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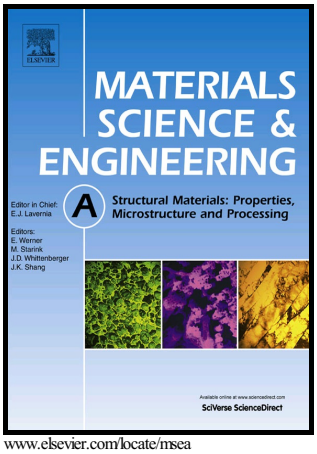

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Texture-induced anisotropic phase transformation in a NiTi shape memory alloy

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Abstract: Texture-induced anisotropic phase transformation of a rolled NiTi sheet was investigated via uniaxial tension and cyclic loading using *in situ* laboratory X-ray diffraction. The tensile tests were carried out along rolling direction (RD) and transverse direction (TD), which respectively have the highest and lowest phase transformation plateau strain. The initial preferred orientations of the rolled sheet (single austenite phase) concentrate on the ζ and γ fibers, i.e. <110>∥ND and <111>∥ND (normal direction). For loading along RD, six favorably oriented martensite variants form and lead to the formation of the new texture component {111}<112>, whereas along TD, three favorably oriented martensite variants form, making the initial {110}<110> texture component stronger. Besides, the Lüders band can be clearly observed in the first cycle of cyclic loading, during which the favorably oriented martensite variants are firstly induced, followed by the less-favorably oriented martensite variants. The martensite transformation continues after the phase transformation plateau via the propagation of the favorably and less-favorably oriented martensite variants. At high cycles, Lüders band cannot be observed due to remained traces of martensite and grain refinement.

Keywords: Texture; phase transformation; anisotropy; NiTi shape memory alloy; *in situ* X-ray diffraction

1. Introduction

NiTi shape memory alloys have sparked wide interest in exploring their deformation and applications for last several decades due to their distinctive properties such as shape memory effect and superelasticity [1]. Shape memory effect and superelasticity are related to martensitic transformation or its reverse transformation, depending on the service temperatures and stress states. When the service temperature is higher than the finishing austenite transformation temperature A_f, the cubic B_2 austenite is the sole phase unless the external applied stress reaches certain value where the austenite transforms into the monoclinic $B_{19'}$ martensite. Without plastic deformation, upon unloading the applied stress, martensite transforms back into austenite, and thus the applied strain is recovered, which is called superelasticity. When temperature is below the starting austenite transformation temperature A_s, the plastic strain in shape memory alloys will be recovered if heated over A_f, which is called shape memory effect.