MAE COLLOQUIUM

Metallurgy, mechanistic models, machine learning and digital twins of metal printing

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Tuesday, November 26, 4:00 pm | Kimball B11

Refreshments at 3:30 pm | 116 Upson Hall

Abstract:

The purpose of this presentation is to introduce the most interesting contemporary issues in metals printing to a broad audience. Additive manufacturing allows printing of unique metallic components such as patient specific implants, single crystal components and alloys with site specific properties from digital drawings. However, the selection of alloys, process variant and variables result in an exceptional diversity of microstructures, properties and defects. Controlling these attributes based on the existing knowledge of metallurgy is challenging. Furthermore, optimizing structure and properties of components by trial and error is not a viable option because of the large number of variables involved and the high cost of feed stock and machines. Mechanistic models of additive manufacturing, when adequately validated, can provide insight about the evolution of solidification structure, microstructure, common defects and printability. Since AM is relatively new, mechanistic understanding of various aspects of AM is still emerging. Machine learning algorithms aided by data enable printing of defect free parts. A digital twin or a digital replica of the printing machine consisting of mechanistic models, big data, machine learning and sensing and control can reduce the number of trial and error tests to obtain the desired product attributes and reduce the time required for part qualification. Better understanding of the metallurgy of metal printing and the application of the emerging digital tool have the potential to significantly accelerate progress in metal printing.

Biography:

Tarasankar DebRoy is Professor of Materials Science and Engineering at The Pennsylvania State University, an Honorary Member of American Welding Society and a Founding Editor of "Science and Technology of Welding and Joining." He develops numerical models to compute the most important factors that affect metallurgical product quality such as temperature and velocity fields, cooling rates and solidification parameters. His papers, at the cross roads of metallurgy, welding, additive manufacturing and numerical heat transfer have been cited in the literature and have been recognized by the UK Royal Academy of Engineering's Distingusihed Visiting Fellowship, a Fulbright Distinguished Chair in Brazil, The Arata Award of the International Institute of Welding (IIW), France, Easterling Award of the University of Graz, Austria and IIW, Penn State's Faculty Scholar Medal and many other awards from US and international institutions.

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