**Reaction Dynamics from Molecular Ions to Nanoparticles**

Robert E. Continetti

*Department of Chemistry and Biochemistry, University of California, San Diego, La Jolla CA 92093-0340, United States*

*rcontinetti@ucsd.edu*

Experimental chemical physics in the field of reaction dynamics seeks to observe and understand the outcome of molecular collisions and dissociation processes, in the gas phase ranging from atomic and diatomic systems all the way to studies of aerosols and other nanoparticles. Two extreme examples of experimental studies of reaction dynamics spanning this range of inquiry will be presented, making use of similar ion beam techniques including electrostatic ion beam traps and time- and position-sensitive detectors.

In the first instance, a benchmark measurement of the dynamics of an elementary chemical reaction will be reviewed, wherein the negatively charge F¯(H2O) complex is used to promote and study the F + H2O → OH + HF neutral reaction following photodetachment. This type of experiment can be carried out by the technique of photoelectron-photofragment coincidence spectroscopy. This four-atom system has six internal degrees of freedom and represents a grand-challenge for accurate calculations of the Born-Oppenheimer potential energy surfaces and quantum dynamics of the system. Comparison of experiment with theoretical predictions shows that this system can be treated with near chemical accuracy, but there are still challenges in accounting for excited states and long-lived complexes.1

In the second instance, a new single-particle dust accelerator/decelerator will be discussed.2 This apparatus makes use of similar experimental techniques, but is applied to much more complex systems: micron and sub-micron-sized nanoparticles. The mass and charge of single nanoparticles can be measured using charge detection mass spectrometry and the particle then accelerated or decelerated to the desired final velocity for studies of particle impact with surfaces. Applications to measurements of the coefficient of restitution for polystyrene latex spheres and tin nanoparticles and the durability of free-standing nanostructures with respect to particle impact will be presented.

**References**

[1] R. Otto, J. Ma, A.W. Ray, J.S. Daluz, J. Li, H. Guo and R.E. Continetti. Imaging Dynamics on the F + H2O → HF + OH Potential Energy Surfaces from Wells to Barriers. ***Science*** **343**, 396 (2014)

[2] B.D. Adamson, M.E.C. Miller and R.E. Continetti, The Aerosol Impact Spectrometer: a Versatile Platform for Studying the Velocity Dependence of Nanoparticle-Surface Impact Phenomena. ***EPJ Tech. and Instrum****.* **4**:2 (2017)

**Biography**

Robert Continetti received his Ph.D. from UC Berkeley, under Prof. Yuan T. Lee in 1989. After postdoctoral studies with Prof. Daniel Neumark at Berkeley, he became an Assistant Professor at UC San Diego in 1992, where he has remained, and is currently a Distinguished Professor of Chemistry. He has received several prestigious awards, including the Camille and Henry Dreyfus New Faculty Award in 1992, a David and Lucile Packard Fellowship in Science and Engineering in 1994, the Camille Dreyfus Teacher-Scholar Award in 1996, Fellow of the Alfred P. Sloan Foundation in 1997, as well as the ACS Division of Physical Chemistry Award in Experimental Physical Chemistry in 2012. He is an elected fellow of the American Physical Society and the author of more than 100 publications. He has also served as Chair of the Department of Chemistry and Biochemistry at UC San Diego from 2006-2012 and Chair of the Academic Senate of the San Diego Division in 2015-2016. His research interests focus on studies of reaction dynamics of transient gas-phase species using coincidence techniques as well as the spectroscopy and collision phenomena of nanoparticles and aerosols.