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Evolution of Ultrafine Grained Microstructure and Nano-sized Semi-coherent Oxide Particles in Austenitic Oxide Dispersion Strengthened Steel

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Abstract

Ultrafine grained austenitic oxide dispersion strengthened steel was prepared by mechanical alloying of the elemental metal powders and Y_2O_3 powders, then by hot isostatic pressing, hot rolling and solution annealing. The average grain size of the sample was about 260 nm, and the grain structure was stable after isothermal heat treatment at 1150 °C ($\sim 0.8T_m$) for 1000 hr. The high thermal stability of the grain structure is mainly attributed to the uniformly dispersed semi-coherent $Y_2Ti_2O_7$ particles of about 5 nm in diameter. The particles appear to have a strong pinning effect on grain boundaries due to the semi-coherent interface character between particles and the matrix at 1150 °C. A decrease of the number density of $Y_2Ti_2O_7$ particles and coarsening of the particles on the grain boundaries was observed during heat treatments at 1200 °C and 1250 °C, resulting in a steady grain growth at these temperatures.

Keywords

Ultrafine grained microstructure, ODS steel, Mechanical alloying, Grain boundaries, TEM, Zener pinning

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