Development of Small-Volume, High-Precision, and Long-Lifetime Cryogenic Linear Actuators by Using Novel Intermetallic Compounds

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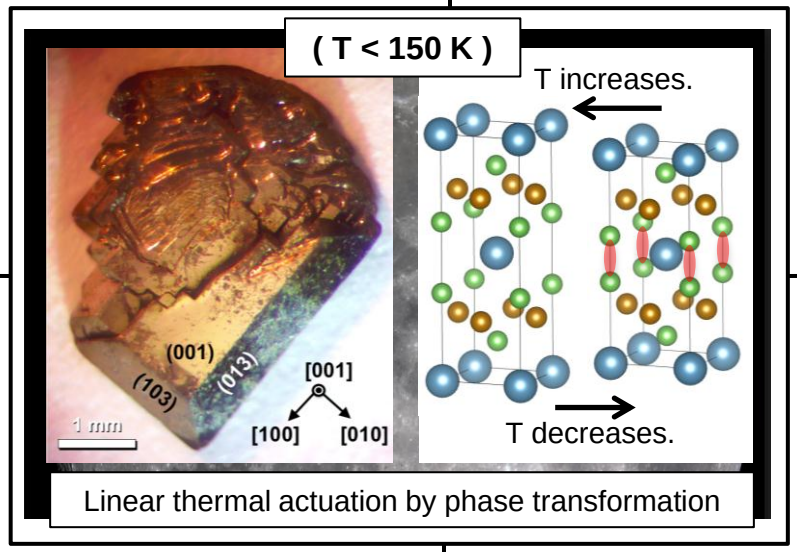
Research Objectives

Objective: To develop small-volume, high-precision and mechanically-robust cryogenic linear actuator via single crystal growth, cryogenic in-situ mechanical test, and creation of proto-type device

Innovation: To apply a new type of material that exhibit a actuation mechanisms completely different from other actuator materials



Linear thermal actuation by phase transformation

The project will start as TRL 1-2 (basic principles observed), and end as TRL 3 (proof-of-concept)

Approach

Large-scale single crystal growth via solution growth technique

In-situ cryogenic micromechanical test under various stress and temperature conditions

Advanced computer simulations (Density Functional Theory) to understand actuation mechanisms

Creation of proto-type device and evaluation of its cryogenic actuation performance with cryogenic mechanical testing system near 0 K

Potential Impacts

Advances in cryogenic actuator technology (CAT) made possible by the application of a completely new class of material

Volume reduction of actuators without sacrificing actuation power

Long-term cyclic actuation without fatigue damages

Understanding of a fundamental science behind a new type of actuation mechanisms

Development of proto-type cryogenic actuator device that can operate near 0 K