

# **Indian Institute of Metals, Kanpur Chapter**

# Annual Report (2022-2023)

Prepared By Secretary, IIM Kanpur Chapter

## Annual Report (2022-2023)

Dear Members of the IIM Kanpur Chapter and Friends,

IIM Kanpur has continued to grow in 2022-2023, as in previous years. We organized several events in past one year. It received huge support from all the past and present members and is immensely thankful to them. Some of our achievements in the current year are as follows:

- Prof. N.K. Batra Metals and Materials Quiz was organized, and the PG students also putup some materials science-based demonstration for the students (*September 3, 2022*).
- Three days Science camp for school students (*May 6-8, 2023*).
- Workshop on Characterization of coating materials was organized (May 9, 2023).
- IIM has organized a few talks this year.
  - ✓ Dr. Praveen Kumar, IISC (April 4,2022)
  - ✓ Dr. Anirban Patra, IIT Bombay (June 30,2022)
  - ✓ Dr. Ilaksh Adlakha, IIT Madras (July 8,2022)
  - ✓ Dr. Rama Srinivas Varanasi, Institute for Materials Research (IMR), Tohoku University (Jan 5,2023)
  - ✓ Dr. Swati Sharma, IIT Mandi (Jan 27, 2023)
  - ✓ Dr. Soumya Sridar, University of Pittsburgh (March 20, 2023)

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 workedvery 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 would extend the same support to the new executive council which will take over.

Sincerely

Sudhe

Sudhanshu Shekhar Singh Secretary, IIM Kanpur Chapter

## **Executive committee**

Chair Prof. Amarendra Kumar Singh Department of MSE, IIT Kanpur amarendra@iitk.ac.in

Secretary Prof. Sudhanshu Sekhar Singh Department of MSE, IIT Kanpur sudhanss@iitk.ac.in

**Treasurer Mr. G. P. Bajpai** Department of MSE, IIT Kanpur <u>gpbajpai@iitk.ac.in</u>

Student Advisor Prof. Nilesh P. Gurao Department of MSE, IIT Kanpur npgurao@iitk.ac.in

**Prof. Anish Upadhyaya** Department of MSE, IIT Kanpur <u>anishu@iitk.ac.in</u>

**Prof. Alka Gupta** Department of MME, CSJMU <u>gupta.alkag@gmail.com</u>

## **Student Body**

President Ms. Gulnaz Parween Department of MSE, IIT Kanpur gulnazp20@iitk.ac.in

Vice President Ms. Harsha Prasad Department of MSE, IIT Kanpur harshap21@iitk.ac.in

Secretary Mr. Antrakrate Gupta Department of MSE, IIT Kanpur antrakrate21@iitk.ac.in

Seminar Coordinator Mr. Parthadhwaj Konduparty Department of MSE, IIT Kanpur parthadh22@iitk.ac.in

E-content Coordinator Ms. Satabhisha Ghosh Department of MSE, IIT Kanpur sghosh21@iitk.ac.in

# **Prof. N. K. Batra Metals and Materials Quiz**

**September 3, 2022** 

08:00 – 13:30 hours

Venue: L-18 (Lecture Hall-18), IIT Kanpur



The annual Prof. N. K. Batra Metals & Materials Quiz – 2022 was jointly organized by the Department of Materials Science and Engineering, Indian Institute of Technology Kanpur and Indian Institute of Metals (IIM), Kanpur Chapter on September 3, 2022 at IIT Kanpur. The quiz witnessed enthusiastic participation from 27 teams representing 14 different schools in Kanpur. This annual event is for the students of Class XI and XII, and is aimed at inculcating their interests in Materials and Metallurgical Engineering.

The event started with the welcoming address from Prof. Kallol Mondal, Head, Department of Materials Science and Engineering IIT Kanpur. In his address, he highlighted the contributions of late Prof. N. K. Batra, and this quiz is named after him. 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. Prof. Abhay Karandikar, Director, IIT Kanpur talked about the importance of materials and inaugurated the quiz. The successful conduction of the inaugural program was done by Prof. Sudhanshu Shekhar Singh, Secretary of IIM Kanpur Chapter. As a part of the event, Prof. Manoj K. Harbola (Professor, Department of Physics, IIT Kanpur) delivered a talk on "*Entertainment with materials around us*", where he showed various experiments on materials used in day-to-day life. An exhibition was also organized by the students of MSE department wherein several models, such as organic light-emitting diodes, simulation-based experiments, crystal structure models, etc., were demonstrated to the students and teachers.

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. The number of teams was reduced to six, four and two after the first, second and third stage, respectively. The final stage consisted of rapid-fire questions, which were to be answered in 75 seconds. The quiz master, Prof. Nilesh Badwe, kept the audience involved in the competition through their quick wit and humour. **Mr. Anuz and Mr. Om Upadhyaya from Kendriya Vidyalaya, IIT Kanpur bagged the first position in the Prof. N. K. Batra Metals & Materials Quiz 2022. Mr. Harsh Jha and Mr. Abhay Chandra of Delhi Public School, Azaad Nagar, Kanpur were the runners-up. The successful conduct of the quiz could only be possible by the unrelenting and enthusiastic efforts of the students of IIM Kanpur Chapter (Ms. Gulnaz Parween, Ms. Harsha Prasad, Mr. Antrakrate Gupta, Mr. Parthadhwaj Konduparty, Ms. Satabhisha Ghosh) and other students of MSE department. Department staff members, Mr. G. P. Bajpai, Mr. Guddu Kumar, Mr. Aniket Dwivedi, and Mr. Govind, also helped in organizing the quiz. The team was mentored by MSE faculties consisting of Prof. Sarang Ingole, Prof. Rajdip Mukherjee, Prof. Niraj Chawake, Prof. Nilesh Badwe, Prof. Arunabh Meshram, Prof. Shikhar Misra, and Prof. Srinu Gangolu.** 

































PAGE 7

# **Materials Camp**

May 6-8, 2023



Materials camp was organized by Material Advantage @ IIT Kanpur, IIM Kanpur Chapter, ASM International Kanpur Chapter and INAE Kanpur Chapter for 3-day during May 06-08, 2023 at IIT Kanpur. The "Materials Camp" attracted participation of 38 students and nine teachers from nine schools of Kanpur (i.e., DPS Azad Nagar, DPS Kalyanpur, Dr. Virendra Swaroop Education Centre, Jai Narayan Vidya Mandir, Kendriya Vidyalaya IIT Kanpur, Methodist High School, Seth Anandram Jaipuria, Shieling House, and Sir Padmapat Singhania). Comprehensive three-day 'Materials Camp' was highly packed. Shri Pradeep Goyal, Senior Vice President of ASM International, graced the event with his online presence for inaugurating the event on May 06, 2023. Prof. Kallol Mondal, Head, MSE Department emphasized the role of material and processing in attaining required performance. Prof. Amarendra Singh, Chair Indian IIM Kanpur Chapter, emphasized on the role of materials in civilization. Prof. Yogesh Joshi, Chair INAE Kanpur, elicited the convergence of all engineering fields through research in Materials Science. Prof. Sudhanshu S. Singh, Secretary IIM Kanpur Chapter, also attended the event.

The first day sessions involved talks on "Classification of Materials" by Prof. Niraj Chawake, followed by real-life demonstrations on materials in a mobile phone by Ms. Shruti Dubey and Ms. Pooja Rani. Then Prof. Kantesh Balani delivered a talk on, "Fascinating World of Materials", which followed an impromptu session by Prof. Anish Upadhyaya on challenges in materials. Thereafter, a session on sample preparatioon and microscopy of various samples in physical metallurgy laboratory, which was coordinated by Mr. Gyan P. Bajpai and Mr. Ajay P. Singh.

The second-day session highlights included demonstrations of Electrospinning, Wetting, Lab-safety and Scanning Electron Microscopy by Mr. P. Shiven, Mr. Govind, Mr. Ajay P. Singh, Ms. Pooja Rani, Ms. Shruti Dubey, Mr. Murli Manohar and Dr. Deepak Khare with assistance of Mr. Dinesh Diwakar and Mr. Raj Babu. In addition, parallel session of virtual lab on "Electron Microscopy for Beginners" was demonstrated by Mr. Dhananjay Umrao, Ms. Sheetal, Mr. Vinay Tripathi, Ms. Reena, Ms. Suman Tripathi, and Mr. Harsh Dwivedi, and was very well received by students.

The third day of the 'Materials Camp' was more on mechanical testing and manufacturing processes to appreciate the utility of processing techniques in changing material shape and also attaining requisite performance. Shri Anil K. Verma, Shri S.K. Agnihotri, Shri I.P. Singh, Shri Rakesh K. Dixit, Shri Gaurav Mishra, Shri Gyanendra Singh, Shri Samardeep Shri Bharat R. Singh, and Shri Pappu Kannaujia anchored the event. Further, third day highlight was an industrial visit to Anod Plasma Spraying, wherein the surface preparation, and coating deposion techniques (such as plasma spraying, and flame spraying) on real-life components were demonstrated by Shri Ritik Tandon and Shri Viraj Tandon. The excitement was all evident in the eyes of participants and had not at all subdued even after three days of engaging sessions. The program ended with distribution of certificates to all the participants and concluded with a very positive note of satisfaction and grand success of 'Materials Camp'.



## **Workshop on Characterization of Coating Materials**

## May 09, 2023 10:00 -17:00 FB421, Department of Materials Science and Engineering

Indian Institute of Metals Kanpur Chapter jointly organized the workshop with Department of Materials Science and Engineering IIT Kanpur, Material Advantage, IIT Kanpur Chapter and Indian National Young Academics of Sciences (INYAS) in association with Anton Paar on Characterization of Coating Materials.

The workshop was on mechanical characterization techniques for the development and quality control of coated materials. Dr. Kallol Mondal, HOD of the Department of Materials and Engineering at IIT Kanpur, Dr. Amarendra Kumar Singh, chair of The Indian Institute of Metals, IIT Kanpur Chapter, and Dr. Kantesh Balkani, faculty advisor of Material Advantage, IIT Kanpur Chapter, encouraged the students and demonstrated the importance of this workshop for the coating materials for structural Applications. The audience was given a brief introduction to the Indian National Young Academy of Sciences (INYAS) and the workshop by Dr. Sudhanshu Shekhar Singh.

Dr. Ankit Jain, Mr. Jitendra Singh, and Mr. Abhishek Singh, all industry experts, were invited from Anton Paar. They conducted presentations to introduce the researchers to the X-ray diffraction spectroscopy equipment and the related solutions to combat different challenges related to various sample conditions for XRD analysis. The session provided participants with the opportunity to interact live with industry experts and gain practical experience. It featured practical training with a variety of cutting-edge surface characterization tools, including Calotest testers, nano-indentation, scratch testers, and tribometers. The mechanical characteristics of coatings, such as hardness, adhesion, wear resistance, and thickness, can be learned from these technologies in useful ways. There was also an online training for handling extremely complicated tribolometer and scratch tester equipment. The session was attended by about 40 research students. The participants found the workshop very useful and informative for their own research work.

















PAGE 12

# **IIM Talks**



## ✓ Dr. Praveen Kumar, IISC Bangalore (April 04, 2022)

On 4<sup>th</sup> April 2022, IIM Kanpur Chapter organized a talk on "Bending Creep of Materials: Rediscovering an Old Alternate Method for Creep Testing" by Dr. Praveen Kumar, Associate Professor, Indian Institute of Science Bangalore. During the session, he covered various topics on creep mechanism. After that, he interacts with faculty and students of IIT Kanpur.

Title: Bending Creep of Materials: Rediscovering an Old Alternate Method for Creep Testing

### Abstract:

The first systematic study on bending creep was performed in 1934. Since then, the method has been a popular alternative method for estimating the creep response of materials, especially ceramics and other brittle materials. However, conventionally, only the "averaged out" creep response has been determined, thereby leaving out a plethora of information available at the local level due to the graded stress and strain fields in a beam. We realized that measuring the local strain field using digital image correlation, in conjunction with simple analytical relationships, can extract multiple stress-strain-strain rate triplets, which can be used to obtain multiple creep curves from a single creep test on a cantilever. Subsequently, we developed a scheme to determine the

creep stress exponent and establish the relevant structure-property relationship for materials in high throughput fashion. Besides the time needed to test a sample, the developed method minimizes the volume of material required to complete the round-robin tests. Finally, I will also discuss our current efforts to further reduce test specimen volume by testing composite and smallsized samples.

### About the Speaker:

Dr. Praveen Kumar received his bachelor of Technology degree in Mechanical Engineering from the Indian Institute of Technology, Kanpur, in 2003. Subsequently, he received M.S. and Ph.D. degrees in Mechanical Engineering from the University of Southern California, Los Angeles in 2005 and 2007, respectively. He is currently an Associate Professor with the Department of Materials Engineering, Indian Institute of Science, Bangalore. His main research interests are the mechanical behavior of materials, with particular emphasis on studying the effects of electric current, temperature and sample length scale, and constructive usage of electromigration, both in solid and liquid metals.

### ------

## ✓ Professor Anirban Patra, IIT Bombay (June 30, 2022)

IIM Kanpur Chapter organized a talk by Dr. Anirban Patra, Department of Metallurgical Engineering and Materials Science, IIT Bombay. The details are as follows:

Title: Strain Gradient Plasticity Modelling of Grain-Scale Deformation Phenomena

### Abstract:

Plastic deformation in polycrystals is inherently heterogeneous, with differential hardening and deformation in the individual grains. This heterogeneous deformation leads to the development of strain gradients and Geometrically Necessary Dislocations (GNDs) in the regions of incompatible deformation, such as grain boundaries. These strain gradients contribute to misorientation developments in the vicinity of grain boundaries and grain size dependent strengthening. This talk

presents recent efforts in our group on modeling the effects of such phenomena on the mechanical properties and microstructure evolution.

We first present a strain gradient J2 plasticity modeling framework used for modeling grain size dependent strengthening. Model predictions of the Hall-Petch effect and Ashby's strengthening model due to GNDs are compared with available experimental data in the literature. Next, we discuss a strain gradient crystal plasticity model for studying the development of misorientation gradients near grain boundaries in an Al alloy. The length of these regions with high misorientations, referred as Near Boundary Gradient Zones (NBGZs), are predicted and compared with our experimental Electron Back Scattered Diffraction (EBSD) measurements. Based on our study, the width (mean with deviation) of the distribution of the length of NBGZs, normalized by the grain size, is found to scale with the initial grain-average Schmid factor. Further, our results also suggest a possibly strong correlation between the length of the NBGZ and the grain size.

### About the Speaker:

Prof. Patra obtained his Bachelors in Metallurgical and Materials Engineering from IIT Kharagpur in 2009 and Doctorate in Materials Science and Engineering from Georgia Tech in 2013. Subsequent to his PhD, Prof. Patra worked in the machining industry at Third Wave Systems, Minneapolis. He then did a post-doc from Los Alamos National Laboratory, before joining IIT Bombay as a faculty in the Department of Metallurgical Engineering and Materials Science in October 2017. His research interests lie in the broad areas of computational mechanics, crystal plasticity, constitutive modeling and computational materials design.

### ✓ Dr. Ilaksh Adlakha, IIT Madras (July 08, 2022)

On 8 July 2022, IIM Kanpur Chapter organized a talk by Dr. Ilaksh Adlakha, Department of Applied Mechanics, IIT Madras.

Title: First-principles investigations into the electrochemical behavior of Mg based intermetallic

### Abstract:

Magnesium alloys have drawn considerable attention for several engineering applications, owing to their excellent properties like low density and high specific strength. The room temperature ductility and mechanical properties of Mg are usually enhanced by alloying additions. Based on the thermomechanical processing, the presence of critical concentration of alloying element typically leads to the formation of stable binary intermetallic phases with Mg thereby, distinctly altering the microscopic electrochemical properties of the alloy. However, the secondary intermetallic phases in Mg alloys are typically of sub-micron size, thus accurate electrochemical characterization is a challenging issue. Using first-principles calculations, the electrochemical behaviour of various Mg intermetallics was strongly dependent on surface-mediated properties and chemical bonding characteristics. Finally, the computational framework provides an accurate screening tool that can assist in alloy design and development of coatings.

### About the Speaker:

Dr. Ilaksh Adlakha is an Assistant Professor in the Applied Mechanics department at Indian Institute of Technology Madras. Ilaksh completed his PhD from Arizona State University (2015), where he focused on examining the hydrogen embrittlement phenomenon in Fe using a multi-scale perspective. During his post-doc, he worked on stress assisted corrosion and investigated the interplay between the various phenomena by combining experimental and modeling observations. His research interests lie at the interface of solid mechanics and materials science with a special focus on the development of structure-property relationships across multiple length scales. To carry out this his research group strives for a multiscale research vision that seamlessly combines computational and experimental tools to provide necessary insights to improve mechanical performance of structural alloys. He has co-authored 21 journal articles and > 25 international conference presentations. Furthermore, he has published in reputed international journals, such as Nature Communications, Acta Materialia, Corrosion Science, International Journal of Hydrogen Energy, and Nature: Scientific Report.

\_\_\_\_\_

### ✓ Dr. Rama Srinivas Varanasi, Tohoku University (Jan 5, 2023)

IIM Kanpur Chapter organized a talk by Dr. Rama Srinivas Varanasi, Postdoctoral Researcher at the Institute for Materials Research (IMR), Tohoku University. The details are as follows:

Title: Understanding the heterogeneous nucleation mechanisms in medium manganese steels

### **Abstract:**

The ferrite-austenite dual-phase medium manganese steels (3-10 wt. % Mn) can be obtained via either of the two heat treatment processes: (i) Ferrite ( $\alpha$ ) formation from austenite ( $\gamma$ ) parent phase during the continuous cooling ( $\gamma \rightarrow \alpha$  transformation). (ii) Austenite reversion from the martensitic matrix ( $\alpha$ ') during intercritical annealing ( $\alpha' \rightarrow \gamma$  transformation). It has been reported that the reversion of austenite from martensite during intercritical annealing is considerably faster. Cold-rolled martensite has extremely high defect density. Solid-state diffusional phase transformations generally occur via heterogeneous nucleation at defects such as dislocations, grain/phase boundaries, triple junctions, etc. Thus, understanding the mechanism of heterogeneous nucleation at these defects is critical in cold-rolled intercritically annealed medium manganese steels. In the current talk, the following phase transformations mechanisms are presented:

(i) Segregation-driven austenite nucleation at ferrite grain boundaries (GBs), wherein the effect of GB misorientation and temperature dependence are discussed. To this end, a correlative transmission Kikuchi diffraction (TKD)/atom probe tomography (APT) approach is combined with density functional theory (DFT) calculations. Additionally, the role of 'short circuit' diffusion paths provided by defects (GBs and dislocations) in the austenite growth is explained [1].

(ii) NbC precipitation at dislocations during intercritical annealing is explained. Furthermore, the formation of transient NbC adversely affects the austenite nucleation and growth, resulting in a reduction of the austenite phase fraction. The corresponding mechanisms are discussed [2].

### **References:**

- [1] R.S. Varanasi, M. Lipińska-Chwałek, J. Mayer, B. Gault, D. Ponge, Scr. Mater. 206 (2022) 114228.
- [2] R.S. Varanasi, B. Gault, D. Ponge, Acta Mater. 229 (2022) 117786.

### About the Speaker:

Rama Srinivas Varanasi is currently a postdoctoral researcher at the institute for materials research (IMR), Tohoku university. He received his Ph.D. from the Max-Planck-Institut für Eisenforschung in 2021. Before his Ph.D., he completed his dual degree from the department of Metallurgical and Materials Engineering, IIT Madras, in 2017. As a dual degree student, he visited RWTH Aachen university twice as a DAAD scholar. His research focuses on two areas: (i) Mechanisms of deformation and hydrogen embrittlement in advanced high-strength steels. (ii) Fundamentals of diffusional and diffusionless phase transformations in metallic materials. To this end, he employs correlative atom probe tomography (APT)/ transmission Kikuchi diffraction (TKD) studies and in-situ (and quasi-in-situ) electron channeling contrast imaging (ECCI) coupled with electron backscatter diffraction (EBSD).





### ✓ Dr. Swati Sharma, IIT Mandi (Jan 27, 2023)

IIM Kanpur Chapter is organized a talk by Dr. Swati Sharma, Assistant Professor at IIT Mandi. The details are as follows:

### Abstract

Fabrication of flexible and wearable devices demands a biocompatible, electrochemically and mechanically stable, high-performance functional material. Different forms of carbon can potentially fulfil these requirements, but they are either not compatible with microfabrication, or entail cumbersome and expensive multi-step processing. In Carbon Engineering Lab at IIT Mandi, we develop advanced device-friendly carbon materials and manufacturing processes useable in flexible sensors, energy storage devices and implantable bioelectronics. This is done by microstructural tuning of polymer-derived carbon, ensuring a low processing cost and scalability. In this talk, two main methods used in flexible carbon microdevice fabrication, (i) micropatterning of carbon fiber mats, and (ii) laser-induced carbonization of polymer films for direct carbonwriting, will be discussed and compared for different applications. As examples, the use of carbon fibers in neural implants and that of laser-carbon in supercapacitors, electrocatalysts and sensors will be described. In addition, the talk will cover a general introduction to carbon materials and their structure, the influence of manufacturing conditions on their properties, and their classification as graphitizing and non-graphitizing carbon. State-of-the-art characterization techniques such as *in situ* transmission electron microscopy of polymer-to-carbon conversion will also be touched upon.

### About the speaker

Swati Sharma is an Assistant Professor at IIT Mandi in the School of Mechanical and Materials Engineering. Before joining IIT Mandi in 2019, she worked as a Scientist and Group Leader at the Karlsruhe Institute of Technology and the University of Freiburg in Germany for over five years. She obtained her M.S./ Ph.D. from the University of California Irvine, USA in 2013. Prior to this,

she spent one year at UNIST, South Korea as a Researcher. She completed her B.E. (Hons.) in Chemical Engineering from BITS, Pilani in 2004 and worked as a Research Scientist for over 4 years at Ranbaxy Research Laboratories, Gurgaon. Her current research is focused on carbon materials and manufacturing. She is best known for proposing a new microstructural model for non-



graphitizing carbons, confirming the presence of fullerenes in this class of carbon materials. Her research contributions have been published in several reputed journals, patents and books. She is a council member of the Indian Carbon Society and a popular teacher on NPTEL and other online platforms.

## ✓ Dr. Soumya Sridar, University of Pittsburgh (March 20, 2023)

IIM Kanpur Chapter organized a talk by Dr. Soumya Sridar, Visiting Research Assistant Professor, University of Pittsburgh. The details are as follows:

**Title:** Application of computational thermodynamics for design of materials and post-processing operations

### Abstract:

Computational thermodynamics combined with experimental validation has become a feasible approach for designing new materials and post-processing operations, replacing brute-force experimental investigations involving high material costs. This talk will demonstrate how thermodynamic and kinetic simulations can be employed for the design of materials and post-processing with three case studies. The first case study will discuss the application of the CALPHAD (Calculation of Phase Diagrams) method to develop a thermodynamic database

for a multicomponent chloride salt system crucial for nuclear fuel reprocessing and the prediction of critical attributes of the electrolyte using the developed database. In the second case study, highthroughput CALPHAD computations for design of transition interlayers to join dissimilar alloys employed in advanced ultra-supercritical power plants and applying kinetic simulations to determine the homogenization heat treatment parameters and location-specific solidification cracking susceptibility will be presented. The third case study will demonstrate the use of kinetic simulations to effectively design decarburization heat treatment to improve the mechanical properties of additively manufactured stainless steel after being subjected to a surface modification technique for reducing surface roughness.

### About the Speaker:

Dr. Soumya received her Integrated M.Tech + PhD degree in 2018 from the Department of Metallurgical and Materials Engineering, Indian Institute of Technology Madras. Her doctoral thesis focused on developing a thermodynamic database for multicomponent nitride systems using the Calculation of Phase Diagrams (CALPHAD) method coupled with ab initio calculations. She joined as a Postdoctoral Associate at the University of Pittsburgh in April 2019. Her postdoctoral research involved the design of functionally graded materials processed by additive manufacturing using the Integrated Computational Materials Engineering (ICME) technique in conjunction with experiments. In addition, she continued developing thermodynamic databases for multicomponent chloride salts using the CALPHAD method. Currently, she is working as a Visiting Research Assistant Professor and exploring new research initiatives linked with CALPHAD and additive manufacturing. Her areas of expertise include phase diagram determination and application of computational thermodynamics for microstructure engineering and alloy design.