Atomistic Mechanisms of Hysteresis in Shape Memory Materials

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Our LUCI award will fund a collaboration with Dr. Richard D. James, a professor at the University of Minnesota with a prestigious Vannevar Bush Faculty Fellowship from the DOD Office of the Undersecretary of Defense Research and Engineering Basic Research Office. His project is on the understanding of shape memory materials, which can accommodate macroscopic shape changes by switching between crystal structures, and even remember their previous shape and return to it when heated. Our collaboration will focus on the atomic-scale processes that dissipate energy (hysteresis) during the transformation, preventing them from changing shape or causing damage after multiple cycles. Understanding these limitations from the atomic scale will allow us to improve the properties of shape-memory materials, leading to entirely new classes of materials such as shape memory ceramics, which could be dramatically stiffer, corrosion resistant, and operate at higher temperatures than current metallic shape memory alloys. These advanced materials will enable the development of DOD technologies such as actuators with no moving parts that can be miniaturized for small autonomous systems, or deployable structures that develop their final shape in the field without the need for manual assembly.