

## Overview of the Nanosystems & Structures Group

The Nanosystems & Structures (NS&S) Group was formed within the Measurement Science and Systems Engineering (MSSE) Division at the Oak Ridge National Laboratory (ORNL) in March of 2008. Today NS&S conducts basic and applied research in the areas of physical and chemical sensing, with a focus on fabrication and measurement techniques in microscale and nanoscale systems and structures; superhydrophobic, electronic, and photonic nanomaterials; and development of MEMS/NEMS devices and sensors.

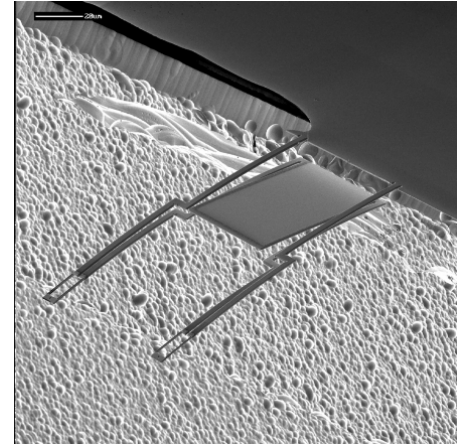


Fig. 2. Example of a microfabricated suspended bimaterial micromechanical element that responds to thermal energy.

- Nanowire arrays.
- Fiber-optic sensors.

### Research Facilities

NS&S laboratories include the following equipment and capabilities.

- Microfabrication equipment— Focused ion beam tool with 60 nm beam size, applicable to all materials (Fig. 3); precitech ductile grinding machine.
- Measurement and characterization—Scanning electron microscopy, infrared and photothermal spectroscopy, AFM, optical metrology, finite element modeling and analysis.
- Draw tower—Using a glass drawing process that is based on a modified “Taylor wire drawing” technique, glass coated wire fibers can be fabricated. These fibers can be bundled together and fused into a solid rod, forming large dimension nanowire arrays (Fig. 4), or metal-based polarization preserving optical fibers.

### Capabilities

Within the MSSE Division research environment, NS&S provides expertise in the areas of nano-structured materials and surfaces, and micro-/nano-sensors. Examples of these capabilities include

- Superhydrophobic materials (Fig. 1).
- Uncooled infrared detectors (Fig. 2).
- MEMS chemical sensors.
- Calorimetric spectroscopy.

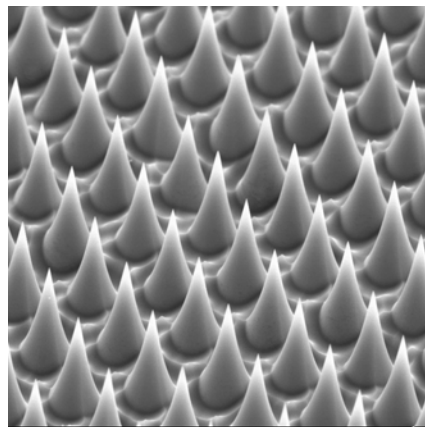


Fig. 1. SEM image of a superhydrophobic glass cone array.

Research at  
the Forefront  
of the  
Micro-/Nano-  
Scale  
Revolution

**Purpose:** The NS&S Group was formed to perform research and development in micromechanical, physical, and chemical sensors; nanostructuring of surfaces; and investigation of novel phenomena at the nanoscale.

**Sponsors:** Department of Energy and other federal agencies (Department of Defense, National Institutes of Health) and U.S. industry.

#### Group Members:

- Panos G. Datskos (Leader)
- Regina R. Parks (Admin. Support)
- Joseph Cunningham
- Brian R. D’Urso
- Tom V. Dinsmore
- Troy R. Hendricks
- Scott R. Hunter
- Nickolay V. Lavrik
- Slo Rajic
- Daniel Schaeffer
- Chuck R. Schaich
- John T. Simpson
- Barton Smith
- Ivan Vlasiouk

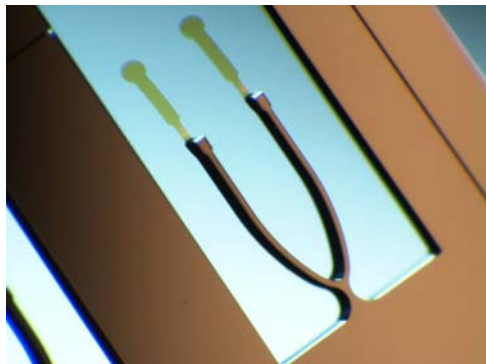
#### Complementary ORNL Facilities:

- Center for Nanophase Materials Sciences.
- The Nanofabrication Research Laboratory

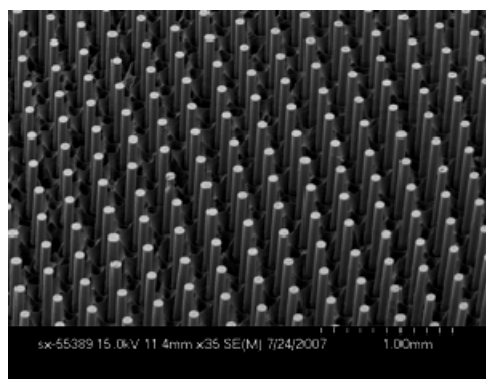
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**Fig. 3. Microfabricated tuning fork for sensing Coriolis forces.**



**Fig. 4. Tungsten wire array in a glass matrix.**

### Additional Nearby Facilities

Because of our unique location, in addition to NS&S facilities and laboratories we have access to many other world-class ORNL laboratories and facilities, including the following.

- The Center for Nanophase Materials Sciences, a collaborative nanoscience user research facility for the synthesis, characterization, theory/modeling/simulation, and design of nanoscale materials.

- The Nanomaterials Theory Institute, the theory, modeling and simulation arm of the Center for Nanophase Materials Sciences. Its goal is to span the full range of modeling tools, from electronic structure methods and atomistic simulation through to mesoscale methods and macroscale finite element techniques to perform virtual design and synthesis of new nanostructured materials and nanoscale systems.
- The Nanofabrication Research Laboratory, a 10,000 ft<sup>2</sup> facility for the directed assembly and study of nanomaterials in a clean-room environment.
- The National Center for Computational Sciences, a DOE user facility designated by the Secretary of Energy as the Leadership Computing Facility for the nation.
- The High Temperature Materials Laboratory, a DOE user facility dedicated to solving materials problems that limit the efficiency and reliability of systems for power generation and energy conversion, distribution and use. The HTML includes six user centers available to researchers in industry, universities, and federal laboratories.

### Contact Information

To learn more about the exciting NS&S programs and partnering with us, please contact Panos Datskos (datskospg@ornl.gov) at 865-574-62055.