Boulder Fluid and Thermal Sciences Seminar Series

Tuesday, September 27, 2016
3:30pm-4:30pm (refreshments at 3:15pm)
Bechtel Collaboratory in the Discovery Learning Center (DLC)
University of Colorado, Boulder

Cavity-Enhanced Dual-Comb Spectroscopy for Detection of Traces of Biological and Chemical Molecules

Nazanin Hoghooghi, *University of Colorado, Boulder*

An optical frequency comb is a pulsed laser whose spectrum consists of an array of equally spaced narrow lines sometimes covering 100s of nanometers of optical bandwidth. Using optical frequency combs enables us to achieve both high sensitivity and wide spectral coverage for detecting trace amounts of biological and/or chemical molecules. By coupling the light from an optical frequency comb to a cavity which acts as an enhancement resonator, the effective interaction length between the laser light and the gas sample is significantly increased. In this way, a 10,000-fold increase in effective interaction path length can be achieved. In this talk, a near-infrared (NIR) cavity-enhanced dual-comb spectrometer which combines the benefits of optical frequency combs and an enhancement cavity will be introduced. We will present recent advancements as well as performance metrics we will obtain in the future.

A Molecular View of Pyrolysis of Complex Fuels in a Hot Micro-reactor

Barney Ellison, *University of Colorado, Boulder*

Climate Change and the world's energy crisis are inextricably linked. Because of this connection, the world must find replacements for roughly 90% of all the energy we now depend on. Biomass from vegetation is the only renewable source of carbon-based transportation fuels and chemicals for manufacturing. To understand the thermal decomposition mechanisms of biomass, we are developing a tiny furnace to study the thermal cracking of complex organic molecules. We use a heated 0.5 mm x 2 cm SiC microtubular reactor to decompose biomass monomers such as aldehydes, ketones, and alkylaryl ethers. Thermal decomposition of 0.01 % samples mixed with He or Ar carrier gases takes place at pressures of 75-250 Torr and at temperatures up to 1700 K. Residence time of the organics in the reactor is roughly 50-200 μsec. The organic decomposition products are identified by three independent techniques: VUV photoionization mass spectroscopy (PIMS), resonance enhanced multiphoton ionization (REMPI), and infrared (IR) absorption spectroscopy after isolation in a cryogenic matrix. *Ab initio* CCSD(T) electronic structure calculations have been carried out to guide our assignments.