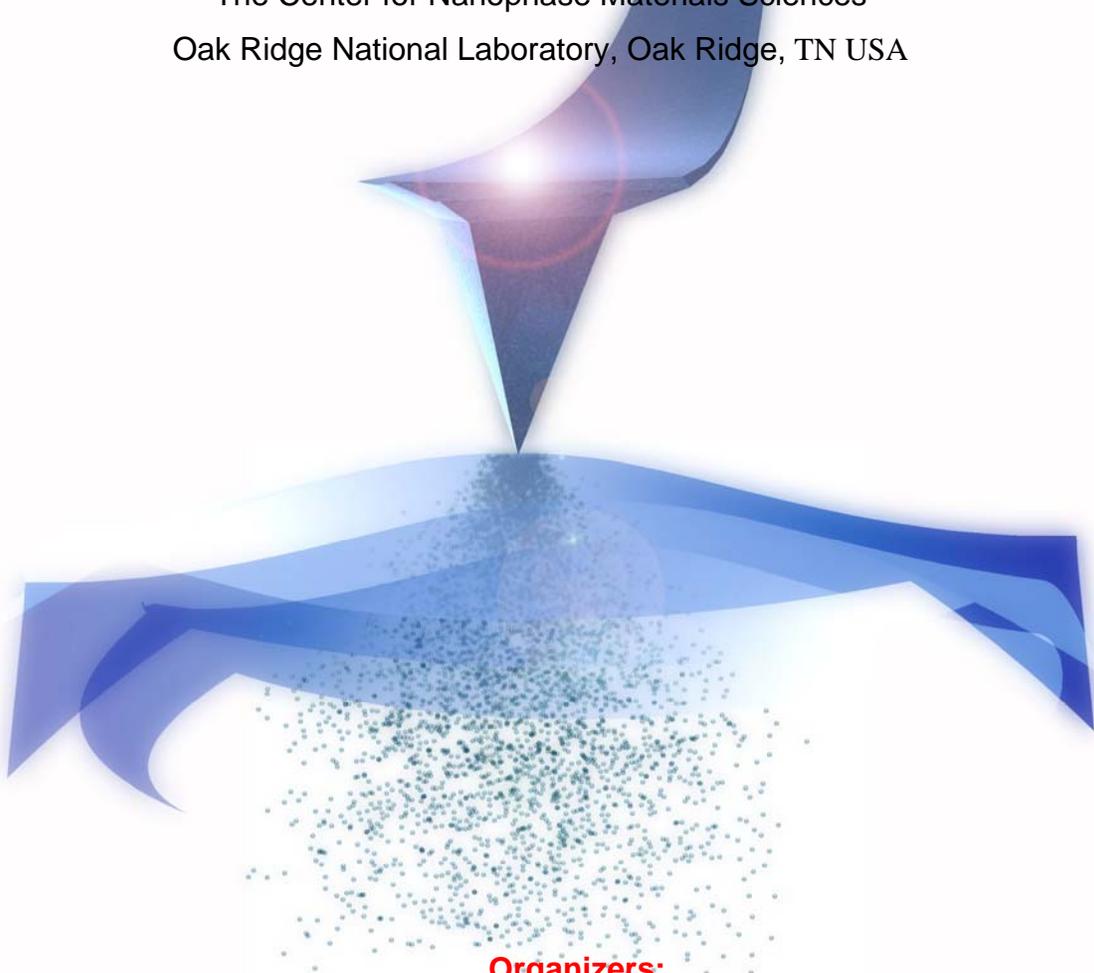


Center for Nanophase Materials Sciences Workshop

**Advanced Scanning Probe Microscopies at the CNMS: Materials
Structure and Function from Atomic to Micron Scales**

September 21-22, 2011

The Center for Nanophase Materials Sciences
Oak Ridge National Laboratory, Oak Ridge, TN USA



Organizers:

Arthur P. Baddorf (ORNL)

Sergei V. Kalinin (ORNL)

Invited Lecturers:

S. Jesse, A. Tselev, A.P. Li, P. Maksymovych, N. Balke, Z. Gai, M. Pan - ORNL

With the participation of:

Asylum Research, Anasys, Bruker, NT-MDT,
Omicron NanoTechnology USA, RHK, SPECS

Advanced Scanning Probe Microscopies at CNMS: Materials Structure and Function from Atomic to Micron Scale

The Center for Nanophase Materials Sciences, Oak Ridge National Laboratory,
Oak Ridge, TN 37831, USA

Arthur P. Baddorf and Sergei V. Kalinin

Development of nanoscience and nanotechnology requires the capability to image, manipulate, and control matter and energy on the nanometer, molecular, and ultimately, atomic levels. Scanning probe microscopy (SPM) techniques provide unparalleled access to the nanoscale world through structural, functional, and chemical imaging and manipulation on nanometer and atomic scales. Beyond imaging surface topography, SPMs have found an extremely broad range of applications for probing electronic, transport, optical, magnetic, mechanical, and electromechanical properties – often at the level of several tens of nanometers and below. Achieving full potential of SPM requires focused effort on developing novel SPM platforms and imaging modes, data interpretation routines, as well as capabilities for the in-situ sample preparation.

This workshop features presentations by CNMS staff members and SPM industry focused on technical capabilities developed and/or available at CNMS. These include:

- Atomic and vibrational imaging by low-temperature high magnetic field STM
- Transport characterization by 4-probe STM/SEM
- Scanning Electron Microscopy with Polarization Analysis
- Piezoresponse Force Microscopy and Spectroscopy
- Band Excitation SPMs for thermal, magnetic, and mechanical property mapping
- Electrochemical Strain Microscopy of Li-ion and oxygen conductors
- Microwave imaging and spectroscopy

This workshop will also feature presentation by leading SPM vendors devoted to the latest advances in SPM modes. Ultimately, we aim to build a network of advanced SPM practitioners to promote rapid dissemination of theoretical knowledge, experimental protocols, and novel technique development in these rapidly growing areas.

For more information and registration, please check regularly the CNMS web site at www.cnms.ornl.gov or contact the organizers at sergei2@ornl.gov or baddorfap@ornl.gov.

Workshop outline

Advanced Scanning Probe Microscopies at CNMS

Day 1

- 8.00 a.m – 8.30 a.m. (20 min) *Introduction: Overview of SPM methods at CNMS*
(S.V. Kalinin and A.P. Baddorf)
- 8.30 – 9.45 *Low-T High-B STM: Elastic and Inelastic Spectroscopies* (M. Pan)
- 9.45 – 10.15 Coffee break
- 10.15 – 11.00 *Advances in LT QuadProbe Instrumentation and Control*
(Zhouhang Wang, RHK)
- 11.00 – 12.15 *Electron Transport Characterization by 4-Probe STM* (A.P. Li)
- 12.15 – 1.00 Lunch
- 1.00 – 1.45 Bruker
- 1.45 – 3.00 *Microwave microscopy and spectroscopy* (A. Tselev)
- 3.00 – 3.30 Coffee break
- 3.30 – 4.15 *Combination of AFM with optical techniques* (P. Dorozhkin, NT-MDT)
- 4.15 – 5.00 *New Developments in SPM and Nanoprobng at Omicron* (J. Hilton,
Omicron Nanotechnology USA)
- 5.00 – 6.00 *Local Transport and Potential in Ultrahigh Vacuum*
(P. Maksymovych)

Day 2

- 8.30 – 9.45 *Multi-Frequency Methods in SPM – Band Excitation Applications for
Thermal, Mechanical, and Electrochemical Imaging* (S. Jesse)
- 9.45 – 10.15 Coffee break
- 10.15 – 11.00 *AFM-IR: Multifunctional technique enabling nanoscale IR
Spectroscopy, mechanical and thermal property measurements*
(K. Kjoller, Anasys)
- 11.00 – 12.15 *Electrochemical Strain Microscopy* (N. Balke and A. Kumar)
- 12.15 – 1.00 Lunch
- 1.00 – 2.15 *Piezoresponse Force Microscopy and Spectroscopy* (S.V. Kalinin)
- 2.15 – 3.00 *Fast Piezoelectric and Electrochemical Imaging* (R. Proksch,
Asylum Research)
- 3.00 – 3.30 Coffee break
- 3.30 – 4.15 SPECS
- 4.15 – 5.30 *Nanomagnetics by SEMPA and MPMS* (Z. Gai)

Lab tours by individual arrangement (during the sessions)