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Coarsening Materials Microstructures: Evolving Information Complexity and a Role for Machine Learning

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Abstract
The temporal evolution of microstructural features in metals and ceramics has been the subject of intense investigation over many years because deviations from normal grain growth behavior that lead to abnormal grain growth (AGG) are ubiquitous and strongly dictate observed mechanical and magnetic properties. In this talk, I examine the kinetics of evolving synthetic and experimental microstructures, as quantified by their embodied information, to identify temporal signatures of the onset of AGG. This is accomplished by tracking the information content of coarsening microstructures via selected metrics and measures of shared information and interaction strength. As the information content of a system is a proxy for the entropy, a thermodynamic description of grain growth is also outlined. Finally, I describe how machine learning strategies focusing on salient features permit one to identify precursors of AGG and thereby allow the prediction of such rare events well in advance of their occurrence.

Bio
Dr. Rickman earned his Ph.D. in Physics from Carnegie Mellon University and joined Lehigh University in 1993 after postdoctoral appointments at the University of Michigan and Argonne National Laboratory. He holds a joint appointment in the Departments of Physics and Materials Science and Engineering, and has received the Class of '61 Professorship. Dr. Rickman has received several honors including the Young Investigator Award from the National Science Foundation and the Chambers Junior Professorship and the Culler Prize (Miami University). He is currently an editor for Acta Materialia and Scripta Materialia and is a Fellow of ASM International and Fellow of the American Ceramic Society.

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