The Department of Mechanical Engineering Presents

Arun Devaraj, Ph.D.

Materials Scientist, Physical and Computational Sciences Directorate, Pacific Northwest National Laboratory, Richland, Washington

Title: Mapping Phase Transformation Pathways in Materials and Linking it to Processing-Microstructure-Property Relationships

Abstract: Materials scientists studying processing-microstructure-property relationships dream of knowing how the processing influences the exact location of each atom in a material and how that impacts its properties. Such detailed understanding of material microstructure can inform novel solid phase material processing approaches to design breakthrough materials with unique persistently metastable microstructure and better properties and performance. This same ideal applies to researchers interested in understanding how materials degrade in extreme environments, such as corrosive environments in internal combustion engines, and high voltages in batteries. Understanding material degradation enables researchers to design long-lasting, damage-tolerant, high-performance materials. Often, no single characterization method can provide information on materials from the physical component level down to atomic scale, so multiple imaging methods must be seamlessly integrated. At Pacific Northwest National Laboratory (PNNL), to address key scientific questions about materials relevant to U.S. Department of Energy (DOE) research priorities, we couple methods spanning atom probe tomography, aberration corrected transmission electron microscopy and synchrotron-based high energy x-ray diffraction to enable comprehensive understanding of the relationships between material processing parameters, microstructure evolution, mechanical properties, and performance. This correlative multimodal imaging can also provide information at multiple length scales relevant to predictive materials modeling. This talk will describe PNNL efforts on a new 5 year solid phase processing initiative to elucidate phase transformation pathways during shear deformation of materials using novel in situ methods and ex situ high resolution multimodal microstructural characterization. Value of similar approaches to study material degradation during high temperature oxidation will also be presented. These efforts in turn can enable design of novel engineered materials. Examples including lightweight automotive structural alloys, metallic nuclear materials, and biological materials such as tooth enamel will be presented.

About the Speaker: Dr. Arun Devaraj is a materials scientist at PNNL. He has revealed mechanisms of non-equilibrium behavior in metallic alloys including in beta Titanium alloys, Aluminum alloys and UMo nuclear fuels, leading to better understanding of metastable phase transformations and microstructural control. He is recognized for contributions to expanding the application of atom probe tomography (APT) and correlating APT results with other material characterization methods such as transmission electron microscopy, x-ray absorption near edge spectroscopy, and in-situ high energy x-ray diffraction at DOE synchrotron facilities. He is the thrust lead of the PNNL solid phase processing science initiative and a principal investigator for DOE office of vehicle technology propulsion materials program, NNSA tritium science programs and PNNL LDRD projects and mentor many students and postdocs. His research interests cut across automotive materials, nuclear materials, energy storage and conversion, and biomaterials. He has published over 75 peer-reviewed journal articles, including in Nature Communications and Science Advances. He was awarded the Ronald L. Brodzinski Early Career Exceptional Achievement Award from PNNL in 2019. Dr. Devaraj is a steering committee member of the International Field Emission Society, past leader of an APT Focused Interest Group in the Microscopy Society of America, key reader for Metallurgical Transactions, and guest editor for JOM, Advanced Structural and Chemical Imaging, and PLOS One.

JOIN US

FRIDAY, JANUARY 10, 2020
WINSTON CHUNG HALL 205/206
11:00-11:50AM