

sintered alloys exhibited phase separation of BCC to two FCC phases and hardness around 6.3 GPa. From the indentation fracture studies, it was demonstrated that CNTs as reinforcement phase can enhance fracture toughness even in brittle HEA materials. G. Phani Kumar (IIT Madras) discussed the challenges in extending the interface response function concept in the solidification of multi-component alloys. This approach involves different physical properties that are required for the calculation, verification of the validity of the underlying assumption in the theory and a set of controlled experimental studies. R. Sankarasubramanian (DMRL, Hyderabad) elaborated on the issue that integrating microstructural modelling and simulation with experiments has become an essential part of the developments of new materials. It was pointed out that density functional theory (DFT)-based first principles calculations, molecular dynamics and Monte Carlo simulations are widely used atomic modelling techniques. Some of the key challenges in the atomistic modelling of multicomponent alloys were discussed and possible solutions are highlighted. Abhik Chowdhury (IISc, Bengaluru) presented phase field modelling approach for microstructural evolution in multi-phase multicomponent alloys, thus highlighting the utility of the phase field method both in the context of

ICME as well as modelling of microstructures in HEAs. Jatin Bhatt (VNIT, Nagpur) utilized thermodynamic modelling for predicting metallic glass formation in HEAs.  $P_{HSS}$  parameter analogous to glass formability has been used to distinctly categorize solid solution forming HEAs from metallic glass (MG) forming alloys. The capability of the  $P_{HSS}$  model and the scope for further research in the direction of HEAs were discussed.

From the various discussions and analyses mainly during the two brainstorming sessions chaired by Atul Chokshi (IISc, Bengaluru) and Hari Kumar respectively, and 'The way-forward' session chaired by Ranganathan, several important points on this fascinating area have emerged with much clarity. In fact, it has now become clear that the alloy-design strategy of combining multiple elements in near-equiatomic proportions has tremendous potential for developing novel materials under the category of HEAs. However, there are several unresolved matters related to elemental distribution, exact calculation of phase selection, phase stability at lower temperature, exact contribution and measurement of configurational entropy, phase separation, role of misfit strain and its estimation at the level of nano- and microscale and structural application. The deformation science and the role of nanotwins and dislocations in the pres-

ence of strain due to the presence of multicomponent solutes need to be understood. It was also realized whether HEAs can be effective in case of ceramic systems as well as other alloys where interstitial instead of substitutional elements are present. It has been recently emphasized<sup>5</sup> that the HEA-based design strategy should not be restricted to single-phase solid solutions alone, which has also emerged from the present workshop. It should be extended to a wide range of complex materials for exploiting the renaissance in physical metallurgy realized in recent times.

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## MEETING REPORT

### Tropical ecology congress 2014\*

The Tropical Ecology Congress (TEC) organized recently in New Delhi was attended by over 500 delegates, compris-

ing more than 50 foreign delegates representing 17 countries. The congress was inaugurated by Skip Judson Van Bloem (Baruch Institute of Coastal Ecology and Forest Science, Clemson University, USA and the International Society for Tropical Ecology (ISTE)). The congress covered multiple dimensions of global change in a total of 21 technical sessions comprising 140 oral and 170 poster presentations, 7 plenary lectures, 3 panel discussions, and 2 special sessions. A panel of five experts reviewed the posters presented during the congress and selected the ten best among them. As expected, the impact of climate change was evident in many presentations and lectures. Furthermore, presentations

addressed the current environmental problems such as disturbance, degradation of ecosystems, invasive species and water scarcity. That invasive species can also be useful in certain situations was an interesting conclusion of a study presented at the congress. Important conclusions include: understanding the environmental connections between the regions and their ecosystems could play a role in achieving issues of equity and justice; in developing countries environmental data are required not only for academic purpose, but also for realizing successful international negotiations and reducing conflicts; the payment for ecosystem services should be periodically analysed in view of scientific facts, though they may

\*A report on the 'Tropical Ecology Congress 2014: Tropical ecosystems in a changing world' organized by the School of Environmental Sciences, Jawaharlal Nehru University (JNU), New Delhi, during 10–12 December 2014 in collaboration with the International Society for Tropical Ecology headquartered at the Banaras Hindu University, Varanasi with support from the National Biodiversity Authority, Mountain Division, Ministry of Environment Forests and Climate Change, Department of Science and Technology, Indian Council of Agricultural Research, Indian National Science Academy, Council of Scientific & Industrial Research and JNU.

not always lead to conservation. For example, trophy hunting in a longer run may result in genetic erosion in some species.

Some of the major themes covered were: climate change in relation to managing water flows from the Himalaya; forecasting forest characteristics along disturbance regimes; restoration of degraded ecosystems using non-native species; climate change-induced species extinctions; impact of climate change on pollination; potential of limnological research for mitigating the ever-increasing scarcity of freshwater; changing carbon and nitrogen fluxes and issues related to raising plantations in dry deciduous forest region; clean energy sources to mitigate climate change; biodiversity conservation in mountain ecosystems under changing climate scenario; tree ring research; sustainable management of ecosystem services and livelihood issues; integrated approach for reclaiming mine waste; potential of agro-forestry in climate change mitigation in marginal areas; sustainable management of upland farming systems, and conservation of rare and endangered species. As a side event, the congress also facilitated organization of the General Body Meeting of ISTE.

Issues of Himalayan environment and development in the context of global climate change were discussed by S. P. Singh (formerly at H.N.B. Garhwal University) who underlined that adaptation to climate change in much of the Himalaya would necessitate managing water flows in rivers as well as streams and springs so crucial for local livelihoods, and taking measures to minimize damages that water gushing from the Himalayan rivers causes downstream. In this context, cross-country cooperation and networking need to be given more importance. Peter Z. Fule (Northern Arizona University, USA) presented the findings of his group on forecasting forest characteristics and disturbance regimes under future climate. He highlighted the role of climate-sensitive simulation models in the understanding and evaluation of possible future forest trajectories. Van Bloem highlighted the scope of non-native species in restoring degraded landscapes. On the basis of his long-term studies in the tropical Americas, he showed that the non-natives, if selected and managed appropriately, could enable faster recovery of degraded ecosystems. N. H. Ravindranath (Indian Institute of

Science (IISc), Bengaluru) said that climate change is a powerful stressor on the terrestrial ecosystems where a large number of species face increased risk of extinction as the climate change interacts with other threats and pressures such as habitat loss, fragmentation and degradation, pollution and invasive species. He stressed on the need of research to identify policies and management practices to build resilience to current stressors as well as future climate change. Renee M. Borges (IISc, Bengaluru) described pollination biology of figs and the role of plant-produced volatile organic compounds in a variety of contexts that include response to abiotic and biotic stresses, as long-distance and short-distance chemical communication to attraction of pollinators (wasp) and repulsion of herbivores.

Brij Gopal (National Institute of Ecology, Jaipur) highlighted the importance of limnological research to mitigate water problems aggravated by climatic and demographic changes. Lalji Singh (Indira Gandhi Agricultural University, Raipur) presented the outcomes of his research on storage and flux of carbon and nitrogen in tropical dry deciduous forests. Madhoolika Agrawal (Banaras Hindu University, Varanasi) spoke on the impacts of climate change in the tropics and challenges of adaptation and mitigation. She stressed on clean energy and greenhouse gas (GHG) efficient development to address the climate change issues effectively. P. K. Jha (Tribhuvan University, Nepal) presented his research outcomes on the impacts of climate change on biodiversity in the Nepal Himalayas. He stressed on the need of interdisciplinary research and long-term instrumental records of past weather data crucial for understanding the complex interaction between climate change and biodiversity. R. R. Yadav (Birbal Sahni Institute of Palaeobotany, Lucknow) outlined the progress of tree-ring research in different aspects of environmental studies in India. Akhilesh Gupta and Nisha Mendiratta (Department of Science and Technology (DST), New Delhi) presented an overview on the National Mission for Sustaining Himalayan Ecosystem in the face of global change. N. P. Melkania (Uttarakhand Open University, Haldwani) described issues related to intrusion of tropical species in the montane ecosystem of Uttarakhand. Helena Freitas (University of Coimbra, Portugal) highlighted the importance of

introduction of new UNESCO Chair at the University of Coimbra to safeguard biodiversity for sustainable development. M. N. V. Prasad (University of Hyderabad) discussed integrated approaches based on biogeotechnologies for reclamation of mine wastes. S. R. Gupta (Kurukshetra University, Kurukshetra) presented an overview of agroforestry systems of salt-affected and waterlogged areas, carbon sequestration and the role of agroforestry in climate change mitigation. R. K. Maikhuri (G.B. Pant Institute of Himalayan Environment and Development (GBPIHED), Garhwal Unit, Sringer Garhwal)) highlighted vulnerability of upland agricultural systems to climate change, particularly increasing insect/pest incidences under changing precipitation regimes. S. S. Samant (GBPIHED, Himachal Unit, Kullu) shared the results of scientific assessment of diversity of pollinators for sustainable horticulture development in apple-growing areas of Himachal Pradesh. Carl I. Evensen (University of Hawaii) talked about conservation of rare and endangered native plants of Hawaii.

Eklabya Sharma (International Centre for Integrated Mountain Development (ICIMOD, Kathmandu, Nepal) highlighted the significance of the Hindu Kush Himalayan region as the provider of a range of ecosystem services to more than 1.3 billion people of South Asia, and key challenges and opportunities for sustainable management of mountain ecosystems. Nakul Chettri (ICIMOD) discussed the dynamic nature of mountain ecosystems and described the transformation taking place in these fragile ecosystems. Citing examples from long-term research carried out on wetlands of China, Wu Ning (ICIMOD) discussed the importance of wetland ecosystems and their role in carbon dynamics. Ram Chaudhary (Tribhuvan University, Nepal) informed about the lessons learned from trans-boundary landscape-level planning process from the Kangchenjunga Landscape initiative among Nepal, India and Bhutan. Sangay Wangchuk (Ministry of Agriculture and Forest, Bhutan) highlighted the success story of Bhutan Biological Conservation Corridor programme. G. S. Rawat (Wildlife Institute of India, Dehradun) discussed the high-altitude ecosystems and their critical role in ecosystem functioning and biodiversity conservation in the wake of global change.

Panel discussions on 'Implementation of Convention on Biological Diversity' were organized by JNU; on 'Managing mountain ecosystem for sustaining services' by ICIMOD and on 'Changing climate: implications for Himalayan ecosystems and people' by GBPIHED. Forest Research Institute, Dehradun 'Managing forests for multiple values: landscape approach' and Indian Institute of Remote Sensing, Dehradun 'Terres-

trial ecosystem analysis and modeling' organized special sessions during the Congress. TEC 2014 succeeded in bringing together several national and international organizations to participate and organize specific sessions or panel discussions

Interactions during the congress helped in the development/implementation of a number of collaborative and interdisciplinary research programmes,

including the 'Network Programme on Convergence of Traditional Knowledge Systems for Sustainable Development in the Indian Himalayan Region' supported by DST.

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