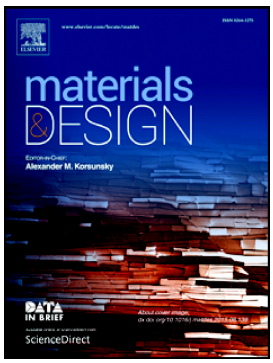

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Mechanical properties and corrosion resistance of ultrafine grained austenitic stainless steel processed by hydrostatic extrusion

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Abstract

The material studied is a commercially available 316 LVM stainless steel with an initial grain size of 30 μm. To refine the microstructure down to the nanoscale, hot (at 1000°C) and room temperature hydrostatic extrusion were applied with a total true strain of 1.4. An annealed sample with coarse grains of 35 μm in diameter was used as a reference sample. The results indicate that after hot hydrostatic extrusion, the microstructure consisted mainly of cells with tangled dislocation walls, while after room temperature hydrostatic extrusion, twins of various width and shear bands could be distinguished. Hydrostatic extrusion is also an efficient way to tailor the corrosion resistance and mechanical properties of 316 LVM stainless steel. Performed at room temperature, hydrostatic extrusion resulted in an ultra-high-strength material with limited but sufficient ductility. Performed at high temperature, hydrostatic extrusion resulted in a material with a very good combination of strength (approximately 900 MPa) and ductility (elongation to failure higher than 20%). Both hydrostatically extruded steels maintained good passivation behaviour in 0.1M H_2SO_4. In the presence of chloride ions, susceptibility to localized attack increased for the steel extruded at room temperature, but did not change for the hot-extruded steel.

Keywords: austenitic stainless steel; hydrostatic extrusion; severe plastic deformation; dynamic recrystallization; corrosion resistance

1.Introduction

Austenitic stainless steels are widely used in many industrial sectors, including chemical and bioengineering, due to their good corrosion resistance. However, conventional microcrystalline austenitic stainless steels exhibit relatively low hardness and mechanical strength. These