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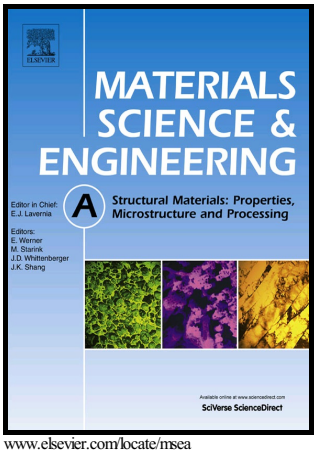

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Impact of severe plastic deformation on microstructure and fracture toughness evolution of a duplex-steel

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Abstract

The application of duplex steels is constantly increasing due to their excellent combination of high strength and fracture toughness complemented with superior resistance to localized chemical corrosion and stress corrosion. Since ultrafine-grained and nanocrystalline metals have shown improved mechanical and physical properties compared to their coarse grain counterparts, a further optimization of duplex steels could be realized by an additional nano-structuring process. Therefore, in the present study, a conventional duplex steel (X2CrNiMoN22-5-3) was deformed by high pressure torsion (HPT). The evolution of the microstructure and hardness upon deformation was examined. Special attention was devoted to the change of fracture toughness induced by HPT. In order to take grain shape changes during deformation into account, specimens with different orientations with respect to the principal shear deformation direction were tested. A pronounced anisotropy in the crack propagation behaviour depending on the specimen orientation combined with an exceptional increase of strength was discovered.

Keywords: severe plastic deformation; high-pressure-torsion; duplex steels; fracture toughness; anisotropy;

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1. Introduction

Duplex steels are of high interest from the industrial point of view, because they combine the high strength and stress corrosion resistance of ferrite with the toughness and resistance against erosive corrosion of austenite. Therefore, such materials are widely used for specialised industrial applications, such as in the paper and oil industry [1]. For the future development of this material class grain-refinement seems to be a feasible way to optimize the mechanical properties. The improvement of mechanical properties is classically achieved by