Materials Science and Engineering

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"Development of Experimental and Computational Tools for the Elucidation of Composition-Processing-Microstructure-Property Relationships for Ti-based Alloys"

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ABSTRACT

The concept of and evidence for the classic materials science paradigm (e.g., processing-(composition+microstructure)-property-performance) is clear for most advanced materials, including Ti-based alloys. However, the *details* associated with the various interrelationships (e.g., processing-microstructure) are less well established. In order to field new advanced materials and manufacturing processes, materials scientists and engineers must understand these linkages rapidly and, importantly, quantitatively. This requires some subtle yet important changes in the way materials are investigated. This talk will present three case studies where experimental tools and computational methods have been developed to provide information critical to understand the linkages in complex and modern materials science problems – all related to titanium and its alloys. These case studies include: (1) additive manufacturing, where simulation, critical experimentation, and/or modeling of each linkage in the materials science paradigm has been undertaken; (2) understanding deformation processes in ultrafine grained pure materials or highly constrained two-phase materials where a new characterization technique with ~1nm resolution provides very rich datasets containing spatial distributions of dislocation densities; and (3) combinatorial studies to understand the oxidation behavior of titanium alloys at elevated temperatures.