

Materials Science and Engineering Winter 2020 Seminar Series
Friday, January 10, 2020 | 10:30 AM – 12:00 PM | 2101 Engineering V



QUANTIFYING MICROMECHANICAL RESPONSE IN POLYCRYSTALLINE ENGINEERING ALLOYS FOR MODEL- DRIVEN MICROSTRUCTURAL DESIGN

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High-performance designs are requiring metallic alloys that enable weight reduction, increased operating temperatures, and improved fatigue life. These requirements are pushing an acceleration of the alloy design cycle through use of computational model-driven design of processing and properties. To trust and deploy these models, *quantitative* microstructural and micromechanical measurements made *in-situ* at the finest time (<ms) and length (nm- μ m) scales are necessary and now possible with improvements to data reconstruction algorithms, brighter X-ray sources, and more efficient detectors. With these measurements now maturing, the frontier lies with applying new means to analyze these rich data sets to efficiently extract the critical microstructural features and evolution events needed for model development. In this presentation, an example analysis of *in-situ* grain-scale structural and mechanical evolution in an aluminum-lithium alloy (Al-Li 2099) will be described. The detailed experimental characterization, together with the application of an unsupervised learning technique (principal component analysis), enabled the identification of a damage initiation mechanism associated with the long-standing challenge of delamination fracture in addition to the microstructural features at fault.

Darren Pagan is the staff scientist overseeing the structural materials and mechanics program at the Cornell High Energy Synchrotron Source (CHESS). Darren earned a B.S. degree in mechanical engineering from Columbia University in 2010 and his Ph.D. in mechanical engineering from Cornell University in 2016. His dissertation research focused on developing crystal kinematic and scattering models for quantifying heterogeneous plastic deformation in single crystals during thermo-mechanical loading from *in-situ* X-ray data. As a postdoctoral researcher at Lawrence Livermore National Laboratory, Darren developed new methods for integrating diffraction data with crystal plasticity finite element modeling and used X-ray techniques to characterize granular material deformation *in-situ* under quasi-static and dynamic loading conditions. Darren's current research focuses on developing data analysis methods for quantifying material deformation in metallic alloys and composites, and experimental capabilities for characterizing microstructure evolution during materials processing.

LIGHT REFRESHMENTS WILL BE PROVIDED.