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

The Influence of Interfaces and Adsorption on the Microstructure and Behavior of Ceramics

by

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The adsorption of dopant atoms at grain surfaces can have a profound influence on grain morphology and the ensuing microstructure of ceramics. Watanabe and Sunagawa noted that the morphology of flux grown sapphire crystals could be changed when rare earth oxide additions exceeded a critical level. Below that critical level, $(22\bar{4}3)$, $(10\bar{1}1)$ and (0001) faces dominate the crystal morphology. However, above this level, the $(22\bar{4}3)$ surface disappears being replaced by smooth $(11\bar{2}0)$ prism faces appear; in addition, the rate of growth normal to the prism plane increases with increase in the ionic size of the rare earth. More recent studies reveal that rare earths can adsorb at the surfaces of alumina grains altering grain growth and creep behaviors.

Similar dopant segregation at grain interfaces occurs in zirconia and impacts oxygen transport, hence ionic conductivity. On the other hand, interfaces, particularly by developing nanostructured ceramics can enhance ionic conductivity as noted in nanocrystalline zirconia and in nanometer thick zirconia films. In these cases, the use of nanostructure to increase ionic conductivity takes advantage of the enhanced transport along interfaces, which in nanostructured superlattices of ceria offers a number of potential advantages for advanced fuel cell design.

Dopant adsorption effects are found in liquid phase sintered ceramics as well with rare earth adsorption in silicon nitride serving as a classic case as reflected by the effects on grain morphology, phase transformation and mechanical properties. The effect of rare earth adsorption at grain surfaces is known to increase as the rare earth ion size increases. Recent results reveal that the rare earth adsorption behavior is retained regardless of a secondary additive (e.g., magnesia, silica or alumina). The secondary additive can alter the second phases that form, as well as modify densification, the phase transformation and the mechanical behavior, to increase as the rare earth ion size increases.

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Main meeting room at Institute of Engineering Innovation, UT
(工学部総合研究機構　9 号館 1 階　大会議室)

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