MICROSTRUCTURE AND MECHANICAL PROPERTIES OF AN ODS RAF STEEL FABRICATED BY HOT EXTRUSION

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Ingots of an oxide dispersion strengthened (ODS) reduced activation ferritic (RAF) steel with the Fe-14Cr-2W-0.3Ti-0.3Y_2O_3 chemical composition (in weight percent) were synthesized by mechanical alloying of about 500 grams of Fe, Cr, W and Ti elemental powders with 0.3 wt. % Y_2O_3 particles in a planetary ball mill in hydrogen atmosphere, at 300 rpm for 50 hours using a ball-to-powder ratio of 8:1, followed by degassing at 800°C for 2 hours, and compaction of the milled powders by hot extrusion at 1100°C, using either a square- or a cylindrically-shaped die. The microstructure and mechanical properties of the ingots have been characterized by means of scanning and transmission electron microscopy and Vickers microhardness measurements, tensile and Charpy impact tests, respectively. It was found that the microstructure of the hot extruded ingots is composed of ferritic grains (Figure 1) having size of a few 100 nm containing complex nanometric Y-Ti-O oxide particles (Figure 2) with a mean size in the range of 5 ÷ 10 nm, uniformly distributed in the matrix. It was found that the ingots produced by hot extrusion exhibited an improved Charpy impact behaviour as compared with the ingots produced by hot isostatic pressing at 1150°C under 200 MPa.

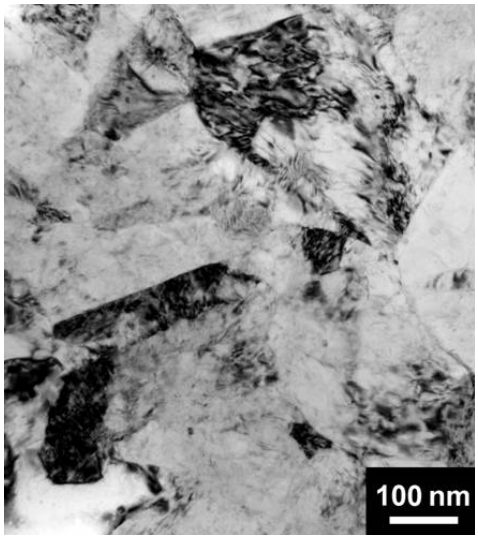

Figure 1: TEM image of the microstructure of a hot extruded Fe-14Cr-2W-0.3Ti-0.3Y_2O_3 ODS RAF steel; Image plane perpendicular to extrusion direction.

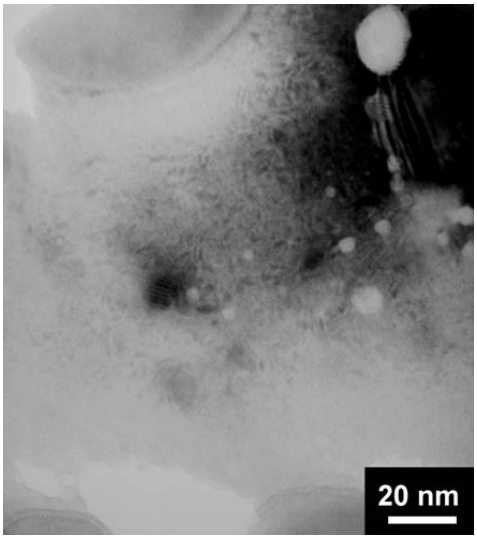

Figure 2: TEM image of complex nanometric Y-Ti-O oxide particles in a hot extruded Fe-14Cr-2W-0.3Ti-0.3Y_2O_3 ODS RAF steel.