

Electrical Properties of Heterogeneously Doped Yttria  
Stabilized Zirconia  
Binod Kumar, Christina Chen, and Chakrapani Varanasi  
University of Dayton Research Institute, Metals and  
Ceramics Division  
Dayton, OH 45469-0170  
and  
Joseph P. Fellner  
Propulsion Directorate, Air Force Research Laboratory  
Wright-Patterson AFB, OH 45433-7251

**Abstract:** This paper will discuss the effects of heterogeneously doped nanosize  $\text{Al}_2\text{O}_3$  on ionic conductivity of 8 mol% yttria stabilized zirconia (YSZ). The dopant concentration was varied from 0 to 20 wt%. At lower dopant concentrations, up to 6 wt% grain growth occurred and the grain boundaries were reformed. Subsequent increases in the dopant concentration decreased the grain size. Contrary to expectations, the electrical conductivity of the doped specimens remained relatively unaffected. The effect of  $\text{Al}_2\text{O}_3$  doping on electrical conductivity will be explained on the basis of antagonistic influences. The doping leads to the creation of space charge regions in the vicinity of YSZ- $\text{Al}_2\text{O}_3$  boundaries, conducive to enhanced transport of oxygen ions and thus conductivity. The physical presence of  $\text{Al}_2\text{O}_3$  also leads to a blocking effect and reduced conductivity. The net result of the two antagonistic influences is small and reflected by a relatively flat conductivity variation as the concentration of  $\text{Al}_2\text{O}_3$  is increased to 20 wt%.