



Indian Institute of Metals, Kanpur Chapter

Annual Report

(2019-2020)

Prepared By

Secretary, IIM Kanpur Chapter

Dear Colleagues,

IIM Kanpur has continued to grow in 2019-2020, as in previous years. The current executive committee took over in July 2019 and organized several events in past one year. It received huge support from all the past and present members and we are immensely thankful to them.

The activities in the current year are as follows:

- Prof. N.K. Batra Metals and Materials Quiz was organized and the PG students also put up some materials science based demonstration for the students (August 18, 2020).
- The 74th IIM Foundation Day was celebrated at DMSRDE, Kanpur (March 05, 2020).
- International Workshop on High Entropy Materials (IWHEM 2020) was organized (March 7-8, 2020)
- EC meetings (**2019:** July 8, Sep 20, Nov 8, **2020:** Feb 21, July 13)
- IIM organized talks
 - Dr. Pratik K. Ray, IIT Ropar (July 23, 2019)
 - Shri Rituraj Dwivedi (Joint GM, Ordnance Factory, Kanpur) (Aug 19, 2019)
 - Dr. Rajiv Mishra, University of North Texas (UNT), USA (September 13, 2019).
 - Dr. S. Mishra, University of Manchester, UK. (December 31, 2019)
 - Captain Sanjay Roy, CO 1BRD (March 5, 2020)
- Annual General Meeting (AGM) was held on July 28, 2020 (online mode)

The details of the various events are enclosed in the report, herewith.

The success of the aforementioned events goes rightfully to the energetic student members who worked very hard to make the events successful. In the end, I would like to thank all the executive members and volunteers who have worked tirelessly throughout the year to take the IIM Kanpur Chapter to greater heights. I am certain that everyone, including me would extend the same support to the new executive council which will take over.

Sincerely,



Dr. Sudhanshu Shekhar Singh

Secretary, IIM Kanpur Chapter

Executive Committee (2019-2020)



Chair
Prof. Amarendra Kumar Singh



Secretary
Prof. Sudhanshu Shekhar Singh



Treasurer
Shri. G. P. Bajpai



Student Advisor
Prof. Nilesh Prakash Gurao



Member
Prof. Monica Katiyar



Member
Prof. Anish Upadhyaya



Member
Prof. Krishanu Biswas



Member
Prof. Shikhar Krishn Jha



Member
Dr. Alka Gupta

Student Body



President
Mr. Shivam Singh



Vice President
Mr. Uttam Reddy

The following are the members of the executive committee (2020-2021)

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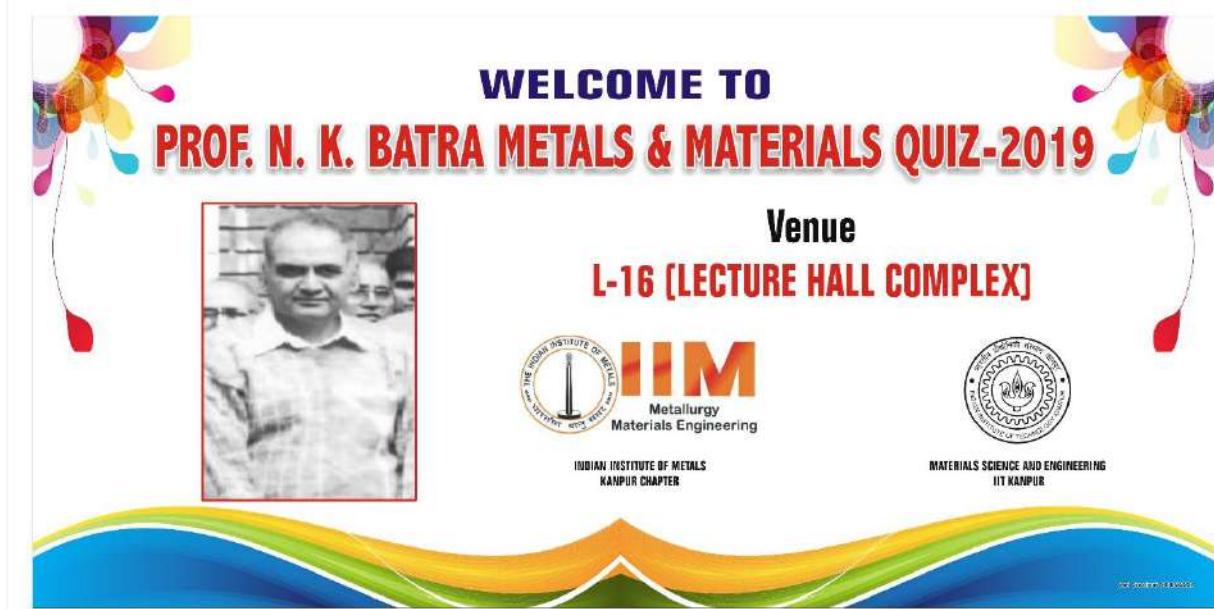
One scientist nominated from DMSRDE

Prof. N.K. Batra Metals and Materials Quiz

August 18, 2019

8:00 — 13:00

Venue: Lecture Hall – 16, LHC, IIT Kanpur



The annual **Prof. N. K. Batra Metals & Materials Quiz – 2019** was jointly organized by the Department of Materials Science and Engineering, Indian Institute of Technology (IIT) Kanpur and Indian Institute of Metals (IIM), Kanpur chapter on the August 18, 2019 in IIT Kanpur. The quiz witnessed enthusiastic participation from 35 teams representing various schools (18 schools) in Kanpur. This annual event is meant for Class XI and XII students and is aimed at inculcating their interest in Materials and Metallurgical Engineering.

The event initiated with the enlightening speech by the welcoming remarks from Prof. Gouthama, Head (Acting), Department of Materials Science and Engineering IIT Kanpur. In his speech, he highlighted the contributions of late Prof. N. K. Batra in whose memory this quiz is named. Prof. Amarendra Kumar Singh, Chairman IIM Kanpur Chapter, also extended a warm welcome to all the participants and described about Indian Institute of Metals and the quiz. As a part of the event, Shri Rituraj Dwivedi (Joint General Manager, Ordnance Development Centre, Ordnance Factory, Kanpur) delivered a talk on “**Selection of materials in defence applications**” in which he elaborated on the materials selection criterion for the Dhanush and Sarang guns used by the Indian Defence Forces. An exhibition was also organized by the MSE department students wherein

several models, such as organic light-emitting diodes, simulation-based experiments, etc were demonstrated to the students, teachers and the community.

The quiz competition consisted of a preliminary screening round, followed by four stages. The Screening Test comprised of a written test from which 8 teams were shortlisted for the next round. The first stage was divided into two rounds i.e. **Quizzical Suspects** and **Clue round**, where the students had to guess the answer with the help of given clues. The number of team was reduced to 6 after this stage. The second stage comprised of **Connect the Dots and Visual round**, where the participants had to identify the underlying concept through a combination of pictures and videos. 4 teams were shortlisted for the next round. The third stage consisted of **Buzzer round** and **Double trouble round**, from which two teams were selected for the final round. The final round, which consisted of rapid-fire questions to be answered in 60 seconds. The quiz masters (Ms. Zuveria Firdouz, Mr. Saikat Mandal and Mr. Prakhar Bhandari, all are PG students in the department of MSE) kept the audience involved in the competition through their quick wit and humour.

Aryaman Mehrotra and Shreedhar Malpani from Seth Anandram Jaipuria, Kanpur bagged the first position in the Prof. N. K. Batra Metals & Materials Quiz 2019. Ishita Tripathi and Paritosh Awasthi from Puranchandra Vidyaniketan, Kanpur were the runners-up. The two winner teams from the regional city rounds will be invited to compete now at the National level Prof. Brahm Prakash Memorial Quiz competition to be held at the Indira Gandhi Centre for Atomic Research, Kalpakkam later in this year. The quiz was organized under the stewardship of Prof. Sudhanshu S. Singh, Secretary, Prof. N.P. Gurao, Student Advisor of IIM Kanpur chapter and Prof. Shikhar K. Jha. The successful conduct of the quiz could only be possible by the unrelenting and enthusiastic efforts of the students of IIM Kanpur chapter led by Mr. Uttam Reddy and Mr. Shivam Singh of IIT Kanpur.

Glimpses of the N.K. Batra Quiz Event





IIM Foundation Day

The 74th IIM Foundation Day was celebrated on Thursday, March 5 in Director's Conference Hall at DMSRDE, Kanpur. The event started with the welcome address by Prof. Amarendra Singh (Chairman, IIM Kanpur Chapter, IIMKC), where he talked about the history of IIM and activities of IIM Kanpur Chapter. This was followed by the addresses by Dr. N. Eswara Prasad (Director, DMSRDE, Kanpur) and Prof. Amol Gokhale (Vice president and President Elect, IIM). Dr. Prasad emphasized about the pioneering role that IIM has played in making India a leader in production of metals and materials. He further suggested that organizing regular conferences/workshops to connect the industry to academia is the need of the time. Prof. Gokhale shared his views about the present and future of the Indian Institute of Metals. The key note address was delivered by the chief guest, Captain Sanjay Roy, CO 1BRD, where he discussed about the BRDs and the materials aspects in the air force. The function was concluded by the Vote of Thanks by Dr. S. M. Abbas (Sc. 'G', DMSRDE) and Prof. Sudhanshu Shekhar Singh (Secretary, IIM Kanpur Chapter). Office bearers of IIMKC (Prof. N. P. Gurao and Mr. G. P. Bajpai) along with other scientists from DMSRDE graced the occasion.



3rd International Workshop on High Entropy Materials (IWHEM 2020) at IIT Kanpur



IWHEM 2020 conference was held recently at IIT Kanpur. This was the 3rd in the series after Madras and Hyderabad conferences, organized in 2015 and 2017 respectively. Organized by the Department of Materials Science and Engineering, IIT Kanpur and Indian Institute of Metals Kanpur Chapter during March 7th -8th, 2020, the conference covered technical topics dealing with subjects bounded by structure, phase formation, diffusion, phase equilibria and phase transformation, properties, applications and other fundamental aspects of high entropy materials. High Entropy Materials (HEMs) as a research field in materials science and engineering has matured over the last few years. Just after the discovery of high entropy alloys (HEAs) in 2004, the research activities were mainly centred around the metallic alloys. This has led to discovery of many FCC and BCC HEAs, including refractory HEAs. In 2012, novel entropy stabilized multicomponent ceramic was reported and thus, the materials or phases predominantly stabilized by configurational entropy of mixing is now popularly known to be high entropy materials. It has expanded the field, opening up new vistas of



exciting research on these materials. This field has recently emerged as one of the most fascinating and challenging areas of materials research. In order to take stock of the advancement, the third international workshop on HEMs was organized at IIT Kanpur.

IWHEM 2020 was attended by nearly 150 delegates of which, 5 were foreign nationals drawn from 5 different countries and large number of Indian delegates with majority research scholars and young scientist. Some towering personalities engaged in HEMs research and development participated in the conference and presented their work as plenary and keynote speakers, including such stalwarts as Prof. J.-W.Yeh (Taiwan), Dr. Dan Miracle (USA), Prof. Karsten Durst (Germany) ,Prof.Ho Jin Ryu (Korea), Prof. Chris Berndt (Australia), to name a few. There are 25 Indian speakers from various IITs (Kharagpur, Bombay Madras, Kanpur, BHU (Varanasi), Hyderabad, Indore), NITs (Nagpur, Jaipur, Warangal, Trichy) and R Labs (BARC, Centre for Plasma Research, Assam). It is to be noted the conference were organized

in the time (weeks before the country wide locked down started) of COVID -19 and hence, few invite speakers from abroad and India could not join. Some of the invited speakers delivered lectures using online platform. The invited talks covered all the important topics mentioned earlier.



IWHEM 2020 Conference was inaugurated by the Deputy Director, IIT, Kanpur, Prof. Manindra Agrawal in the presence of Head

of the Department of Materials Science and Engineering, Prof.Monica Katiyar and Dr. Dan Miracle was chief guest. The technical session followed immediately in the Outreach Auditorium of IIT Kanpur. This is a unique conference in which only single session was held for two days for better visibility and impact of the research activities. This also includes two dedicated poster sessions for research scholars and young scientists. These poster sessions were organized to encourage students, research scholars and young scientists in India to take



up research on this emerging field of materials science and engineering. There were 70-odd posters presented in the conference. The best posters (5 each day) were awarded with books and certificates. Overall, the conference went on well with the intended audience.

- Krishanu Biswas & Kaustubh Kulkarni (Co-Conveners, IWHEM2020)

Annual General Meeting

**July 28, 2020
Online Via Google Meet**



Annual General Meeting IIM Kanpur Chapter

The Annual General Meeting of IIM Kanpur Chapter took place on July 28, 2020. The event started with welcoming by Prof. Amarendra K. Singh, Chairman IIM Kanpur Chapter. Prof. Sudhanshu Shekhar Singh, Secretary, IIM Kanpur Chapter gave an overview of the events conducted throughout the year. This was followed by the presentation by Mr. G. P. Bajpai, Treasurer IIM Kanpur Chapter on the financial status. The name of the executive members of IIM Kanpur chapter for 2020-2021 was announced by Prof. Krishanu Biswas, election officer. The new EC members were announced in the Annual General Meeting (the list has been given in the beginning of this document).

IIM Talks

Department of MSE and IIM Kanpur Chapter jointly organized a talk on "New opportunities with friction stir processing of transformative high entropy alloys" by **Dr. Rajiv Mishra**, Distinguished Research Professor, University of North Texas (UNT), USA, on 13 Sep 2019.



Abstract:

Friction stir processing (FSP) has now been established as a unique high-temperature severe plastic deformation technique. On the other hand, complex concentrated alloys (CCAs) extend the compositional paradigm shift of high entropy alloys (HEAs) to new microstructural opportunities. Combining FSP with CCAs provide opportunities for exploring tunable performance by manipulating deformation mechanisms. Fe-Mn-Co-Cr-Si alloys exhibit potential for a combination of phase transformation and twinning. These alloys give greater flexibility for tailoring transformation-induced plasticity (TRIP) and twinning-induced plasticity (TWIP), which have guided design of next-generation steel alloys over the last 20 years to a new level. For TRIP CCAs, the ductility can be extended to as high as 50% while maintaining a strength exceeding 1 GPa. The Fe-Mn-Co-Cr-Si alloys show extensive gamma (f.c.c.) to epsilon (h.c.p.) phase transformation followed by additional twinning in the epsilon phase. Design of non-equiautomic CCAs provides a vast, and vastly unexplored compositional space for developing new alloys with tunable properties. Key opportunities for enhanced fatigue limit in FSP-TRIP CCAs will be presented.

About the speaker:

Dr. Rajiv Mishra obtained his bachelor's degree from the University of Rajasthan in 1982, followed by M.Tech from IIT Kanpur. He pursued his doctorate research at the University of Sheffield, UK. He is currently a Professor at the Department of Materials Science and Engineering, University of North Texas, USA. His research interests include Friction stir welding and processing of ultrafine-grained materials, Superplastic forming, High-temperature mechanical behavior of materials, Discontinuously reinforced aluminum composites, Nanophase aluminum alloys, Bulk metallic glasses, Materials selection for alternative energy systems and Hydrokinetic energy.

Indian Institute of Metals (IIM), Kanpur Chapter, organized a talk on “The Effect of Excess Vacancies on Dynamic Precipitation in Aluminum Alloys” by **Dr. S. Mishra**, Postdoctoral Research Associate at School of Materials, University of Manchester, UK, on 31 Dec 2019.



Abstract:

It has been demonstrated that deformation strongly accelerates the decomposition of supersaturated solid solution in age hardenable aluminum alloys. The prevailing effect in producing this acceleration is a rapid increase in non-equilibrium concentration of vacancies due to non-conservative motion of jogged screw dislocations. These vacancies tend to increase the diffusion rate which in turn enhances both the precipitate nucleation and growth process. Past studies have revealed that in scenarios where vacancy annihilation is negligible (very slow strain rates~10⁻⁵ to 10⁻⁶ sec⁻¹), precipitate growth rate is independent of strain rate. In these cases, precipitate growth rate depends only upon the total imposed strain. However, recent ex-situ and in-situ studies have revealed that in situations where vacancy annihilation is non-negligible (~10⁻³ to 10⁻¹ sec⁻¹), the precipitate nucleation and growth rates depend strongly upon strain rate. Based on the experimental results, the limitations of excess vacancy model are discussed, and further modifications are proposed. The possibility of integrating the classical Kampmann-Wagner numerical framework with crystal plasticity model to clearly establish the temperature and strain rate dependence will also be discussed.

About the Speaker:

Dr Sumeet Mishra completed his PhD from Indian Institute of Technology Kanpur with a thesis on experimental and theoretical investigations of the effect of precipitates on mechanical behavior and deformation texture of an aluminum-magnesium-silicon alloy. Prior to joining The University of Manchester, he was a postdoctoral fellow at Indian Institute of Science Bangalore where his research work involved understanding texture and microstructure evolution during incremental sheet metal forming of light weight alloys. At University of Manchester, Dr. Sumeet is involved in understanding the deformation response in the two-phase regime of Ti-6Al-4V alloy by carrying out compression tests at different temperature under constant true strain rate to simulate experimental processing conditions. Apart from Ti alloys, Dr. Sumeet is also developing a model based on Kampmann-Wagner numerical framework to understand precipitation kinetics in age hardenable Al alloys with special focus on vacancy assisted nucleation and growth.

Indian Institute of Metals (IIM), Kanpur Chapter, organized a talk on “Designing oxidation resistant high temperature materials” by **Dr. Pratik K. Ray**, Assistant Professor Department of Metallurgical and Materials Engineering, IIT Ropar, on July 23, 2019



ABSTRACT:

Higher operating temperatures result in higher Carnot efficiencies, and this has been the driver behind research efforts on high temperature materials. Designing such materials for extreme environments is a multifaceted challenge with alloy chemistries and processing routes being tailored for optimal mechanical properties and minimal environmental degradation. In this talk, we will address one aspect of this multifaceted challenge. The focus shall be primarily on designing materials based on their phase stability and oxidation resistance, over a broad range of temperatures (800 – 2000 °C), involving different oxidation mechanisms. Our recent results on three different materials systems will be presented, namely, Ni-based alumina formers with Mo additions (800 – 1200 °C), Mo based refractory silicides (1000 – 1500 °C) and ultra-high temperature ceramics (1400 – 2000 °C). Refractory metal alloying in Ni based systems, as well as refractory metal-based alloy systems can boost the operating temperatures significantly; however, they also result in significant complexities in the oxidation behavior. We will discuss the oxidation behavior of such materials, appropriate mitigation strategies and new directions in high temperature alloys research.

About the Speaker:

Dr. Pratik K. Ray obtained his bachelor’s degree in Metallurgical and Materials Engineering from NIT Rourkela, after which he finished his Master’s from IIT Madras. He obtained his doctoral degree from Iowa State University. Thereafter he worked first as a post-doc and then as a scientist in Ames Laboratory (a US Department of Energy Lab) before joining IIT Ropar in June of this year. Dr. Pratik works largely in the area of processing and oxidation behavior of high temperature alloys and ceramics and on the thermodynamics and kinetics of phase transformations.