Oxide nanoparticles in an Al-alloyed oxide dispersion strengthened steel: crystallographic structure and interface with ferrite matrix

Oxide nanoparticles are quintessential for ensuring the extraordinary properties of oxide dispersion strengthened (ODS) steels. In this study, the crystallographic structure of oxide nanoparticles, and their interface with the ferritic steel matrix in an Al-alloyed ODS steel, i.e. PM2000, were systematically investigated by high-resolution transmission electron microscopy. The majority of oxide nanoparticles were identified to be orthorhombic YAlO3. During hot consolidation and extrusion, they develop a coherent interface and a near cuboid-on-cube orientation relationship with the ferrite matrix in the material. After annealing at 1200 °C for 1 h, however, the orientation relationship between the oxide nanoparticles and the matrix becomes arbitrary, and their interface mostly incoherent. Annealing at 1300 °C leads to considerable coarsening of oxide nanoparticles, and a new orientation relationship of pseudo-cube-on-cube between oxide nanoparticles and ferrite matrix develops. The reason for the developing interfaces and orientation relationships between oxide nanoparticles and ferrite matrix under different conditions is discussed.