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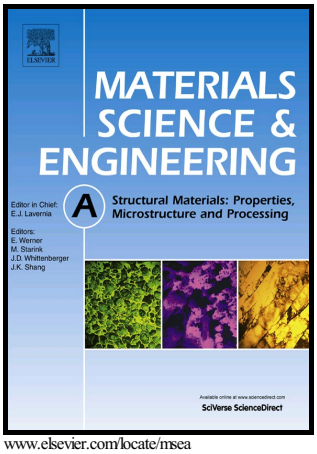

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Mechanical properties and microstructural evolution of nanocrystalline titanium at elevated temperatures

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Abstract

An investigation was initiated to study the mechanical properties and microstructural evolution of nanocrystalline titanium in the temperature range of 473-923 K after processing by high-pressure torsion (HPT) under a pressure of 5.0 GPa for up to 10 turns. The results show there is a significant improvement in both the tensile strength and the ductility in nanocrystalline Ti by comparison with coarse-grained (CG) Ti at elevated temperatures. The strength of HPT-processed Ti drops to that of CG Ti at temperatures above 773 K because of grain growth. An investigation of the mechanical behaviour at elevated temperatures reveals an increasing-decreasing-increasing trend in the elongations to failure with increasing temperature. An elongation of >130 % was achieved both at 673 K and above 773 K for the HPT-processed samples and this was significantly larger than for the CG Ti. The highest measured elongation was ~200% for the HPT-processed sample tested at 923 K. A good combination of strength and elongation to failure was achieved in the temperature range of 573-773 K after HPT processing.

Keywords: High temperature behavior; high-pressure torsion; nanostructured materials; severe plastic deformation; titanium

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