Hydrologic Modeling at the Watershed Scale Under Climate

Thermo-Mechanical Characterization of Shape Memory Alloys

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Shape Memory Alloys (SMAs) are a class of metals that undergo a diffusionless phase transformation between a high-temperature austenitic phase and a low-temperature martensitic phase. The martensitic to austenitic phase transformation allows for recovery of deformation induced into the martensitic phase, and is known as the Shape Memory Effect (SME). When engineered properly, the SME can be utilized to create an actuation device capable of generating large forces/stresses (up to 500MPa) over large displacements/strains (4% - 8% mm/mm); however, unless SMA actuators are thermo-mechanically conditioned, plastic strains may develop and the required force or displacement may not be attained. Although considerable work has been performed to understand the key mechanisms of Nickel-Titanium (NiTi) SMA behavior, little of this work follows a standard testing protocol, develops data appropriate for design of SMA actuators, or quantifies a conditioning methodology. As SMA use in the aerospace industry has matured, interest has grown to better understand NiTi SMA characterization and conditioning. Specifically, NASA- Glenn Research Center (GRC) has become an active leader in the development and processing of SMAs for use as actuators in NASA programs.

This research project will aim to formalize a thermo-mechanical characterization process for NiTi SMAs by addressing the interaction between processing, recoverable and non-recoverable deformation. Using material provided from NASA-GRC, this project will then exercise this process to characterize a baseline commercial alloy through a series of thermomechanical and physical property measurements. The research project will culminate by extending the characterization methodology to elevated temperatures and investigate high transformation temperature SMAs.

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