**On the plastic deformation accompanying cyclic martensitic transformation in thermomechanically loaded NiTi wires**

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Tensile deformation of medical grade NiTi wires having wide range of different microstructures was investigated in thermomechanical loading tests up to failure from -100°C to 450°C. Supplemental in-situ electrical resistance, synchrotron x-ray diffraction, digital image correlation and ex-situ TEM studies were employed to characterize the acting deformation/transformation processes.

Special attention was paid to generation of unrecovered strains generated in cyclic thermomechanical loads on medical grade superelastic NiTi wire. It was observed that plastic deformation occurs only when forward or reverse martensitic transformations proceeds under external stress. Taking advantage of this, unrecovered strains generated separately by the forward and reverse martensitic transformations were evaluated. It was found that the unrecovered strains increase exponentially with increasing stress and temperature at which the forward and reverse transformations occurred and that slightly larger unrecovered strains were generated by the reverse transition than by the forward one. The magnitudes of unrecovered strains were presented in a “3D unrecovered strain-stress-temperature diagram”. Within the framework of continuum mechanics, a theoretical model of the coupling between transformation and plasticity was derived from the requirement for strain compatibility at propagating habit plane interfaces and stationary grain boundaries. The model qualitatively explains most of the presented experimental results, except of the tests performed at high temperature-high stress conditions.

In addition to the dislocation slip accompanying propagation of reverse martensitic transformation, martensitic transformation into twinned austenite B2=>B19´=>B2T was found to proceed alongside the dislocation slip at high temperature – high stress conditions, modify the alloy microstructure and destroy the superelastic and actuation functionalities. On the other hand, the coupled transformation-plasticity renders NiTi excellent ductility and allows for its low temperature processing and shape setting.