

Discovery and naming of four new elements in the periodic table

At the 25 July 2016 meeting of the International Union of Pure and Applied Physics (IUPAP) National Committee held in New Delhi, it was reported that the IUPAP has made an important and interesting announcement concerning four new elements in the Periodic Table (at numbers 113, 115, 117 and 118). The experimental discovery of these four new elements was confirmed by a Joint Working Party of IUPAP and IUPAC (International Union of Pure and Applied Chemistry) in January 2016. These new elements have now been named as follows.

Element 113: Nihonium (symbol Nh) was named after 'Nihon', the Japanese name for Japan (the land of the rising Sun). This element was discovered in heavy-ion collision experiments carried out at the RIKEN Nishina Center for Accelerator Science in Japan. The experiment involved bombardment of a bismuth target with a beam of zinc-70 ions from the RIKEN heavy-ion facility and monitoring the lighter products after alpha-decay.

Element 115: Moscovium (symbol Mc) was named after the Moscow region, the location of the Joint Institute for Nuclear

Research (JINR) in Dubna, Russia. The JINR has enjoyed high reputation since its establishment in the Soviet Union. In this particular discovery, the heavy ion accelerator facilities of the Flerov Laboratory, including their gas-filled recoil ion separator, were utilized by JINR scientists in collaboration with researchers from the Lawrence Livermore National Laboratory, Oak Ridge National Laboratory, and Vanderbilt University, USA to carry out experiments in which targets of americium were bombarded by energetic calcium-48 ions.

Element 117: Tennessine (symbol Ts) was named after the US state of Tennessee, in recognition of the long-standing contributions of the Oak Ridge National Laboratory, Vanderbilt University and the University of Tennessee in the production of new elements. Tennessine was produced by bombarding targets of berkelium by calcium-48 ions at the JINR. The rare berkelium target was produced at the high-flux reactor at Oak Ridge National Laboratory.

Element 118: Oganesson (symbol Og) was named after the eminent nuclear physicist, Yuri Oganessian, who has long led the successful Dubna research in the

physics of super heavy nuclei and the search for new elements. The IUPAP/IUPAC Joint Working Party considered it appropriate that Yuri Oganessian be recognized on the occasion of the results obtained in the collaboration between JINR and the Lawrence Livermore National Laboratory which produced oganesson by bombarding a californium target by an energetic calcium-48 beam.

With the confirmed discovery and naming of these new elements, the seventh row of the periodic table has been completed. The question now arises as to whether or not the periodic table has an end.

The chemical and physical properties of these extreme elements and their isotopes remain to be discovered. Laboratories have already embarked on searches for elements, if any, in the eighth row of the periodic table, and work is underway to consolidate the identification of copernicium and heavier elements.

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MEETING REPORT

Sustainable development of the Indian Himalayan Region*

A national consultation meeting on the Indian Himalayan Region (IHR) was held (i) to foster cooperation on sustainable development across the IHR and

*A report on the Multi-stake holders' National Consultation meet organized by G. B. Pant Institute of Himalayan Environment and Development (GBPIHED), as a technical secretariat of the Himalayan Sustainable Development Forum (HSDF), in collaboration with the Department of Science and Technology (DST), Government of India and Indian Himalayas Climate Adaptation Programme (IHCAP) of Swiss Agency for Development and Cooperation (SDC) and held on 29 and 30 December 2015 in Indian Habitat Centre, New Delhi.

promote science-policy-practice connect; (ii) to facilitate dialogue among stakeholders on strategies for climate change adaptation in identified sectors; (iii) to build a vibrant knowledge network to support National and State action plans for climate change, and (iv) to suggest institutional framework for implementation of strategic adaptation plan. The consultation meeting was structured in three technical sessions and each session consisted of keynote address, presentation from participants and a panel discussion. The event was attended by eminent scientists, policy-makers, heads of leading research institutions, NGOs, and consultants from the IHR states:

Himachal Pradesh, Uttarakhand, Manipur, Assam and Meghalaya.

R. M. Pant (National Institute of Rural Development and Panchayati Raj, Guwahati) pointed out that the IHR is a source of immense natural resources that is vulnerable to natural and manmade disasters. Shirish Sinha (SDC, New Delhi) highlighted the key achievements of Indo-Swiss joint research partnership programmes, which includes capacity-building programme on Himalayan glaciology; development of institutional framework for climate change adaptation planning; vulnerability, risk and hazards assessment of biodiversity, etc. P. P. Dhyani (GBPIHED, Almora) briefly

emphasized the role of GBPIHED in sustainable development of the Himalaya by means of research and developmental programmes. The Chief Guest V. K. Gaur (Indian Institute of Astrophysics, Bengaluru) felt the need for cooperation among institutions, Government departments, and local bodies with their specialized knowledge on climate change to mitigate the adverse effects of climate change.

In Technical Session I (Climate change and disaster risk reduction), Gaur (keynote speaker) explained the dynamics of Earth's climate with the positive and negative feedback mechanisms. He narrated that biodiversity conservation and management should be an integral part of any climate change adaptation programme due to its role in the climate feedback system. Further, he stated that the rate of change of climate variables is increasing and can have severe consequences over the Himalayan ecosystem. Aditi Kapoor (Alternative Futures, New Delhi) presented a macro risk-reduction policy framework, which consists of risk assessment and planning at local level, and effective strategies for implementation of the policies at the ground level. This policy framework also highlighted the financial, technological, and human resource aspects as a force to traditional knowledge system and other allied services. Further, she highlighted that the new policies should have transformative approaches to build resilience against climate change.

The following recommendations were made after first technical session: (1) To address the gap in scientific knowledge of mountain hydrology and climate change, there is need of advancement in numerical understanding of the same. (2) Climate change adaptation planning and management should be supported by valid scientific inputs. (3) Creation of safe zone for post-disaster rescue and relief operations. (4) Planning of biodiversity conservation in adequate spaces should be carried out through community participation. (5) Data-sharing policies need to be simplified among inter-state and cross-country boundaries. (6) Creation of new livelihood options for communities of the IHR in the changing climate. (7) Promote investments in developmental planning of the IHR. (8) Urban ecosystem must also be considered in sustainable development of the IHR.

In Technical Session II (Environmental governance for effective climate change adaptation), the keynote speaker Ranjedra K. Pachauri (TERI, New Delhi) advised that a fragile region such as the IHR should be treated differently compared to those of the plain regions of the country. He narrated that certain impacts of climate change are inevitable and considering this, the mitigation and adaptation strategies should be planned. He also highlighted the need of pursuing a path of climate change adaptation at global, national and local level, and climate change mitigation measures at the global level. Further, he emphasized that the climate change impacts on agriculture need to be addressed more precisely through introduction of climate-resilient agriculture or climate smart agriculture. Suparna Jain and her team (The Environmental Law and Development Foundation, Noida) reviewed existing climate change policies and adaptation plans in the IHR. According to them appropriate laws are necessary to support the implementation of policies. They also suggested the synchronization of climate change adaptation plans and policies for the entire IHR.

The following recommendations were made after the second technical session: (1) Out-migration and livelihood problems of Himalayan states should be addressed on priority basis through education and awareness programmes. (2) Need of strict regulation at local level for developmental planning and any intervention against climate. (3) Adaptation policies and laws should be related to ecological realities of the time. (4) Gender inequalities intersect with climate risks and vulnerabilities. Therefore, there is a need for gender equality to enhance effectiveness and sustainability of climate change projects and policies. (5) Climate change adaptation should be linked to good governance which will focus effective coordination among communities, policy makers and institutions.

In Technical Session III (Tourism and climate change), the keynote speaker R. B. Singh (Delhi School of Economics, New Delhi) portrayed the geographical and cultural diversity of the IHR. He stressed upon the impact of extreme climatic events on tourism in the Himalayan region while giving the examples of Uttarakhand tragedy in 2013, floods in Jammu and Kashmir in 2014 and other

mishaps. He also highlighted the need for perception-based and behavioural study of the tourists for planning of sustainable tourism sector. Further, while presenting sustainable participatory design for tourism, he addressed the need of climate change-resilient tourist city and ecotourism as a tool for conservation of the Himalaya. He also enlisted the problems of tourism in the Himalaya; some of them include the government's apathy, poor infrastructure, law and order problems, sanitation and environmental pollution, limited budget allocation, high taxes, lack of marketing in the IHR tourism sector, etc. Ranjan Joshi (GBPIHED, Almora) in his presentation identified the sustainability issues in the IHR with respect to climate change. His study shows increase in tourist inflow through three broad categories of tourism: commercial urban/leisure tourism, religious/pilgrimage tourism, and alternative tourism (nature/eco/adventure, etc.). His study also identified the critical problems such as tourist growth in excess of carrying capacity of the region, unplanned and uncoordinated management of tourism resources, lack of regular monitoring for impacts of tourism on the environment, lack of community participation in sustainable tourism, etc. In view of climate change, he also put forth the idea of early warning system and community mobilization for ensuring the safety of tourists in adverse climatic conditions. V. Vivek (Institute of Financial Management and Research, Chennai) highlighted the problem of availability of limited funding and lack of efficient financing mechanisms in both the State and Central governments for climate change adaptation actions/programmes. He also presented various financing options for adaptation in the IHR.

The following recommendations were made after the third technical session: (1) The linkages between climate change-induced disaster and tourism need to be addressed. (2) Integration of natural and cultural heritage in tourism planning is required. (3) Tourism-induced adverse impacts on environment need to be studied and monitored (such as solid-waste generation, etc.). (4) Sustainable mountain tourism needs to be planned and promoted keeping in view the climate change impacts and livelihood options for communities. (5) Regulating tourism within the carrying capacity limits with economic instruments. (6) Land-use policies and practices need to be revisited

for exploring tourism potential. (7) Promotion of multi-lateral finance for climate change adaption programmes is required in the IHR. (8) Facilitate the IHR States with 'Green Bonus' for conserving forests that act as carbon sinks. (9) Dedicated cells and nodal centres for climate change adaptation should be established in the IHR states.

The concluding session of the consultation meeting was chaired by Upendra

Dhar, R. B. Singh and Kireet Kumar (GBPIHED, Almora). All the panellists agreed upon dissemination and replication of success stories/technologies that are related as well as efficient in combating the adverse effects of climate change in the IHR. In brief, the national consultation meet was successful in establishing a science and policy connection for the Himalaya through mutual dialogue among different stakeholders.

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MEETING REPORT

Metals and materials research*

The materials research is a fascinating field, as it continues to unravel the mystery of the existence of exotic materials, their novel structures and unique processing techniques. In view of increasing interest on the cutting-edge researches on materials, an international conference was recently organized. The conference began with the welcome address of T. A. Abinandanan (IISc, Bengaluru). V. S. Raja (IIT Bombay, Mumbai) highlighted the theme of the conference and urged the delegates to actively participate so that it could lead to a scientifically meaningful, enjoyable and beneficial meeting. Anurag Kumar (IISc, Bengaluru) inaugurated the conference and C. N. R. Rao (JNCASR, Bengaluru) delivered the inaugural lecture. On the evening of the first day, a felicitation function was organized to honor S. Ranganathan. During the function, his outstanding contributions to materials research, starting from grain boundary engineering, field ion microscopy, structural metallurgy, quasicrystals, metallic glasses, high entropy alloys and archaeometallurgy were well

articulated by several distinguished scientists.

In addition to an inaugural lecture, there were six plenary talks and 67 invited oral presentations by eminent scientists and 45 poster presentations by senior research scholars and young researchers. There were 175 participants, with 22 overseas participants coming from various parts of the globe. The primary objective of this conference was to bring together eminent experts from academia and research institutions as well as practising engineers, young researchers and students to deliberate critically and evaluate the current progress and bring out the future challenges in the field of materials research. The conference covered a wide spectrum of materials with special focus on the topics of alloy design, advanced steels, archaeometallurgy, atomic resolution microscopy, grain boundaries and interfaces, bulk metallic glasses, quasicrystals, nanomaterials and high entropy alloys. Details of the conference and abstracts are available at www.icmr2016.net. Some of the important technical issues presented and deliberated during the conference are highlighted here.

Advanced materials and characterization

In his inaugural lecture, C. N. R. Rao elaborated on the synthesis of and developments in graphene and graphene-like materials such as MoS₂, WS₂, GaS and

BN. He presented interesting results on few-layer metal chalcogenides and BN. It was shown that transistors and devices could be successfully fabricated using many of the few-layer inorganic materials. A new graphene-like material, viz. B_xC_yN_z with high surface area and novel gas adsorptive properties was mentioned. A. L. Greer (Cambridge, UK) elaborated the optimizing principles for improvement of toughness of metallic glasses. The lack of tensile ductility is a major concern in using a metallic glasses in spite of they being high-strength materials. Controlled annealing of single-phase monolithic metallic glasses was shown to lead to a higher-energy rejuvenated state with improved ductility which could be retained. It was demonstrated that anisotropy could be induced for potential applications. A. Inoue (Japan) described the development of non-equilibrium metallic engineering materials, including bulk metallic glassy alloys and nanocrystalline alloys in various alloy systems by the effective combination of appropriate alloy components, unique preparation techniques and optimum preparation conditions. He presented the developmental history, structural features, fundamental properties, engineering characteristics, applications and future prospects of Al- and Cu-based metastable alloys. C. Barry Carter (University of Connecticut, USA) shared his experience while studying defects using transmission electron microscopy (TEM). He pointed out that data handling while recording them with high resolution and

*A report on the International Conference on Metals and Materials Research (ICMR-2016) held at the Indian Institute of Science (IISc), Bengaluru during 20–22 June 2016 and organized by the Bangalore Chapter and the Metal Sciences Division of the Indian Institute of Metals, and the Electron Microscope Society of India in collaboration with the Department of Materials Engineering, IISc, to coincide with the celebration of the 75th birth anniversary of Prof. S. Ranganathan (IISc).