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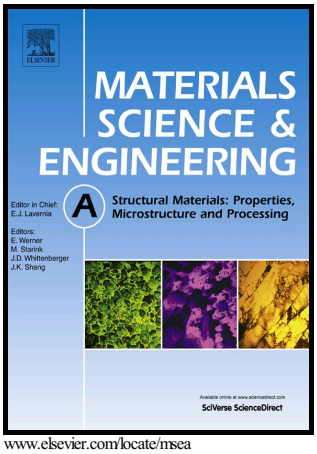

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Deformation twinning activity and twin structure development of pure titanium at cryogenic temperature

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Abstract

We compared deformation twinning activity and twin structure development of pure Ti at cryogenic temperature and room temperature by conducting unidirectional rolling at 77 K and 293 K. Twinning activity was significantly higher in rolling at 77 K than in rolling at 293 K. This was because lowering the deformation temperature increased the necessity for twinning operation to compensate for reduced accommodation of strain along the *c*-axis of the crystal structure, caused by inhibition of <*c*+*a*> slips. Twin structure was also entirely different between the two rolling temperatures. Compared to the case of rolling at 293 K, rolling at 77 K generated thin and numerous individual twins in the twinned grains, thereby giving rise to the development of a totally different twin structure. The differences in twin structure were caused by the combined effect of significant local stress concentration at grain boundaries and a reduction in stacking fault energy by rolling at 77 K. The twin structure strongly contributed to severe twinning-induced grain refinement that occurs at cryogenic temperature.

Keywords: Titanium; Twinning; Grain refinement; Cryogenic deformation; Electron