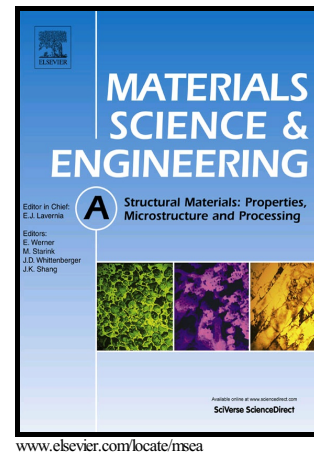


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The room temperature tensile deformation behavior of thermomechanically processed β -metastable Ti-Nb-Ta-Zr bio-alloy: the role of deformation-induced martensite

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Abstract

The present work was planned to investigate the microstructural evolution and mechanical properties of a metastable β -type titanium alloy composing of Ti–27.96Nb–11.97Ta–5.02Zr %wt (so-called TNTZ alloy), after applying a predetermined low-temperature thermomechanical processing (LTMP) cycle. The room temperature uniaxial tensile testing was utilized to evaluate the processed material flow behavior. To this end, the occurrence of any phase transformation and twinning-induced elasto-plasticity effects along with the work hardening behavior of the experimental TNTZ alloy were thoroughly studied. A double yielding phenomenon was realized in the specimens subjected to cold rolling and subsequent short time annealing. The XRD analysis confirmed an increase in volume fraction of α'' martensite as a result of deformation-induced martensite transformation in the microstructure. Electron backscatter diffraction (EBSD) analysis revealed that low angle boundaries would form within grains holding near (001) texture and might well act as a preferred nucleation site to develop deformation-induced martensite. The intersections of α'' martensite and the contribution of dynamic Hall-Petch effect could result in spectacular work hardening behavior in comparison to other β -type titanium alloys. The presence of sub-sized grains in the microstructure was related to the martensite reversion; this could further increase the strain hardening rate in the experimental alloy.

Keywords: β -type Ti alloy; Work hardening; Deformation-induced martensite; Twinning-induced plasticity

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