

SOLUTE-DRAG VS. SOLUTE-ACCELERATION DURING MICROSTRUCTURAL EVOLUTION OF ALUMINA

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The role of dopants in processing ceramics has been an important issue for many years, especially given the contradicting reports of retarded or accelerated grain growth by key dopants and impurities. To fully understand these effects in terms of solute segregation versus enhanced grain boundary (GB) mobility due to liquid phase formation, an effort has been made to quantify the high temperature (1600°C) solubility limit of Mg, Ca, and Si in alumina. Using these values, samples doped below the solubility limit with Mg, or Ca, or C, or co-doped with Mg and Ca were prepared at concentrations which were measured using fully standardized wavelength dispersive spectroscopy. Measurements of GB mobility as a function of measured dopant concentration below the solubility limit has shown that Mg and carbon indeed retard GB mobility by solute-drag. However, Ca impurities increase the GB mobility of alumina at dopant values below the solubility limit (i.e. without forming liquid phases at the grain boundaries or triple junctions). The segregating dopants are associated with 2-D structural and compositional transitions at the GBs, and possible changes in the mechanism of GB migration. This presentation will review recent GB mobility measurements and the concept of 2-D GB transitions and their potential role on the mechanism of GB motion.