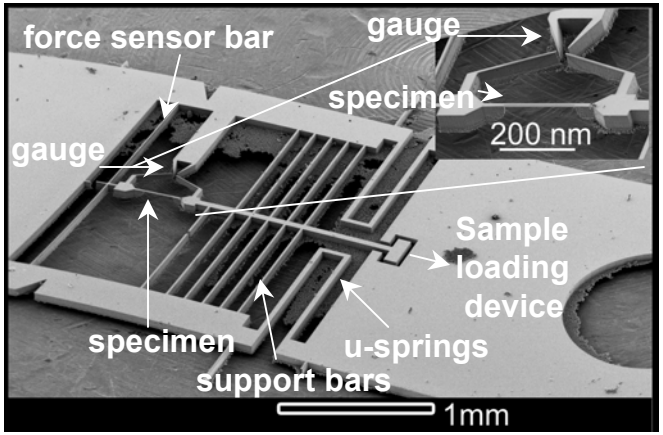
Fundamental deformation and failure processes in nano-grained fcc metals using MEMS-based stages

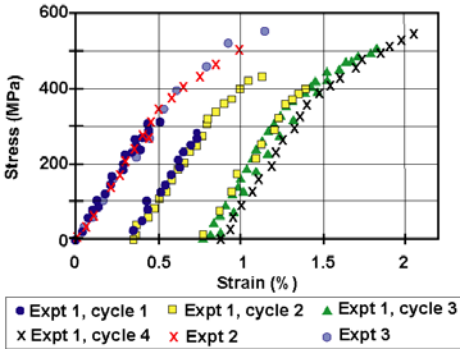
I. M. Robertson and T. Saif, University of Illinois. DMR award # 02037400

- Provides the capability to directly correlate macroscopic system response to microscopic and atomic processes.
- Provides true uniaxial loading of a columnar grained metallic structure with superior adhesion to other test devices.
- Flexible device can be mounted in a variety of test frames.
- Important to the exploitation of nanograined structural systems; design and fabrication of functional MEMS devices; modeling of mechanical response of fine-grained materials in general.

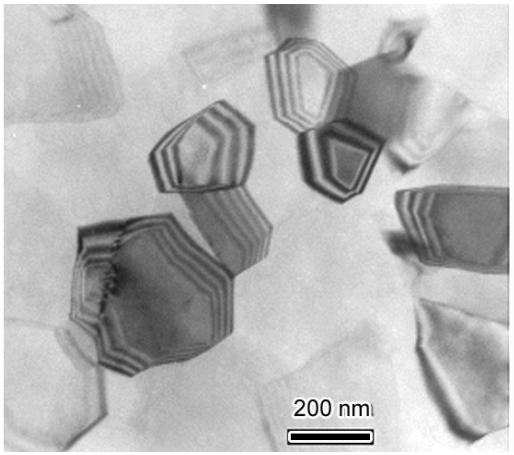
MEMS-based device for in-situ testing - I-STEMS



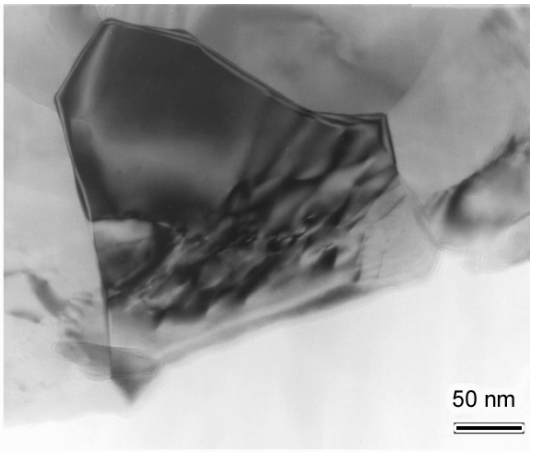
Mechanical properties (50 nm thick Al film)



Initial microstructure (few dislocations)



Along the fracture surface (many dislocations)



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Educational Mission

- To educate graduate and undergraduate students in the complexities of material behavior (mechanical properties, in particular) as a function of scale.

- To introduce the concepts of the nanoworld to students of all ages through use of age-appropriate graphics, videos and demonstrations.

- Exploring your Options and Women in Engineering programs at the University of Illinois will be used to outreach to high school students and 6 through 8th grade females.

A Voyage through the World of Micro Machines

Video available at http://www.engr.uiuc.edu/OCEE/outreach.htm

Introduction to length scales

Labrador

Length 1 m

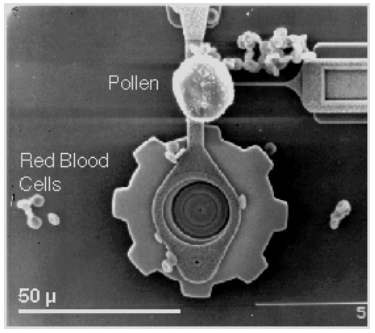
Cat flea

Length 0.004 – 0.012 m

Dog mite

Length 0.00025 m

MEMS gear (SNL)



Gear diameter 0.00005 m