

Grain boundary structure and chemistry as an effect of external fields and processing

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Dopant adsorption at a grain boundary is described by the number of atoms per unit area of unit interface area in comparison to the adjacent bulk phase. The so-called excess quantity can be positive or negative dependent on whether there is an enrichment or depletion of dopant atoms at the grain boundary. In the first part of the talk suitable techniques to determine grain boundary excess quantities will be reviewed and discussed. Subsequently examples will be discussed that include twist in tilt grain boundaries in doped and undoped SrTiO₃ that were exposed to externally applied electric fields, and Y-doped BaZrO₃ that was densified by conventional sintering techniques and ultra-fast high-temperature sintering.

For near 45° twist grain boundaries in Fe-doped SrTiO₃ HAADF-STEM imaging revealed an equilibrium grain boundary thickness irrespective of the bulk chemical potential for Fe [3]. However, STEM-EDS measurements reveal that grain boundary excess quantities vary with the total amount of dopant added to each bicrystal. It will be demonstrated that, in some cases, extended thermal annealing is required post diffusion bonding to achieve equilibrium grain boundary configurations. Electric fields exposed to undoped tilt grain boundaries in SrTiO₃ reveal significant modifications of grain boundary structures owing to the redistribution of oxygen vacancies along the interface plane that is accommodated by disconnection movement.

Professional Status of the Speaker

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