

TITLE: A Ferroelastic Test Rig for Elastocaloric Performance Testing
SPONSOR: Fort Wayne Metals

Proposal/Scope

Ferroelastic materials including NiTi, CuAlNi, and TiNbZrS can be used for their superelasticity or shape memory behavior. When stress is applied, these materials can transform spontaneously to a lower energy atomic orientation for the stressed state and release latent heat of transformation. If superelasticity is stable, the material then reverts to the parent “austenite” phase when stress is removed and the material absorbs a similar quantity of latent heat. As such, these materials can be used to create solid state heat pumps for purposes of cooling or heating applications. As a producer of ferroelastic wire materials, we would like to design and build a simple test rig to evaluate the heat transfer power and structural fatigue capability of candidate wires.

Here is one example of a similar elastocaloric system built by our colleagues at Saarbrücken:
<https://analyticalscience.wiley.com/content/article-do/elastocalorics-cool-into-future>.

The system should be capable of operating wires in tension at specific and adjustable cyclic displacement levels while monitoring temperatures of wires and total heat transfer power. Mechanical design will be critical including understanding and definition of support boundary conditions, thermal boundary conditions, and expected outputs. PLC, Signal Conditioning, fluid flow and heat transfer calculation, as well as wire termination and electrical connection will come into play as well as principles of functional and structural fatigue.

Budget: \$3500