



CALL FOR PAPERS

Abstract Deadline: November 2, 2010

REMINDER:

In fairness to all potential authors,
late abstracts will not be accepted.

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MRS Symposium Z: Nanoscale Electromechanics of Inorganic, Macromolecular, and Biological Systems

Coupling between electrical and mechanical phenomena is ubiquitous in nature and underpins the functionality of materials and systems as diversified as ferroelectrics and multiferroics, electroactive molecules, and biological systems. In ferroelectrics, electromechanical behavior is directly linked to polarization-order parameter and hence can be used to study complex phenomena including polarization reversal, domain wall pinning, multiferroic interaction, and electron-lattice coupling. The very basis of functionalities of biological systems is electromechanics, from nerve-controlled muscle contraction on macroscale to cardiac activity and hearing on microscale, and to energy storage in mitochondria, voltage-controlled ion channels, and electromotor proteins on nanoscale. More broadly, electromechanical coupling is a key component of virtually all electrochemical transformations in which changes in oxidation state are associated with changes in molecular shape and bond geometry. Electromechanical energy conversion is an integral part of processes such as triboelectricity, cavitation, and sonoluminescence. In this perspective, electromechanical coupling is a nearly universal part of energy conversion and transport processes, forms a basis for many device applications, and thus is directly relevant to virtually all existing and emerging aspects of materials science and nanobiotechnology.

The ubiquity and importance of electromechanics is belied by the lack of systematic interdisciplinary studies due to, until recently, the dearth of corresponding nanoscale probing tools, the difficulty in quantitatively determining the relatively small electromechanical coupling coefficients, and extreme breadth of the areas spanning from condensed matter physics to biology and medicine. The development of piezoresponse force microscopy (PFM) and piezoelectric nanoindentation technique in the last decade has led to rapid advances in the investigation of electromechanics with unprecedented resolution. In ferroelectric materials, PFM has enabled imaging static and dynamic domain characteristics at the nanometer level, providing direct experimental observations on switching and fatigue, domain-defect interactions, and nucleation mechanisms. The last several years have also witnessed a number of spectacular advances in PFM imaging and characterization of biological polymers, and expanding PFM capabilities to liquid and vacuum environments. In parallel, many new concepts of electromechanically driven MEMS and energy-harvesting devices were developed and implemented as molecular electromotors and molecular electromechanical systems, suggesting tremendous potential for the field and the breadth of the impact.

The goal of this symposium is to bring together experts from materials science, biology, and organic chemistry communities interested in electromechanical processes; scanning probe microscopists developing experimental pathways for probing nanoelectromechanics; and theorists interested in fundamental mechanisms of electromechanical energy conversion to formulate the outstanding research needs, grand challenges, applications, and development pathways for this rapidly emerging field.

Session topics will include (but will not be limited to):

- Nanoscale ferroelectric, piezoelectric, and multiferroic materials
- Electromechanically active macromolecules
- Single-cell electromechanics: from patch clamp to AFM
- Molecular electromechanical machines
- Piezoelectricity in calcified and connective tissues
- Piezoelectric energy conversion in nanostructures and energy harvesting
- Patterning and spectroscopy with piezoresponse force microscopy
- Novel electromechanical phenomena at the nanoscale
- Modeling and simulation of electromechanical phenomena at the nanoscale

Invited speakers include:

Nina Balke (Oak Ridge National Lab), **Ray Baughman** (Univ. of Texas, Dallas), **Kaushik Bhattacharya** (California Inst. of Technology), **Dawn A. Bonnell** (Univ. of Pennsylvania), **Michael R. Cho** (Univ. of Illinois, Chicago), **Peter Fratzl** (Max-Planck-Inst. of Colloids and Interfaces, Germany), **Tony Jun Huang** (Pennsylvania State Univ.), **Andrei Kholkin** (Univ. of Aveiro, Portugal), **Cewen Nan** (Tsinghua Univ., China), **Bala Pathem** (Univ. of California, Los Angeles), **Gil Rosenman** (Tel Aviv Univ., Israel), **Fraser Stoddart** (Northwestern Univ.), **Zhigang Suo** (Harvard Univ.), **Nagarajan Valanoor** (Univ. of New South Wales, Australia), **Zhong Lin Wang** (Georgia Inst. of Technology), and **Yichun Zhou** (Xiangtan Univ., China).

Symposium Organizers

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