東京大学大学院工学系研究科　総合研究機構

結晶界面工学研究室

Crystal Interface Laboratory, The University of Tokyo

# Crystal Interface Lab. Seminar Series

Institute of Engineering Innovation

The University of Tokyo

## Understanding the Origin of Intergranular Fracture and Improving Toughness in Brittle Materials: Studies of RE-SiC

by


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In brittle materials, toughness is invariably the limiting material property for structural applications; it determines the largest flaw that can be tolerated, which impacts everything from material processing requirements (surface finish, porosity) to strength/fracture loads and fatigue lifetimes. Recent suggestions for improving the toughness of ceramic materials include controlling residual stresses, e.g., in glass and alumina, forming nanocomposites, e.g., with carbon nanotubes, or using nature-inspired processing. However, the use of sintering additives to create nanometer-scale grain-boundary films or phases has traditionally been the most potent means to develop enhanced toughness in structural ceramics. Here we use ultrahigh-resolution transmission electron microscopy (TEM) and atomic-scale spectroscopy in a rare-earth doped silicon carbide (RE-SiC) to examine in detail the mechanistic nature of the intergranular cracking events that occur along the RE-decorated interface between the SiC grains and the grain-boundary phase. We conclude that for optimal toughness, the relative elastic modulus across the grain-boundary phase and the interfacial fracture toughness are the most critical material parameters; both can be altered with judicious choice of rare-earth additives.


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