific aims of the workshop. He also presented briefly the activities of CSIR-NIIST in the area of bioenergy, with special reference to the Centre for Biofuels, established at NIIST with the support of TIFAC (DST), New Delhi and CSIR, New Delhi.

Twenty two lectures were presented by eminent speakers from both the countries. In addition, a poster session was also held on 9<sup>th</sup> September in which participants presented their work. In the afternoon of 9<sup>th</sup> September, the delegates visited the pilot

plant facility of the Centre for Biofuels.

Before the closing session on 10<sup>th</sup> September, a panel discussion was held to identify and recommend R&D areas/topics of mutual interest for both the countries for future collaboration in the area of bioenergy. Prof. Haiwon Lee and Prof. Ashok Pandey moderated this session. Dr. P. Binod, Scientist, CSIR-NIIST was vice-coordinator of the workshop and thanked the delegates, invitees and supporting agencies for their contribution to the success of the workshop.



Group photograph of the Workshop participants at CSIR-NIIST

### Training Programmes

## Training Course on Making Incense Sticks for Special Kids Organised by CSIR-CIMAP

A special training course on *agarbatti* making was organised by CSIR-Central Institute of Medicinal and Aromatic Plants (CIMAP) on 28 September 2013 for physically and mentally challenged children of different schools in collaboration with a local

organisation Shaswat Jigyasa.

About 30 students and their teachers from JB Academy, Faizabad, Navjyoti School of Visually Impaired, Mohanlal Ganj, Asha Jyoti and Pysum Vocational Training Centre, Lucknow participated in the training.

Dr. A.K. Singh, Chief Scientist, CSIR-CIMAP explained the importance of making incense sticks from used and dried flowers which also helps in protecting the environment to a great extent. He also said that regular courses have been planned by CSIR-CIMAP under the CSIR 800 programme on this subject.

Dr. R.P. Bansal, Senior Scientist, CSIR-CIMAP demonstrated the technique of *agarbatti* (incense sticks) making through hand rolling which provides self-employment opportunity to people from all walks of life. Dr. Bansal said that the CIMAP technology replaces use of coal and

*babool*/bark powder with flower powder which also cuts down their cost of production.

Mr Seetanshu Kumar of Shaswat Jigyasa thanked Dr. C.S. Nautiyal, Director, CSIR-CIMAP and CSIR-NBRI for extending support and guidance in organising such a course for special children. The children who learnt the technique of *agarbatti* making and perfuming expressed happiness at being exposed to such skills for the first time in a scientific institute. They were also taken round the fields of medicinal and aromatic plants and were explained about their beneficial effects and uses in medicines and flavours and fragrances.



Special kids learning agarbatti making technique at CSIR-CIMAP

### Foundation Day

## CSIR-CSIO Celebrates Foundation Day



Dignitaries on the occasion of CSIR-CSIO Foundation Day

CSIR-Central Scientific Instruments Organisation (CSIO), Chandigarh celebrated its Foundation Day on 30 October 2013. Prof.

N. Sathyamurthy, Director, Indian Institute of Science Education & Research (IISER), Mohali, was the Chief Guest on the occasion and gave an inspiring, motivating and thought provoking Foundation Day Lecture on “*Symmetry and beauty of the floral world around us*”.

Prof. Sathyamurthy stressed on the need for observation and learning from nature which is present around us. He said that symmetry and its analysis of flowers reveals many secrets hidden by nature. He discussed the importance of microstructural analysis of pollen grains of flowers. He also highlighted the study conducted by him on the purple passion flower. Prof. Sathyamurthy underlined the need for observing and appreciating the symmetry and the beauty of the floral world around us. He correlated

his observations with geological events of earth, paleobotany, microstructure of fluorescence and their constituents.

Dr. Girish Sahni, Director, CSIR-CSIO while welcoming the Chief Guest, highlighted the aims and goals of CSIR-CSIO and its contribution in the field of science and technology. Dr. Sahni also presented an overview of the on-going projects and future plans of the organisation. He said that the lab has traversed a long journey and is celebrating its 54<sup>th</sup> foundation day.

He spoke about the activities carried out in the concluding phase of the 11<sup>th</sup> five year plan and also the planning being done for the 12<sup>th</sup> five year plan. He articulated that there is a need to synergize with each other and look at the positive aspects of individuals and the organization. He said that a great opportunity lies ahead and called for the translation of the scientific research into products and services that can be beneficial to the end user.

The Chief Guest also went around the laboratories of the CSIR-CSIO where the

concerned scientists explained the work being carried out in the areas of optics, prosthetic, advanced metrology, and strategic instrumentation with display of products and project charts.

The Annual Report (2012-13) of CSIR-CSIO was also released by Dr. Girish Sahni.



Release of CSIR-CSIO Annual Report 2012-13 by Dr. Girish Sahni, Director, CSIR-CSIO, Chandigarh on the occasion of CSIR-CSIO Foundation Day

## Lectures

### 19<sup>th</sup> Dr. J.N. Baruah Memorial Lecture held in CSIR-NEIST

The 19<sup>th</sup> Dr. J.N. Baruah Memorial Lecture in the honour and fond memory of former Director of CSIR-North East Institute of Science & Technology, Jorhat and President of Assam Science Society was held in Sivasagar College, Joysagar on 2 September 2013.

The lecture was organized by the Dr. J.N. Baruah Memorial Trust, Jorhat, Assam Science Society, Jorhat Branch in collaboration with CSIR-North East Institute of Science & Technology, Jorhat in association with Sivasagar College, Joysagar at the MCB Auditorium of the Sivasagar College to motivate young students to take up science as a career and to encourage scientific research in biology and chemistry in the North Eastern Region.

The Memorial Lecture programme was

inaugurated by Dr. R.C. Boruah, Acting Director, CSIR-NEIST, Jorhat who in his inaugural lecture said, "Research in Science & Technology is the only way to progress and late J.N. Baruah always encouraged good scientific research." Being an ex-student of the college, he also expressed happiness at the progress of the Sivasagar College.

A brief profile of Late Dr. J.N. Baruah was introduced to the participants by Dr. R.L. Bezbaruah, Senior Principal Scientist, CSIR-NEIST and a brief profile of Prof Alak Kumar Buragohain, Vice Chancellor, Dibrugarh University and Chief Guest of the programme, was introduced by Dr. S.P. Saikia, General Secretary of the Trust and Scientist of CSIR-NEIST.

"There is intervention of Biological Science in each and every activity in our daily life," said Prof. Buragohain in his 19<sup>th</sup>

Dr. J.N. Baruah Memorial Lecture on *The Social Significance of Modern Biology*. He talked lucidly about the Cell Theory, laws of inheritance & survival of the fittest, origin of species, what is life – the physical basis of life, discovery of DNA, genetic engineering of human insulin by Eli Lilly, patenting life form i.e. bacteria *Pseudomonas aeruginosa* for the first time and how the

The sustainable exploitation of natural resources is necessary for posterity, commented Mr. Meenakshi Sundaram, Deputy Commissioner, Sivasagar in his lecture as a guest of honour. Very soon one society will be registered for the protection and conservation of historical sites and environment in Sivasagar, he further added.

Dr. P.G. Rao, CSIR Technical Consultant and Former Director, CSIR-NEIST mentioned in his lecture as guest of honour that late Dr. J.N. Baruah was a pioneer scientist in the region and CSIR-NEIST was ahead of time in research activities by developing technologies like papers from water hyacinth and low cost bamboo house.

Mr. Siddhartha Sharma, son-in-law of Late Dr. J.N. Baruah requested the students to focus on their goals ignoring their social background and barriers.

Ms. Papor Saikia, a student of Higher Secondary Science of Pragiyotika Junior College, Titabor who secured 91.5% marks in the High School Leaving Certificate Examination of Board of Secondary Education, Assam was conferred the J.N. Baruah Student Fellowship by Prof. Alak Kumar Buragohain, the Chief Guest of the programme.

In his presidential lecture, Mr. U.C. Bora mentioned the relevance, utility and success of the programme in NE India.



Dr. R.C. Boruah, Acting Director, CSIR-NEIST addressing the gathering

prospects and fears of modern day Molecular Biology made significant impact on the human civilization and society.

Though there were social fall outs also like eugenics and euthanasia and the famous gas chamber treatment of Adolf Hitler misinterpreting the laws of Gregor Johann Mendel, controversy on cultivation of genetically modified Bt cotton in India, surrogate motherhood, cloning, stem cell, etc.

### Visit

## Industry Sponsored Students Visit CSIR-NML

Students from the Aditya Institute of Technology, Adityapur representing different Industrial units (Tata Steel Ltd.; Alfa Motors Mahindra & Mahindra; RSBT Ltd.; Brakes India Ltd.; JMT Auto Ltd.; Ramkrishna Forging Ltd.; Tata Consultancy Engineering Ltd.; Tayo Rolls Ltd.; RSB Transmission India Ltd.; Kross Manufacture Ltd. and Adhunik Alloys & Power Ltd.) visited CSIR-National Metallurgical Laboratory and interacted with the scientists.

The participants were thrilled to see the various lab facilities and available expertise

at the laboratory. The participants were attentive throughout the session which comprised of presentations, lively discussions, documentary film show on CSIR-NML and practical demonstrations. The entire programme was scheduled for three and a half hours.

Giving an overview of Indian S&T, Dr. N.G. Goswami, Chief Scientist and Head, Information Management and Dissemination Centre and Coordinator of the programme said, "Innovation in a product or adding new features to an existing product ensures its

### Correction

In the November 2013 issue, the heading **Dr. Pijush Pal Roy assumes charge as Acting Director of CSIR-CIMFR** may please be read as **Dr. Pijush Pal Roy assumes charge as Acting Director of CSIR-CMERI**.

expansion of market segment too and this is possible only through generation of new ideas. Therefore, exposure to R&D organization is always beneficial for both the

groups.”

The participants expressed their happiness over the laboratory visit and suggested further interactions in the future.



**Glimpses of the visit**



### **Honours & Awards**

## **CSIR-NIIST Scientist Selected for Third World Academy of Sciences (TWAS) Award in Chemistry**

Dr. A. Ajayaghosh, Scientist-H in the Chemical Science and Technology Division of CSIR-National Institute for Interdisciplinary Science and Technology (NIIST), Trivandrum has been selected for this year's Third World Academy of Sciences (TWAS) Award in Chemistry. He shares the honour with Chung-Yuan MOU of National Taiwan University's Department of Chemistry in Taipei, Taiwan, China.

Dr. A. Ajayaghosh was honoured for his fundamental contribution to the understanding of the self-assembly of linear pi-systems to supra-molecular architectures with diverse shape, size and properties, leading to a new class of soft functional materials



The Award was announced on 30 September 2013 at the 24<sup>th</sup> general meeting of TWAS at Buenos Aires in Argentina. The Award carries a purse of USD 7500 and a plaque. TWAS Prizes are presented every year awarded in nine fields viz. Agricultural Sciences; Biology; Chemistry; Earth Sciences; Engineering Sciences; Mathematics; Medical Sciences; Physics; and Social Sciences. There are 14 prize winners this year including three

women. The winners will lecture about their research at the 25<sup>th</sup> General Meeting of TWAS in 2014, where they will receive the Award.

Dr. A. Ajayaghosh has won many prestigious awards in the past. He was awarded the coveted Infosys Prize in physical sciences in 2012. He won the Shanti Swarup Bhatnagar Prize for the year 2007 and Thomson Reuters Science Citation award for the year 2009.

### Appointments

## Dr. D. Ramaiah Assumes the Charge of Director, CSIR-NEIST

Dr. Danaboyina Ramaiah, former Chief Scientist of the CSIR-National Institute for Interdisciplinary Science & Technology, Trivandrum assumed the charge of Director, CSIR-North East Institute of Science & Technology on 9 October 2013. Joining the Institute as its ninth Director, Dr. Ramaiah took over the charge from Acting Director Dr. R.C. Boruah.

A renowned scientist, Dr. Ramaiah obtained PhD (Chemistry) in 1988 from Indian Institute of Technology (IIT), Kanpur and has extensive research experience in Photosciences and Photonics. He started his career as a scientist at CSIR-NIIST in 1988 and till recently was heading the institute's Chemical Sciences and Technology Division.

Dr. Ramaiah is a recipient of several prestigious fellowships and awards including the Alexander von Humboldt Fellowship-Germany (1992-1993), Bronze Medal of the Chemical Research Society of India (2003), Prof. Anantharaman Memorial Lecture Award (2005), Medal of the Materials Research Society of India (2010) and Outstanding



Performance Award of CSIR-NIIST (2007-2008 and 2008-2009).

He has also been elected Fellow of the Indian Academy of Sciences (2009) and currently is the

Associate Editor of *Photochemistry and Photobiology* (since January 2009) and council member of the Chemical Research Society of India. He has published around 90 papers in peer reviewed international journals, contributed 70 papers in various national and international conferences and holds 15 national and international patents.

While taking over charge, he addressed the CSIR-NEIST staff members and expressed his appreciation and happiness to have the opportunity to lead one great CSIR family. He appealed to all to join him and take a pledge to work together for taking the Institute to the next level of excellence.



### Printed and Published by

Deeksha Bist on behalf of CSIR-National Institute of Science Communication And Information Resources  
Dr K.S. Krishnan Marg, New Delhi -110 012 and printed at NISCAIR Press  
Dr K.S. Krishnan Marg, New Delhi -110 012

**Editor:** Hasan Jawaid Khan; **Editorial Assistance:** Neelima Handoo

**Design:** Neeru Sharma & Sarla Dutta; **Production:** Supriya Gupta

Phone: 25848702; Fax: 25847062; E-mail: csirnews@niscair.res.in; hjk@niscair.res.in

**Website:** <http://www.niscair.res.in>

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Annual Subscription: Rs 500; Single Copy: Rs 50.00

RN 4512/57