Effect of ball milling atmospheres on the microstructure and Charpy impact properties of an ODS ferritic steel

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The aim of this work is to investigate the role of different ball milling atmospheres, hydrogen and argon, on the microstructure, residual porosity, and fracture behavior of an oxide dispersion strengthened (ODS) ferritic steel Fe-14Cr-2W-0.3Ti-0.3Y$_2$O$_3$. The ODS steel has been produced by mechanically alloying (MA) elemental powders in a Retsch ball mill in pure argon or hydrogen atmosphere (99.9999wt.% and 99.998wt.%, respectively). Hydrogen atmosphere has been used to reduce oxygen content and improve the ductility and fracture toughness of the ODS steel. After 42 hrs of mechanical alloying both powders present similar morphology, Vickers microhardness and distribution of fine particles about 20 mm in diameter. The ODS powders were consolidated by hot isostatic pressing (HIPping) at 1150°C for 4 hrs, under a pressure of 200 MPa, in an argon atmosphere. After compaction oxide and carbide inclusions and residual porosity were observed in the case of both materials. Charpy impact tests revealed very low upper shelf energy and high ductile-to-brittle transition temperatures.

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