

# Chemistry Colloquium

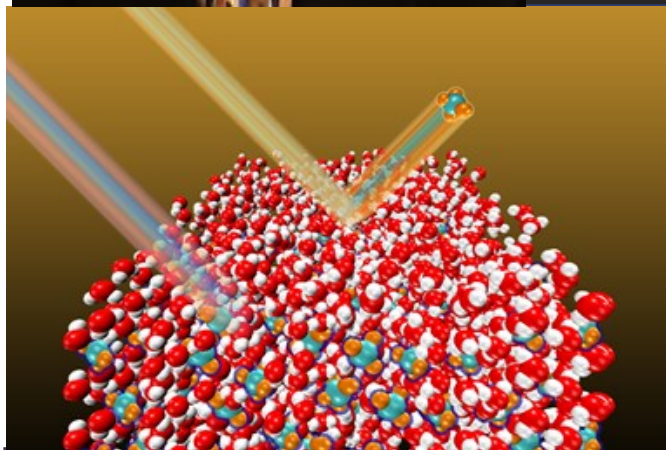
Title: "Gas-Surface Scattering Involving Ice, Isotopes, and Visualization of Reacting Interfaces"



Thursday, September 13, 4:00pm  
Hutchison Hall 473  
University of Rochester  
Department of Chemistry

Guest Speaker:

Professor Steven J. Sibener  
University of Chicago  
Department of Chemistry



**Abstract:** The interaction of energetic atomic and molecular species with ice is of fundamental importance for both terrestrial and astrophysical chemistry. This presentation will examine our recent discovery of a new mechanism by which atomic and molecular species can enter ice, energetic ballistic embedding. This mechanism can lead to the direct absorption of species into the subsurface/selvage region of ice formations, allowing for the laboratory investigation of fundamental kinetic and thermodynamic processes associated with gas capture. Energetic ballistic embedding has now been shown to be a general phenomenon, with application to both atomic and molecular species. These studies have revealed a rich palette of dynamics that are dependent upon the kinetic energy and momentum of the gas-surface encounter, the size and mass of the incident specie, as well as the nature of the ice itself; differing dynamics are seen for crystalline ice in comparison to amorphous solid water. The CO<sub>2</sub>/ice and CH<sub>4</sub>/ice systems are of particular interest because of their fundamental roles in the Earth's aqueous, atmospheric, permafrost, and seabed geosciences, as well as in the interstellar and circumstellar regions. These studies have direct implications for environmental science including global warming, molecule storage and release from permafrost, glacial ice, clathrates, trace gas collection/release, and the composition of astrophysical icy bodies in space. This part of the talk will conclude with very recent developments in which we will demonstrate that a quantitative understanding of isotope-dependent scattering can lead to new, efficacious routes for isotopic enrichment and separation. Complementing the above are measurements from a new and unique laboratory where we have coupled molecular beam reactive scattering at interfaces with real-time or time-lapse atomic-level visualization using STM/AFM imaging. This allows for visualization of the atomic-, nano-, and meso-scale processes that govern site-dependent studies of chemical reactivity, morphological evolution of the reacting interface, and synergistic effects involving nearby reaction sites. We have utilized this new methodology to examine the collision energy and angle dependent oxidation of Si(7x7) and the oxidation of basal plane of graphite. We view such measurements as opening a new window onto interfacial chemistry where one can directly link reaction mechanisms and kinetics to the real-time structural state of the interface.

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