MAGNETO-MECHANICS OF MAGNETIC SHAPE-MEMORY CRYSTALS WITH MICROPEENED SURFACES

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Putting a magnetically-powered "car" in your body.

INTRODUCTION

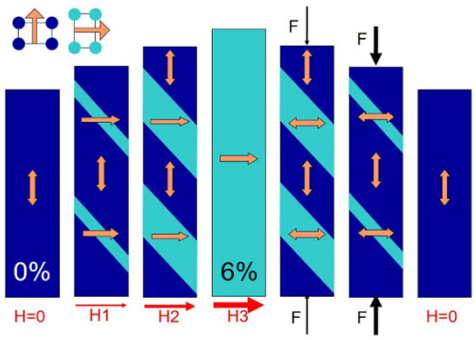
- Magnetic Shape-Memory (MSM) Materials
- Nickel-Manganese-Gallium (Ni_2MnGa)
- Twinning Deformation Mechanism

MSMs & ACTUATION

Movement Driven Purely by Magnets

A. Twin Boundaries

B. Pumps, Positioning Devices, and Circuit Breakers

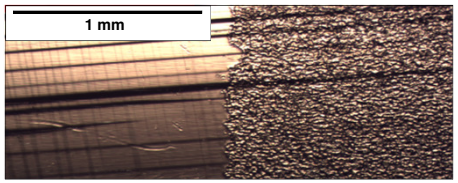


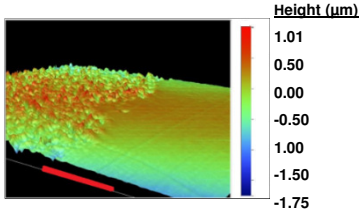
Source: S. Fähler, Tutorial G, MRS Fall Symposium 2009, Boston, MA, November 29, 2009

PROCEDURE

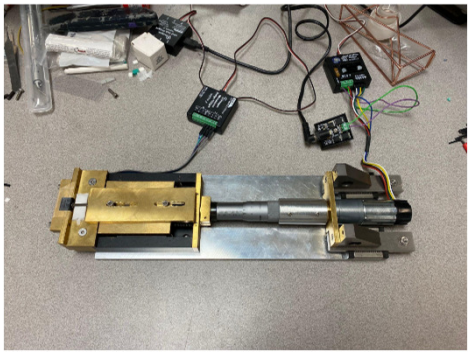
1. Growing the Crystal
2. Cutting
3. Polishing
4. Micropeening
5. Micromechanical Testing
6. Magnetic Reset

Micropeening



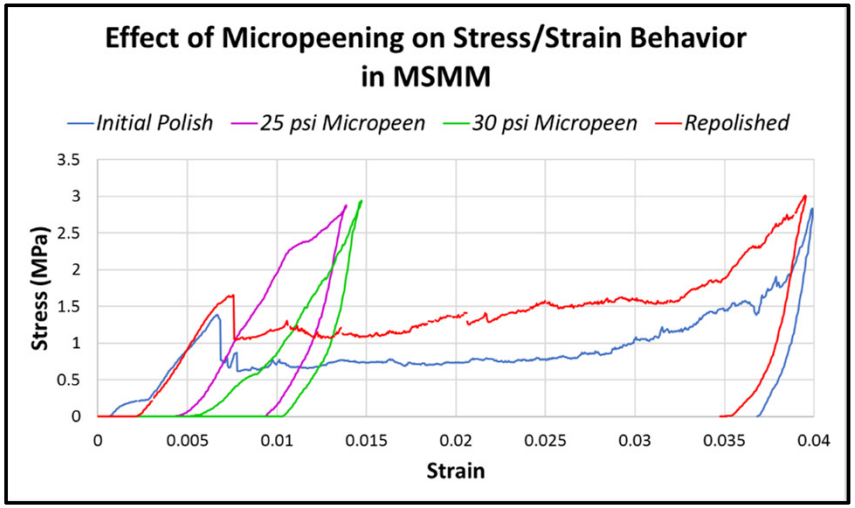


Micromechanical Testing



DATA: STRESS & STRAIN

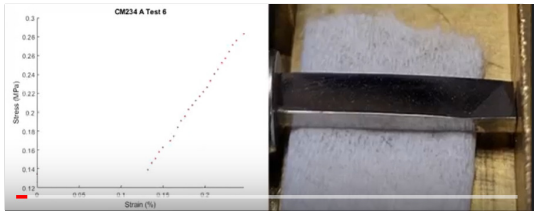
- 3 MPa Limit
- Increasing Stress Thresholds
- Decrease in Strain



CONCLUSIONS

- Twin Boundary Character
  - Appear at Stress Peaks
  - Singular vs. Numerous
- Quantitative Relationship: Micropeening & Stress

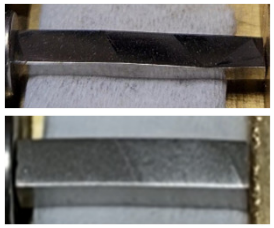
Twin Boundary Movement



FUTURE PLANS

25 psi — A Happy Medium?

- More Systematic Experimentation
  - Micropeen at lower pressures



Twinning Comparison: Polished (top), Micropeened (bottom)

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