PURDUE UNIVERSITY | Materials Engineering
COLLEGE OF ENGINEERING

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Seminar Series

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ARMS 1010

Four Dimensional (4D) Materials Science: Probing Microstructural Evolution of Metallic Materials in Real-Time

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Abstract: The field of materials science and engineering (MSE) is based on the fundamental principle that microstructure controls properties. Traditionally, the study of material structure has been limited by sectioning and post mortem observations. This approach is often inaccurate or inadequate for solving many fundamental problems. It is also often laborious and time-consuming. Advances in experimental methods, analytical techniques, and computational approaches, have now enabled the development of *in situ* techniques that allow us to probe the behavior of materials in real-time. The study of microstructures under an external stimulus (e.g., stress, temperature, environment) as a function of time is particularly exciting. Examples include an understanding of time-dependent deformation structures, phase transformations, compositional evolution, magnetic domains, etc.

X-ray synchrotron micro and nano-tomography provides a wonderful means of characterization damage in materials non-destructively. In this talk, I will describe experiments and simulations that address the critical link between microstructure and deformation behavior of metallic materials, by using a three-dimensional (3D) virtual microstructure obtained by x-ray synchrotron tomography. The approach involves capturing the microstructure by novel and sophisticated *in situ* testing in an x-ray synchrotron, followed by x-ray tomography and image analysis, and 3D reconstruction of the microstructure. Case studies on fundamental precipitation evolution and deformation phenomena in aluminum alloys under cyclic loading and in a corrosive environment will be presented and

Biography: Nikhilesh Chawla is the Fulton Professor of Materials Science and Engineering (MSE) at Arizona State University. He is also a Professor of Mechanical Engineering. Prof. Chawla received his Ph.D. in Materials Science and Engineering from the University of Michigan in 1997. He served as acting chair of the MSE program at ASU in 2010. Prior to joining Arizona State University in 2000 he was a postdoctoral fellow jointly at Ford Motor Company and the University of Michigan, and a senior development engineer at Hoeganaes Corporation.

Prof. Chawla's research interests encompass the mechanical behavior and modeling of advanced materials at bulk and small length scales, including Four Dimensional (4D) materials science, Pb-free solder alloys, composite materials, and nanostructured materials. He has co-authored close to 180 refereed journal publications (h-index of 31) and 360 presentations in these areas. He is the author of the textbook *Metal Matrix Composites* (co-authored with K.K. Chawla), published by Springer. The second edition of this book was published in 2013.

Prof. Chawla is a fellow of ASM International and past member of The Minerals, Metals, and Materials Society (TMS) Board of Directors. He's the recipient of the 2013 Brimacombe Medalist Award from TMS; 2011 Distinguished Lectureship given by Tsinghua University, China; 2009 Raymond Award for Best Paper by the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME); 2004 Bradley Stoughton Award for Young Teachers, given by ASM International; and the 2006 TMS Young Leaders Tutorial Lecture. He's also won the National Science Foundation Early Career Development Award and the Office of Naval Research Young Investigator Award.

Prof. Chawla is editor of *Materials Science and Engineering A*. He also serves on the Editorial Boards of *Advanced Engineering Materials* and *Materials Characterization*. His work has been featured on the show *Modern Marvels* on the History Channel, R&D News, Fox News, and the Arizona Republic. He serves on ASU President Michael Crow's Academic Council, which provides input to the president on academic, structural, and strategic matters