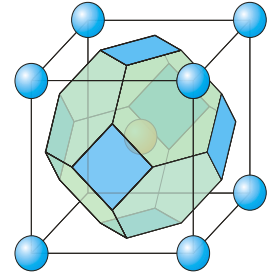


**INTERNATIONAL CONFERENCE
ON
METALS AND ALLOYS:
*Past, Present and Future***



METALLO 2007

**December 07 – 10, 2007
Indian Institute of Technology, Kanpur**

REPORT

A four day international conference on the theme of metals and alloys, METALLO 2007, was organized by the Department of Materials and Metallurgical Engineering, IIT Kanpur and the Kanpur Chapter of the Indian Institute of Metals. The main theme of focus of the conference was the past, present and future of metals and alloys and their applications in diverse engineering fields. The conference showcased the latest global trends in metals and alloys research, education and industry. The conference was held at the newly-built Outreach Centre at IIT Kanpur, from the seventh to the tenth of December, 2007.

The conference honored Professor T.R. Anantharaman, whose eightieth birthday is being celebrated in the year 2007. The conference was supported by the organizations in which Professor Anantharaman was closely associated: Indian Institute of Science, Bangalore; Banaras Hindu University, Varanasi; Thapar University, Patiala and National Physical Laboratory, New Delhi. A citation of honor was read out for Professor Anantharaman during the Inauguration Function. Professor Anantharaman could not attend the conference due to ill health.

The highlights of the conference are outlined in this brief report. The important events of METALLO 2007 are briefly described.

The registration for the conference took place on the evening of the seventh of December, followed by a welcome dinner.

The conference was inaugurated formally on the morning of the eighth of December. The chief guest of the Inauguration Function was Dr. T. Ramasami, Secretary to the Government of India, Department of Science and Technology. Professor R. Balasubramaniam of MME Department, the convener of the conference, welcomed the audience and invited the distinguished guests on to the stage. This was followed by the traditional lighting of the lamp by the distinguished guests, reciting of invocation and rendering of *Kulgeet*. Dr. Anish Upadhyaya, the co-convener of the conference, of the MME department briefed on the background of the conference. Prof. S.G. Dhande, the Director of IIT Kanpur and the chief patron of the conference, in his inaugural remarks emphasized the importance of materials and ever-changing role of engineering materials in modern technology, by pointing out an interesting comparison with that of a snake shedding its skin. He also stressed the importance of people and organizations coming together in collaborative activities, like in the case of four organizations supporting METALLO 2007. The activities of the Kanpur Chapter of IIM were highlighted by Prof. Dipak Mazumdar, Chairman of the chapter, while that of IIM was briefed by Mr. Pughazhenty, Vice-President of IIM. He was representing Dr. S. Banerjee, President of IIM, whose arrival at Kanpur was slightly delayed. Professor Subhash Mahajan, Director of the School of Materials at Arizona State University read out the citation in honor of Prof. Anantharaman. This was followed by release of a book on Prof. T.R Anantharaman. The Head of MME Department, Prof. Rajiv Shekhar, highlighted the research activities of the department and introduced Dr. Ramasami before delivering his Inaugural Address. Dr. Ramasami delivered a scintillating lecture on “An insight into the world of metals and alloys”. He emphasized the important role that metals and alloys will play in the coming years for India’s overall development. Dr. Bikramjit Basu, the co-convener of the conference, proposed the vote of thanks.

Immediately after, the distinguished guests inaugurated the exhibition stalls, the poster session and a full-scale fiber-reinforced plastic replica of the Delhi Iron Pillar. The model was fabricated at the Nehru Science Center, Mumbai, under the National Council of Science Museum, Government of India. The model was erected at IIT Kanpur on the occasion of METALLO 2007.

The highlights of the conference will now be described, taking into account the activities on the three days. The complete conference schedule is attached at the end of the report.



Lamp lighting at the Inaugural Function by Dr. T. Ramasami, Secretary, DST. Also in the picture (from left) are Prof. S.G. Dhande, Mr. L. Pughazhenty, Prof. Subhash Mahajan and Prof. R. Balasubramaniam



A special book on Professor T. R. Anantharaman was released during the Inaugural Function by Dr. T. Ramasami, Secretary, DST.



Inauguration of the Fibre Reinforced Plastic replica of the Delhi Iron Pillar by Dr. T. Ramasami, Secretary, DST.



Some of the participants near the Fibre Reinforced Plastic replica of the Delhi Iron Pillar

08 December 07

There were four speakers in the first session of the conference, which was titled “Metals & Alloys: Fundamentals and Applications.” The first talk was delivered by Professor Dr. Reiner Kirchheim, Director of the Institut für Materialphysik, University of Goettingen, Germany, on “A New Way of Describing the Interaction of Solute Atoms and Defects”. He presented a coherent method which could explain segregation of solutes at interfaces. This was followed by a lecture by Prof. P. Rama Rao of Hyderabad on “Low Stress Creep of Zirconium and its Alloys, Zircaloy 2 and Zr-2.5Nb,” in which he highlighted the importance of microstructural control on properties. Professor P. Ramachandra Rao of Hyderabad delivered an interesting lecture on “Biomimetic Synthesis of Materials,” in which he showed several interesting practical applications of engineering materials were developed using clues from nature. Prof. Subhash Mahajan enlightened the audience on “Physical Metallurgy in Microelectronics: Past, Present and Future,” by providing examples to show the impact of physical metallurgy in the past, present and future development of electronic materials.

After lunch, the participants gathered in the Hall of Fame of the Outreach Centre to view the posters on display in First Poster Session. There were posters presented in this session in the following five thematic sections: Microstructural and Phase Evolution, Mechanical Properties, Powder Metallurgy and Sintering, Nanomaterials, Corrosion and Oxidation and Modeling.

There were four talks in the final session of the day. Professor S. Ranganathan, Honorary Professor at the Department of Materials Engineering at the Indian Institute of Science, Bangalore in his lecture on “The Shape and Growth of Metallic Grains” in which he demonstrated the interplay between static and dynamic structures in terms of geometry. Prof. Peter W. Voorhees, Professor in Department of Materials Science and Engineering, Northwestern University, Evanston, USA explained a single-order-parameter model that accounts for all five degrees of freedom that determine the grain boundary energy and a multiorder parameter model for grain growth, using experimentally measured 3D grain structures in his lecture on “The Topology and Morphology of Interfaces: From Phase Separation to Grain Growth”. This was followed by talks by Dr. Chandra S. Pande, Section Head and Consultant, Materials Science and Technology Division, Naval Research Laboratory, Washington, on “Recent Developments in Grain Boundary Migration and Grain Growth” and by Dr. Srikumar

Banerjee, Director of Bhabha Atomic Research Centre, (BARC), Mumbai on the theme “Challenges in Material Science at Extreme Conditions”. In his lecture, Dr. Pande outlined a new approach based on the stochastic methods to understand modeling of grain growth, after critically reviewing existing analytical / computational methods and available models. Dr. Banerjee explained the underlying science of devices which can be configured to release enormous amounts of nuclear energy in a very short time and explained the inertial confinement fusion facilities, driven by lasers or powerful ion beams, can be used to explore material behaviour at these extreme regimes.

The participants were treated to a special Rajasthani theme dinner at the Director’s Bungalow in the evening.



Group photograph of the participants of METALLO 2007

09 Dec 07

The first session of the day entitled “Nanocrystalline and Amorphous Alloys”. In this session, Prof. Suryanarayana of University of Central Florida, Orlando, demonstrated “Glass Formation by Mechanical Alloying”. Professor Kamanio Chattopadhyay of IISc Bangalore delivered a talk titled “Phase Evolution Change During Non-equilibrium Processing” in which he explained how non-equilibrium solidification conditions allow selection of alternate pathways for the evolution of microstructures. Prof. Pradeep Haldar, of School of Nanosciences and Nanoengineering at the State University at New York (SUNY) at Albany, USA explained how his team has been able engineer new building blocks at the nanoscale, which resulted in novel materials for applications in batteries and solar cells, in his talk entitled “Powering the Future with Nanotechnology”. Prof. Christopher A. Schuh of Massachusetts Institute of Technology, Cambridge, USA, emphasized the unique opportunities of alloying (tungsten with nickel was used as an example) to produce nanomaterials with of very fine grain sizes and explained the effect of deformation using these alloys in his presentation entitled “Probing the Transition between Nanocrystalline and Amorphous Alloys”.

The second technical session was devoted to the theme of “Materials Characterization at Nanoscale”. Prof. K.A. Padmanabhan of Anna University, Chennai revealed new facets of effect of grain boundary structure on superplasticity in his talke “Grain Boundary Siding-controlled Fow and Its Relevance to Superplasticity in Metals, Alloys and Intermetallics and Strain Rate Dependent Flow in Nanostructured Materials.” Prof. Ian Robertson of University of Illinois at Urbana-Champaign, USA kept the audience spell bound with his in-situ transmission electron microscopy video images in his presentation “Direct Determination of Structure-Property Relationship by Performing Experiments Directly in the TEM”. Dr. Anil K. Sachdev from General Motors Research and Development Centre, Warren, USA, presented an interesting talk on “Interdependence of Modeling and Experiments on Materials Design,” in which he highlighted how modeling and experimental procedures can be combined to provide technological solutions, with some examples. The video images of tensile testing of nano samples were particularly revealing. In the last talk of the session, Dr. K. Muraleedharan of DMRL, Hyderabad explained the use of an advanced characterization technique in his talk titled “3D APFIM Investigation of Advanced Materials.”

After lunch, the participants again gathered in the Hall of Fame of the Outreach Centre to view the posters on display in Second Poster Session. There were posters presented in this session in the following six thematic sections: Material Processing, Application and Process Overview, Characterization, Steels, Intermetallics and Electronic Materials

The last session of the day was on the theme of “Microstructure and Mechanical Deformation.” In the first talk, Dr. G. Malakondiah, Director, DMRL, Hyderabad provided some very relevant examples showing the development of novel steels for in his presentation “Development of Specialty Low Alloy Steels.” The day concluded with a very lively presentation by Dr. Matthew R. Barnett of Deakin University on the “Influence of Grain Size and Twinning on Mechanical Response” in which he co-related the size effect that accompanied deformation twinning can explain the steep Hall-Petch slopes seen in metals, where yielding occurs by twinning like in case of magnesium.

A scintillating illustrated lecture-cum classical Bharata Natyam dance performance by Dr. Sharada Srinivasan of National Institute of Advanced Studies, Bangalore on the theme “Materials and Culture” was the special event in the evening. The participants attended the conference dinner, immediately after the dance performance.



View of the Hall of Fame during poster session

10 December 08

In the first technical session of the day, titled “Novel Processing of Advanced Materials,” there were four talks presented. Prof. S. N. Ojha of Department of Metallurgical Engineering, Institute of Technology, Banaras Hindu University explained how process variables during atomization and spray deposition processing of the melt critically controls the microstructure of the deposit in his talk “Spray Deposition Processing of Al-alloys and their composites”. Prof. P. M. Ajayan of Rice University, Houston, USA, reviewed the latest developments in the area of fabrication of carbon nanotube-based architectures, in his talk “Engineering at the Nanoscale: The Carbon Nanotube Experience”. He also showed the audience samples of his path-breaking discovery of paper-like batteries based on carbon nanotubes. Prof. Sanjay Sampath of the State University of New York at Stony Brook, USA reviewed the recent advances in thermal processing of materials, with particular emphasis on coating design and industrial practice of thermal spray processing. Dr. M. Vijayalakshmi outlined the philosophy of development of ferritic steels and its use in nuclear energy applications, in her talk “Ferritic Steels for Nuclear Reactors: Progress and Challenges.”

The second session was on the theme of “Modeling and Experiments for Novel Materials.” Professor Srikant Lele, Rector of Banaras Hindu University, Varanasi, explained the application of a new method to understand thermodynamic properties of metals and alloys in his presentation “Computational Thermodynamics of Alloys using Cluster Variation Method”. Prof. Dipak Mazumdar, Professor in the Department of Materials and Metallurgical Department, IIT Kanpur showed the relevance of modeling to industrial practice by taking the example of the steel industry in his talk “From Laboratory to Steel Making Shop: The Role of Fundamental Process Engineering.” Dr. Gautam K. Dey of Bhabha Atomic Research Center, Mumbai explained the use of high resolution microscopy in understanding nanostructures and interfaces in the presentation “High-resolution Electron Microscopy (HREM) of Interfaces.” He demonstrated how HREM has emerged as a very powerful tool for understanding the structure of alloy phases and nanocrystalline materials.

The last session of the conference was devoted to “Degradation of Metals and Alloys.” Dr. R.W. Revie of CANMET Materials Technology Laboratory, Ottawa, Canada briefed the audience about the effect of both metallurgical and environmental factors on stress corrosion cracking and hydrogen induced cracking and their relevance in the billion-

dollar oil industry of Canada in his talk “Metallurgical Factors in Stress Corrosion Cracking (SCC) and Hydrogen Induced Cracking (HIC).” Dr. Vinod S. Agarwala briefed the audience about the problems, challenges and achievements concerning corrosion in the military, and the life cycle costs related to it. His presentation was titled “Corrosion in the Military and Life-Cycle Costs.” He showed practical examples in which corrosion control was achieved in naval and military applications by careful analysis of the corrosion problem. Dr. L.K. Singhal of Jindal Steels Ltd., Hisar, highlighted the latest developments in stainless steel technology, especially emphasizing the development of low-nickel stainless steels, in his presentation “Impact of Advances in Technology on Stainless Steel Products.” In the final talk of the conference, Dr. Paul T. Craddock, formerly of the British Museum, London, described the early technology used for producing zinc and discussed the likely origins of the methodology in his interesting lecture “Zinc: an Advanced Material of India.” The important role played by India in large scale zinc extraction was particularly highlighted.

A valedictory function concluded the conference. The best posters were announced and the winners were awarded prizes. The convener of the conference R. Balasubramaniam proposed the final vote of thanks.



Volunteers of METALLO 2007



The Chief Guest of the Cultural Program, Mrs. Dhande, with Sharada Srinivasan, R. Balasubramaniam, Bikramjit Basu and Anish Upadhyaya

R. Balasubramaniam (Convener), Anish Upadhyaya (Co-Convener) and Bikramjit Basu (Co-Convener)

METALLO 2007

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