Application of a microstructural model to simulation of a TiNi beam bending performance and calculation of thickness stress distributions

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This work presents a numerical simulation of a TiNi shape memory alloy (SMA) beam performance in the mode of pure bending with the use of Bernoulli-Euler hypotheses. The beam is subjected to an action of a bending torque, an axial force and temperature variations. Thickness distributions of the stress and strain as well as the beam deflection for various stages of thermomechanical loading are obtained. The formulation of the boundary-value problem includes the equations describing the mechanical equilibrium and the constitutive behavior of an SMA representative volume, for which two models - a microstructural and a macroscopic ones are used. They account for the deformations due to elasticity, thermal expansion and phase transformation. It is noted that since the microstructural model automatically accounts for the tension-compression asymmetry of TiNi the use of this model for the description of the SMA behavior predicts that the neutral line of the bent beam does not pass through its center and the beam performance in the mode of bending differs from that in the mode of tension.