MATERIALS SCIENCE AND ENGINEERING

SEMINAR

"Grain Boundary Structures and Transitions: A Tool for Describing Abnormal Grain Growth"

by

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ABSTRACT

Alumina has served and continues to serve as a model material for grain growth in ceramics, particularly anisotropic growth that varies with dopant. The cause of promotion or suppression of abnormal grain growth by doping alumina with a wide range of cations has been the subject of research over the past 50 years. Dillon et al recently identified the existence of six distinct grain boundary structures in doped alumina systems and related these structures to their roles in abnormal grain growth in polycrystalline alumina. The six structure types are [I] sub-monolayer adsorption of solute cations, [II] no segregate (clean) boundary, [III] bi-layer segregation of dopant on the face of each adjacent grain, [IV] an amorphous intergranular film ~0.5nm thick, [V] an amorphous intergranular film ~1.5nm thick, and [VI] a fully wetting intergranular film whose thickness is dependant on the amount of available liquid phase or dopant. Each of these boundary structures exhibits specific migration properties. While the presence of these boundary structural types has been defined, there is little understanding of how particular aspects of a microstructure influence the structure and migration kinetics of specific grain boundaries. Dillon et al theorize that abnormal grain growth occurs due to the coexistence of two different boundary structures within the same microstructure. The framework of boundary structures also assumes that a high mobility boundary will maintain its faster mobility as it traverses through the microstructure, independent of grain misorientation and grain boundary plane.
This review will focus on how these structural types can be used to understand the kinetics of grain boundary motion and their ability to explain the occurrence of abnormal grain growth. Experiments that will lead to a deeper understanding of how microstructure influences boundary structure and migration kinetics will also be proposed.

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