CHARGED GRAIN BOUNDARIES AND THE MICROSTRUCTURAL EVOLUTION OF IONIC CERAMICS

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The macroscopic properties of polycrystalline ionic ceramics are determined by the doping levels, point defects, and their interaction with the microstructure, as they are specified via processing and the target application. Here, the starting powders react, densify, and coarsen into microstructurally tailored grain topologies that are aimed to enhance (but sometimes limit) the performance of the device that are part of. The extent of these interactions varies with grain size, crystallographic orientation, and misorientation distribution, as well as applied fields, such as stress or electric fields. In order to understand the grain boundary characteristics, including their electrochemical properties and the driving forces that control grain coarsening, a thermodynamically consistent diffuse interface theory has been developed. The theory naturally incorporates the effects of grain boundary drag as imposed by the interfacially accumulated charged defects on the grain growth of polycrystalline ceramics. Applications to materials such as YSZ, GCO, and STO (and comparisons against experimental results) are presented.