

# MEMS Reliability in Liquid Environments

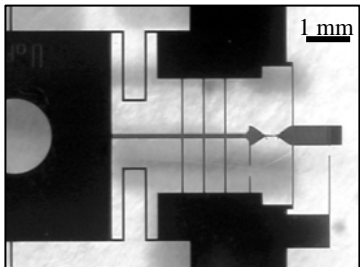
Prof. E. K. Longmire\*, Prof. S. C. Mantell†, S. M. Ali†, T. P. Kuehn†, M. J. Stegmeir\*

\*Aerospace Eng. & Mechanics, †Mechanical Engineering, University of Minnesota

NNIN Facilities utilized: Nanofabrication Center & Characterization Facility

## MEMS Reliability in Liquid Environments

- ◆ Microcantilever test structures made of Silicon, Silicon Nitride (SiN), have been microfabricated. SU-8, and Titanium have been used as coatings.
- ◆ Microcantilevers are cyclically actuated in water, saline, glucose solution and air.
- ◆ Operational failures studied by monitoring changes in resonance frequency.
- ◆ Test specimens for uniaxial tensile fatigue testing of Aluminum in liquids have been fabricated and tested.



Optical image of test specimen for uniaxial tensile fatigue testing of Al in liquids

Funding: NSF/CMS- 0300125

## MAJOR OBSERVATIONS

- ◆ Operational failures characterized by an unpredictable change in resonance frequency of microcantilevers were observed in liquid environments and are summarized below

Environment → Material ↓	Air	Water	Saline	Glucose	Reason for failure
Silicon (Si)	✓	✓	Fail	✓	Chemisorption
Titanium coated Si	✓	×	Fail	×	Stress corrosion
SU-8 coated Si	✓	Fail	×	×	Water absorption
Silicon Nitride	✓	✓	✓	×	-

✓ Reliable × : Not tested

## Conference Papers:

- ◆ T. P. Kuehn, S. M. Ali, S. C. Mantell, and E. K. Longmire, "Testing reliability of MEMS materials in liquids," SPIE Conference on Reliability, Packaging, Testing and Characterization of MEMS/MOEMS VI, San Jose, CA, Jan 2007,
- ◆ S. M. Ali, S. C. Mantell, and E. K. Longmire, "Reliability of microcantilevers in liquid environments," SPIE Conference on Reliability, Packaging, Testing and Characterization of MEMS V, San Jose, CA, Jan 2006.