Title: “Pushing the Spatio-temporal Limits of Scanned Probe Microscopy to Image Charge Generation, Ion Motion, and Individual Spins”

Guest Speaker:
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Hutchison Hall Room 473
University of Rochester

Abstract: Imaging the structure and function of soft materials at nanometer resolution represents a major challenge in analytical, physical, and materials chemistry. In this talk I will describe my group’s work to address this challenge by pushing the spatio-temporal limits of scanned probe microscopy. First, I will describe how we have used time- and wavelength-resolved scanned-probe photocapacitance and photovoltage experiments to gain fresh microscopic insight into the puzzling processes of charge generation and charge motion in organic and hybrid photovoltaic films. We have developed a new approach for imaging sample conductivity that has allowed us to improve the time resolution of photocapacitance measurements from microseconds to nanoseconds [1] and provide evidence that illuminating perovskite films with light generates mobile lattice defects [2]. Second, I report on my laboratory’s work using scanned-probe microscope technology to detect magnetic resonance as a force, with sensitivity sufficient to push magnetic resonance imaging (MRI) to nanometer resolution. I will describe the development of attonewton-sensitivity cantilevers with integrated nanomagnet tips. We have used these cantilevers to detect magnetic resonance from a polymer film at cryogenic temperatures with a sensitivity of a few hundred proton magnetic moments [3]. I will describe efforts to significantly improve the per-spin sensitivity and acquisition time of nano-MRI by using paramagnetic dopants and microwave irradiation (i.e., dynamic nuclear polarization) to create hyperpolarized nuclear spins [4]. Finally, I will describe ongoing experiments aimed at detecting and imaging electron spin resonance from individual nitroxide spin labels. Taken together, these experiments suggest that cantilever-detected magnetic resonance is on its way to becoming a powerful new route for creating a three-dimensional image of a single copy of a globular protein, membrane protein, or macromolecular complex.

Host: Professor Lewis Rothberg ● Email: Lewis.Rothberg@rochester.edu