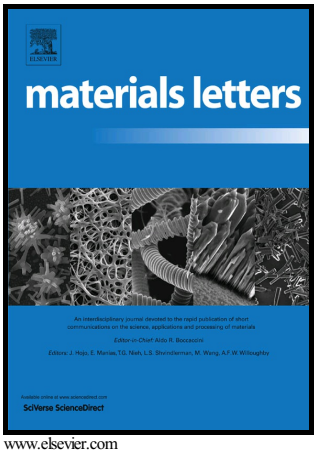

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Effect of Strain-Paths on Mechanical Properties of Hot Rolled Commercially Pure Titanium

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ABSTRACT

In this paper, a fine distinction between the role of strain-paths on the evolution of mechanical properties has been reported. Commercially pure (CP) titanium plates were subjected to hot rolling of 90% reduction in thickness through different strain-paths such as unidirectional rolling (UDR), multistep cross-rolling (MSCR) and reverse-rolling (RR). It was observed that the sample rolled through RR had higher mechanical properties (both yield strength and ductility) followed by the samples rolled through MSCR and UDR respectively. The grain size dependence of yield strength in differently pressed samples did not follow the trend anticipated in accordance with Hall-Petch relationship. It was further observed that the RR samples had higher stored energy followed by MSCR and UDR samples which eventually controls the evolution of microstructure and hence defines the mechanical properties.

Keywords: CP-titanium, Strain-Paths, Stored Energy, Microstructure, X-ray Techniques, Deformation and Fracture.

1. Introduction

CP-titanium is predominantly used in structural applications where formability and corrosion resistance are very important with moderate strength [1]. However, due to the inherent anisotropy of the unit cell CP-titanium has pronounced mechanical anisotropy which is always a concern in forming of these metals into different shapes/parts [2-4]. The anisotropy of the material can be reduced by weakening/tailoring the texture of the material which can be achieved through plastic deformation at different strain-paths [5-8]. In a recent publication [9] the role of strain-paths on texture and microstructure evolution of CP-titanium during hot rolling has been reported. Three different strain-paths such as UDR (Unidirectional rolling) [10], MSCR (Multistep cross-rolling) [10] and RR (Reverse rolling) [10] has been employed during hot rolling of CP-titanium. It has been found that the samples had a dominant basal (fiber) texture irrespective of the strain-paths. The average grain size and average grain orientation spread has been found to be lowest for the samples hot rolled to 90% reduction in thickness. The present study is an attempt to investigate the role of strain-paths on the mechanical properties of cp-titanium hot rolled to 90% reduction in thickness.