Mechanical Engineering Department Seminar

3:35pm September 10, 2014
1130 Mechanical Engineering
111 Church Street SE, Minneapolis, MN 55455

Drag Force at the Nanoscale: Applications in Aerosol and Molecular Cluster Analysis

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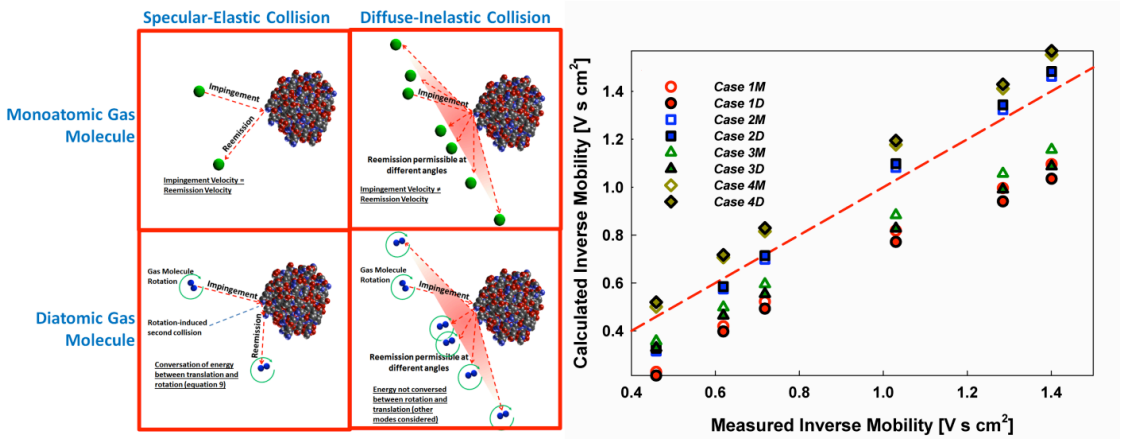
In a number of gas phase environments, including the ambient atmosphere and combustion systems, the formation of molecular clusters and nanoparticles can have an overall influence on system behavior/performance, and chemical and structural characterization of the clusters and particles present is often interest. Such characterization is typically not straightforward to carry out; clusters and nanoparticles are typically too small to individually scattering visible light photons, and are often not present in high enough concentrations for light absorbance measurements. Typically, the most tractable approach to analysis is to ionize the clusters/particles of interest and monitor their speeds (the time taken to arrive at an appropriate detector) in a region of controlled electric field strength. This speed is governed by a balance between the electrostatic force driving motion, and the drag force resisting motion, hence structural characterization for clusters and nanoparticles in the gas phase is carried out by drag measurement. This talk will provide an overview of recent theoretical and experimental developments from our lab group in both predicting the drag force on clusters and nanoparticles directly from structural models, and interpretation of drag measurements for clusters. Specifically discussed will be utilization of gas molecule trajectory tracking to accurately determine the drag force on a cluster from an all-atom model of cluster structure, as well as comparison of predictions to measurements made on ~1 nm cluster ions using a differential mobility analyzer coupled to a mass spectrometer.



Bio: Dr. Chris Hogan is an Assistant Professor in the department of Mechanical Engineering at the University of Minnesota. He received a BS degree in Biological & Environmental Engineering from Cornell University in 2004, and a PhD degree in Energy, Environmental, & Chemical Engineering from Washington University in 2008. After studying as a Postdoctoral Associate at Yale University in 2008-2009, he joined the faculty at the University of Minnesota in July 2009. He is the recipient of the 2011 Sheldon K. Friedlander Award for "Outstanding PhD dissertation in a field of aerosol science and technology", and the 2013 Marian Smoluchowski Award for "Outstanding contributions in aerosol science". Currently, his laboratory group, the Nanoparticle Physics Laboratory, focuses on the analysis of mass, momentum, and energy transport processes in nanoparticle-laden aerosols and colloids.