

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



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

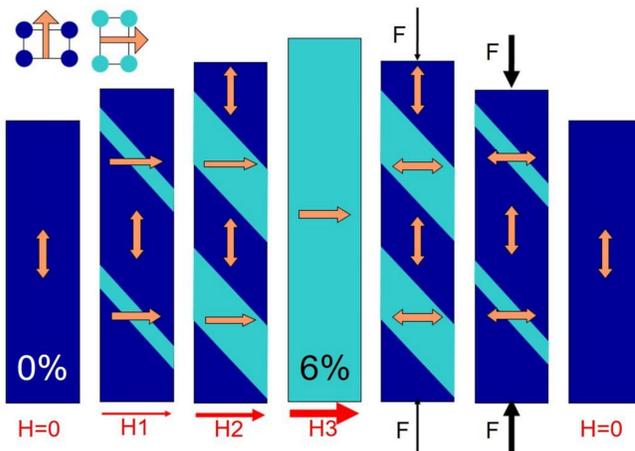
## INTRODUCTION

- Magnetic Shape-Memory (MSM) Materials
- Nickel-Manganese-Gallium ( $\text{Ni}_2\text{MnGa}$ )
- Twinning Deformation Mechanism

## MSMs & ACTUATION

*Movement Driven Purely by Magnets*

- A. Twin Boundaries
- B. Pumps, Positioning Devices, and Circuit Breakers

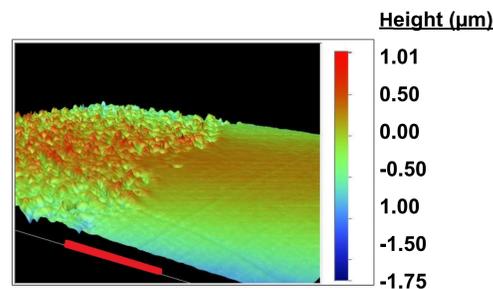
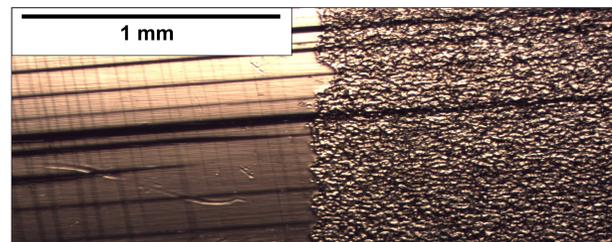


Source: S. Fähler, Tutorial G, MRS Fall Symposium 2009, Boston, MA, November 29, 2009

## PROCEDURE

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

### Micropeening

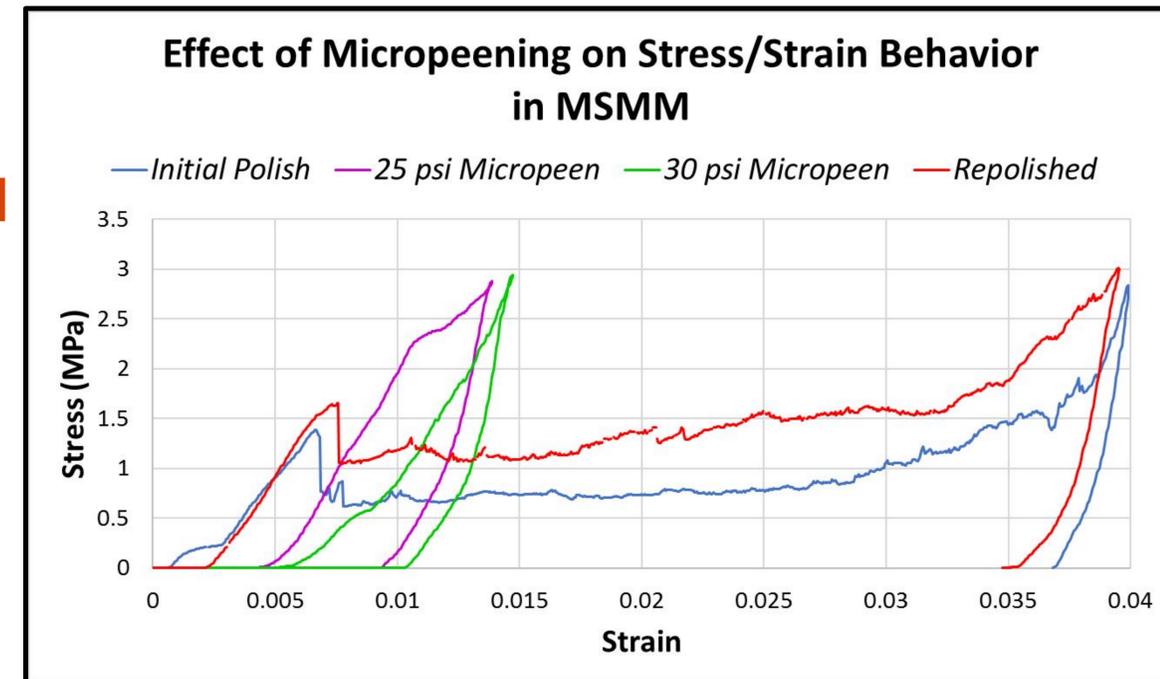


### Micromechanical Testing



## DATA: STRESS & STRAIN

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



## CONCLUSIONS

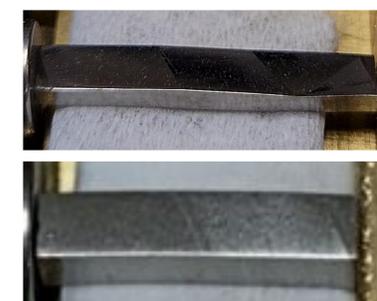
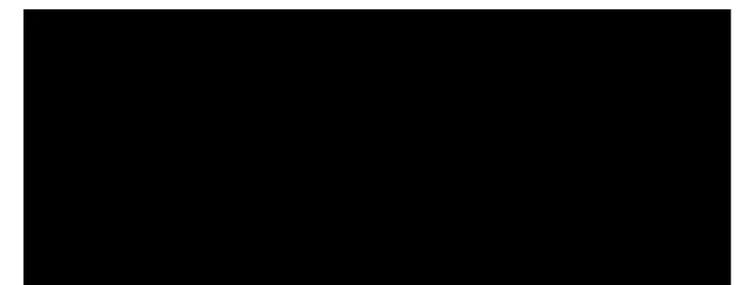
- Twin Boundary Character
  - Appear at Stress Peaks
  - Singular vs. Numerous
- Quantitative Relationship: Micropeening & Stress

## FUTURE PLANS

### 25 psi — A Happy Medium?

- More Systematic Experimentation
  - Micropeen at lower pressures

### Twin Boundary Movement



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