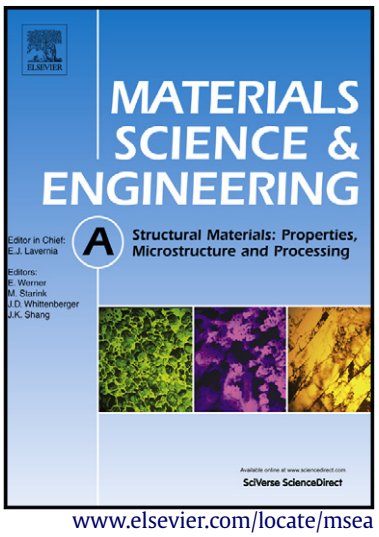

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C. Elibol, M.F.-X. Wagner

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Investigation of the stress-induced martensitic transformation in pseudoelastic NiTi under uniaxial tension, compression and compression-shear

C. Elibol[1] and M.F.-X. Wagner

Technische Universität Chemnitz, Materials Engineering Group, Chemnitz 09125, Germany

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Abstract — Pseudoelastic shape memory alloys exhibit a localized phase transformation under uniaxial tensile loading; the current understanding is that the transformation proceeds homogeneously under compressive loading. In the present work, the localization of the stress-induced martensitic transformation in martensite bands in a pseudoelastic NiTi shape memory alloy is studied with a focus on predominantly compressive loading. We consider three different load cases: uniaxial tension, uniaxial compression, and, most importantly, a combination of compression and shear loading. The thermo-mechanical behavior of pseudoelastic NiTi bar specimens under quasi-static loading conditions (with strain rates of about 10^{-4} s^{-1}) is characterized at room temperature. Digital image correlation is used to document the surface strain fields in situ during all the experiments. We characterize the localization of deformation (formation and growth of martensite bands) for the first time during combined compression-shear. Our results confirm that the deformation behavior of NiTi differs between tension and compression. The material exhibits a distinct mode of the formation and growth of localized martensite bands when under uniaxial tension. Under simple compression, the deformation proceeds homogeneously. However, a deformation inhomogeneity can also be observed during compression-shear loading. Based on this novel observation, we argue that a localization of the stress-induced martensitic transformation in pseudoelastic NiTi is not necessarily limited to tensile loading: It may well occur under more complex load cases involving compression, such as compression-shear loading, where the

[1] *Corresponding author.*

E-Mail: cagatay.elibol@mb.tu-chemnitz.de