Massachusetts Institute of Technology Department of Chemistry 77 Massachusetts Avenue
Cambridge, Massachusetts
02139-4307

Department of Chemistry's Modern Optics Spectroscopy Seminar presents:

Professor Renee Frontiera

McKnight Land-Grant Assistant Professor
Department of Chemistry
University of Minnesota

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How the environment controls chemistry: Raman spectroscopic probes of the effects of nanoscale environments on chemical reaction dynamics

My research program is broadly interested in how local environments affect chemical reaction dynamics. We focus on highly heterogeneous systems such as cellular membranes or photocatalytic devices, developing and using new spectroscopic approaches to probe the dynamics on the relevant length scale. This talk will focus on two approaches to nanoscale Raman spectroscopies, techniques which are capable of monitoring chemical composition and dynamics on nanometer length scales. First, I will discuss the development and implementation of a new super-resolution Raman microscopy technique, which is capable of probing chemical composition on the 10 nm length scale. This all-optical, label-free technique should have numerous applications in imaging of soft and dynamic materials, including biological samples. The technique combines methods from super-resolution fluorescence microscopy with stimulated Raman microscopy. I'll discuss our approach to achieving resolution well below the optical diffraction limit, implementation of this new technique, and approaches to reaching resolution on the nanometer length scale. Secondly, I'll present how we use plasmonic nanomaterials, which interact strongly with light and confine it to nanometer length scales, to probe and drive new chemical reactions. We use surface-enhanced Raman spectroscopy on ultrafast timescales to monitor plasmon-driven processes in real time. Currently we are investigating the use of these nanomaterials to provide highly energetic carriers and localized heating for photocatalysis.

Biography:
Renee R. Frontiera is an assistant professor of Chemistry at the University of Minnesota. Her research group uses Raman spectroscopic techniques to examine chemical composition and chemical reaction dynamics on nanometer length scales and ultrafast time scales. She received her Ph. D. in 2009 from the University of California – Berkeley, under the advisement of Richard A. Mathies. Her postdoctoral research at Northwestern University was under the supervision of Richard P. Van Duyne. Her research group at the University of Minnesota was founded in 2013, and she is the recent recipient of an NSF CAREER award, a DOE Career award, and an NIH Maximizing Investigators' Research Award (MIRA).

Host: William A. Tisdale
ARCO Career Development Professor
Chemical Engineering Department
tisdale@mit.edu, 617-253-4975