Shape memory effect in NiTi microwires under thermo-mechanical cycling
Gong, Yue, gongyue@umich.edu; Daly, Samantha, University of Michigan, United States

ABSTRACT
Although the superelasticity of NiTi has been rigorously studied, experimental work on its shape memory properties is more limited despite its wide breadth of application in actuation. As most actuators are in wire form, this study focuses on the characterization of phase transformation in shape memory NiTi microwires (diameters of nominally ≤500 μm). The shape memory effect is achieved by detwinning and subsequent phase transformation of the martensite phase. Prior experimental studies have largely focused on bulk characterization of this effect, not addressing grain-level martensite to austenite phase transformation, martensitic detwinning, and effect of localized plasticity at the microstructural length scale. These and other microscale characteristics of transformation are studied here using custom in-SEM, full-field deformation tracking, an in-situ thermo-mechanical loading stage, and in-situ EBSD at elevated temperature. In-situ measurement of full field strains with scanning electron microscopy digital image correlation (SEM-DIC) was matched with EBSD data to understand the effect of microstructure on localized transformation and plasticity. Detwinning propagation, plastic deformation, slip, and the martensite to austenite phase transformation were identified from matched SEM-DIC and EBSD results. Results were compared between thermo-mechanical load cycles to investigate the origin of material shakedown at the microscale level.