EXTREME ENVIRONMENTS AND DYNAMIC MORPHOLOGY:

ANTICIPATING AND HARNESSING EVOLVING STRUCTURE-PROPERTY RELATIONSHIPS

Faced with longer service lifetimes, higher operating temperatures, more complex loading configurations, and aggressive environments, reliable operation of many key technologies hinges upon the durability of materials or material systems. In these extreme environments, understanding the evolution of material properties may be even more important than the initial performance of the material. Our research focuses on linking thermodynamic and kinetic considerations to key morphological factors, which ultimately dictate failure mechanisms. In this talk, we will highlight two case studies, wherein understanding these relationships is allowing us to capitalize on the dynamic morphology to enhance performance. First, complex nickel-based superalloy thin films deposited via DC magnetron sputtering will illustrate a route for accelerated aging studies of conventionally processed alloys, with further consequences for oxidation/ corrosion resistance and high-throughput thermodynamic evaluations of novel alloy systems. We will conclude with a discussion of intrinsic toughening mechanisms in structural and functional ceramics and the impact of localized microstructural contributions to the activation of ferroelastic toughening.

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Dr. Jessica A. Krogstad

University of Illinois, Urbana-Champaign

Jessica A. Krogstad is an assistant professor in the Department of Material Science and Engineering at the University of Illinois, Urbana-Champaign. She received her PhD in Materials at the University of California, Santa Barbara working with Prof. Carlos G. Levi in 2012. Her doctoral work examined phase evolution and structural stability in zirconia-based thermal barrier coatings. Between 2012 and 2014, she held a postdoctoral appointment in the Department of Mechanical Engineering at Johns Hopkins University with Prof. Kevin J. Hemker. There she focused on the investigation of high temperature metallic systems for MEMS applications and high temperature micro-mechanical testing for experimental validation of multi-scale damage models of superalloy and composite materials in the spirit of integrated computational materials engineering (ICME). Her current research explores the interplay between phase or morphological evolution and material functionality in structural materials under extreme conditions. She is the recipient of the DOE Early Career Award, the NSF CAREER Award and the TMS Young Leaders Award

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