NEWS

UK–India partnership: a new centre for brain development and repair

Two Bangalore-based institutes have forged research collaborations with the University of Edinburgh, UK to study brain disorders and disabilities. After two years of collaborative research, the two institutes – National Centre for Biological Sciences (NCBS) and Institute for Stem Cell Biology and Regenerative Medicine (inStem) – have together founded the Centre for Brain Development and Repair (CBDR) in Bangalore, formally unveiled on 16 February 2013.

'The idea to set up a centre converged after several intellectually stimulating workshops, symposia and exchange of ideas between neuroscientists from both the countries to set up a platform, a unique model distinguished from the existing conventional ones, where the principal investigator designs and executes research in his or her lab. However, at the new centre we shall try and integrate basic science with clinical expertise in a team-driven effort to understand the neural basis of autism spectrum disorders,' says Sumantra Chattarji, Professor of Neurobiology at NCBS and Director of the new Centre.

The Centre's objective is to study disabilities that arise from alterations in brain development and will initially focus on learning about autism spectrum disorders and other intellectual disabilities.

Chattarji told *Current Science* that the Centre will be working closely with Bangalore-based National Institute of Mental Health and Neurosciences (NIMHANS) and Christian Medical College, Vellore. Sanjeev Jain, Professor and Head, Department of Psychiatry at NIMHANS, will play an important role in this regard.

Professors Siddharthan Chandran and Peter Kind from the University of Edinburgh will act as Associate Directors of the newly found Centre.

A radical model: bridging the gap

'There is a need to bridge the gap between basic research and clinical expertise,' views Chattarji. 'Therefore, fostering an environment where clinician–scientists can investigate medically relevant research questions is a high priority for this initiative.'

'Over the next five years, we plan to probe various aspects of autism spectrum disorders and intellectual disabilities at many levels – from their genetic and molecular underpinnings, through their impact on synapses and circuits, all the way up to behaviour. The hope is that such multi-level research will also help generate assay platforms that can better inform future drug discovery efforts as well,' shared Chattarji. The same platforms can eventually be used to initiate research in other major neurological disorders such as dementia and neurodegenerative disorders that critically undermine quality of life and remain a major public health threat to India.

UK–India partnership

Collaborative research between inStem, NCBS and University of Edinburgh in the past two years has resulted in developing new approaches in understanding brain development disorders. 'The Centre can be seen as a milestone in UK–India bioscience partnering, which represents a transformative collaborative programme and brings together world-class expertise in several scientific disciplines', added Chattarji.

Siddharthan Chandran (Professor of Neurology and Director of the University of Edinburgh's Centre for Clinical Brain Sciences) said that the new Centre will focus on common psychiatric and neurological diseases that cause a major burden for patients in both India and the UK, but will also train the next generation of scientists who will take forward laboratory discoveries to the clinic.

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MEETING REPORT

Electron microscopy – CWEM-2012*

The Conference cum Workshop on Electron Microscopy (CWEM-2012) under the aegis of Electron Microscope Society of India (EMSI) began with a brief introduction of the conference theme by G. V. S. Sastry (IIT-BHU, Varanasi). D. Pandey (Director, IIT-BHU) spoke on the role of electron microscopy in unravelling the complicated structural details, especially in advanced materials. He also emphasized on the fact that 'technology drives science', i.e. advances in technological developments for materials characterization have contributed enormously to scientific understanding. The aim of the meeting was to conduct a workshop on 'electron backscattered diffraction' (EBSD) and to exchange the views regarding latest developments in areas of electron microscopy. A special session included invited lectures on the role of electron microscopy of quasicrystals.

R. L. Schwarzer (Germany) conducted a workshop on the basic principles and details of EBSD techniques and instrumentation. He delivered a lecture on the current state and future prospects of EBSD and its comparison with XRD for texture measurement. It is important to know the size, shape and texture of grains for predicting the properties of engineering materials. He also emphasized that spatial resolution of X-ray pole figure measurement is often insufficient

*A report on the Conference cum Workshop on Electron Microscopy (CWEM-2012) under the aegis of Electron Microscope Society of India, held in the Department of Metallurgical Engineering, Indian Institute of Technology, Banaras Hindu University (BHU), Varanasi during 6–8 December 2012. CWEM-2012 was organized on the occasion of the 150th birth anniversary of Pt Madan Mohan Malaviya, founder of BHU.

specially for studying the texture gradients and local microstructure. It was also demonstrated that it is difficult to distinguish steel martensite from ferrite by X-ray diffraction (XRD), whereas EBSD can do so in a more quantitative manner.

D. Banerjee (IISc, Bangalore) discussed techniques of orientation imaging microscopy and its application for processing of Ti-alloys. He dealt with the evolution of micro-texture in Ti-alloys and studied these features by orientation imaging technique integrated in scanning electron microscope (SEM) and transmission electron microscope (TEM). H. S. Ubhi (Oxford Instruments, UK) described the application of EBSD technique for materials characterization. It was shown that for nanomaterials characterization, conventional EBSD cannot be effective. In this case higher spatial resolution can be enhanced using TEM. The methodology employing transmitted Kikuchi diffraction (TKD) or t-EBSD has been developed for characterizing nanostructured materials. This technique has the potential to evaluate the useful information in Al, Mg, Ti, Ni and steels in various states of severe deformation, which is not normally possible by conventional EBSD technique.

A. K. Singh (DMRL, Hyderabad) discussed the formation of grain-scale shear bands during cold rolling of 7010 Al alloys (Al–Zn–Mg–Cu) and its implication on the stability of a specific type texture. The shear band formation has been studied by EBSD. TEM studies confirm the presence of shear bands having sharp mis-orientation across the bands. The texture evolution is due to the rotation around [112] axis within the shear bands area facilitated by change of the initially co-planar slip systems to single slip. This eventually leads to the development of brass-type texture.

O. N. Srivastava (BHU, Varanasi) elaborated the relevance of TEM in exploration and characterization of nanomaterials. He demonstrated that the structural details in nanoscale of carbon nanotube, graphine and fullerene can be revealed due to the development of aberration-corrected TEM. It may be pointed out that aberration (especially spherical aberration) was highly responsible for not allowing the resolution to be attained at sub-Angstrom level. Besides, the corrections of spherical aberration, attempts are on to correct the chromatic aberration so that the best resolution can be achieved. G. K. Dey (BARC, Mumbai) studied the cross-sectional microscopy for surface engineered materials. He revealed with examples as to how the aberration correction technology is useful to enhance the performance of TEM to a newer dimension.

Sven Hovmöller (Sweden) discussed some aspects of electron crystallography through a new technique known as rotation electron diffraction (RED). Using this technique one can construct the 3D diffraction space (reciprocal space) by avoiding the dynamical diffraction effect. In conventional electron diffraction, by the very mechanism of diffraction phenomena, one cannot avoid the dynamical diffraction effects even when the specimen is reasonably thin. Thus, the quantitative intensity evaluation from the electron diffraction data was always elusive. However, using RED[1] one can avoid multiple diffraction effects and obtain the intensity-like kinematical condition analogous to XRD. It is more powerful than XRD as it collects the data from single crystals of small volume, i.e. $<1\ \mu m^3$. The commission on 'Electron Diffraction' of IUCr has recently been changed as 'Electron Crystallography' to explore the structures of complex phases using advanced techniques like electron microscopy and diffraction.

Vikram Jayaram (IISc, Bangalore) elaborated on surface deformation during wear and indentation by employing TEM. The combination of focused ion beam milling and TEM enabled site-specific examination of localized deformation during wear and indentation. From the study of indentation behaviour of multilayer TiN–AlTiN and ZrN–Zr at nano-level, the profound role of the interfaces for crack initiation during interfacial sliding by accommodating strain was established. S. Shankaran (IIT, Madras) highlighted detailed electron microscopic techniques for studying the microstructural evolution and precipitation kinetics of two Al-based *in situ* composites. The study suggested that precipitation is due to diffusion-controlled mechanism.

R. Mitra (IIT, Kharagpur) explained the structure and composition of internal interfaces in selected composites (e.g. Al–TiC, Al–TiB_2) using scanning as well as conventional and high-resolution TEM, accompanied by energy dispersive spectroscopy with a special emphasis on correlation with mechanical behaviour of the composites. P. Ghosal (DMRL, Hyderabad) highlighted the synthesis, structure and dispersion of carbon nanotubes (CNTs) and nanofibres (CNFs). The structure–property correlation was established and it was demonstrated that 30–40% strength improvement in mechanical property of carbon epoxy composite with rubbery additives along with CNTs could be possible.

T. K. Nandy (DMRL, Hyderabad) characterized dislocation behaviour of several metallic alloys by two-beam imaging technique in TEM using the trace analysis and stereographic projection. The detailed analysis of the dislocation behaviour in B2 phase of Al–Ru alloy was highlighted. The utility of the weak beam technique in the analysis of dislocation dissociation was also demonstrated. S. Sant (IIT, Kharagpur) studied the TEM of thin films of II–VI compound semiconductors. Molecular beam epitaxial (MBE)-grown ZnSe films and sputter-deposited ZnO films were analysed. The growth twins in ZnSe and the hexagonal grains in ZnO were demonstrated. The appropriate microstructural development which is crucial for the electronic properties was explained.

In the special session on electron microscopy of quasicrystals chaired by S. Lele (IIT-BHU), G. V. S. Sastry highlighted work on electron microscopy of quasicrystals carried out in his department. He discussed how the discovery of quasicrystals in $Mg_{32}(Al,Zn)_{49}$ alloys was made by P. Ramachandra Rao and Sastry, which gave a new direction of research in quasicrystals[2]. The electron microscopy work of Sastry and co-workers in 1978 came close to the discovery of quasicrystals as it had identified a new ordered crystalline phase which can be understood as a precursor phase[3]. The salient features in Al–Pd–Mn–Ga were also discussed. R. K Mandal (IIT-BHU) elaborated on the work on indexing the electron diffraction and XRD patterns of the decagonal quasicrystals based on 6-D model[4]. He pointed out that the problems of selecting basis vectors exist in quasicrystal structure. However, he proposed a set of proper basis vectors in hyperdimensional space for unifying the icosahedral, decagonal and diagonal phases.

N. K. Mukhopadhyay (IIT-BHU) pointed out that the role of electron microscopy was realized from the fact that 'seeing is believing'[5] in the context of discovery of quasicrystal in 1982 for which the Nobel Prize was awarded to D. Shechtman in 2011. He further discussed that how the analysis of electron diffraction patterns of $Mg_{32}(Al,Zn,Cu)_{49}$ quasicrystal phase led to the classification of quasicrystals by determining their quasilattice constant ($a_R \sim 5.15$ Å), which was different from the originally discovered Al–Mn quasicrystals ($a_R \sim 4.61$ Å). He also emphasized that the discovery of the ordered quasicrystals was possible through systematic electron microscopy and diffraction analysis[6]. According to him, the fuzzy features (i.e. diffuse intensity)[7] observed in electron diffraction patterns promise to settle the structures of ordered quasicrystals. The synthesis of nanostructured quasicrystals and their softening behaviour depending on crystallite size were also highlighted.

K. Biswas (IIT Kanpur) demonstrated that Al-based quasicrystals can be studied as promising candidates for certain catalytic reactions such as methanol steam reforming (SRM). His work on Al–Ni–Co quasicrystals shows that leaching can be related to the electrochemical corrosion. Cross-sectional SEM and TEM studies revealed the micromechanisms for leaching. The work of V. C. Srivastava (NML, Jamshedpur) showed that by spray-forming, a large ingot of single-phase quasicrystal (centimetre dimension) can be fabricated. The annealing twinning-like features were observed in Al–Fe–Cu quasicrystals phase. Al–QC composite materials (up to 20% quasicrystals) exhibited superior mechanical properties compared to Al-alloys.

M. Abu Shaz (BHU, Varanasi) explained his work on Ti-based quasicrystals and demonstrated that the distortion and shift of the diffraction spots could be attributed to the variable phason strain. He also elaborated on his work about the hydrogen storage capacity and desorption from Ti-based (Ti–Zr–Ni) quasicrystals. T. P. Yadav (BHU, Varanasi) studied the effect of leaching on surface microstructure and chemical composition of Al-based quasicrystals. His work demonstrated the important information for the preparation of model catalysts of nanoparticles of catalytically active metals on quasicrystal surface. It was further shown that the leached five-fold surfaces exhibited micron-sized dodecahedral cavities on which the nanopartcles are precipitated in ten-fold cavities.

S. Banerjee (SINP, Kolkata) discussed the typical electrical and magnetic properties of icosahedral quasicrystals. These anomalies were believed to be related to the typical structural and microstructural characteristics of these quasicrystals materials. He emphasized on further studies in this direction. The work of G. K. Dey (BARC, Mumbai) revealed the electron microscopic features during the evolution of quasicrystals phase from amorphous and liquids of complex metallic alloys. The effect of cooling rate on the microstructure of ZrCuNiAl alloy was examined. The peculiar contrast observed in electron microscopy from these alloys and their approximants is yet to be understood. The development of microscopic technique will help elucidate this issue.

The recent technological developments have enhanced our scientific understanding by several fold, especially the development of aberration-corrected (or nearly free) TEM, which can be considered as a most remarkable and major breakthrough in the microscopy technology in recent years. It is also anticipated that nanomaterials characterization, the interface structure, and defects analysis will continue to be the major activities using electron microscopy with enhanced capabilities. Electron crystallography by precision, rotation electron diffraction and tomography will be carried out to resolve the unknown structures of the structurally complex intermetallics and many inorganic phases. The structures of aperiodic crystals, including quasicrystals have to be tackled using the recently developed electron crystallography techniques. It is important to indicate that due to economical constrains, the sophisticated electron microscopy facilities with advanced capabilities may not be possible to be established by many groups. Hence, the conventional techniques with analytical and high-resolution capabilities (with reasonable aberration correction) will still continue to be relevant for characterization of materials. It is pertinent to mention that the forthcoming International Conference on Electron Microscopy and XXXIV Annual Meeting of EMSI (www.emsi.org.in) will be held in SINP, Kolkata during 3–5 July 2013.

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