Research Seminar

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Title: Laboratory Studies on Atmospheric Chemistry Problems Related to Air Quality and Climate

Abstract: Laboratory spectroscopy, kinetics, and photochemistry measurements are essential for understanding atmospheric chemistry problems related to air quality and climate. In this seminar, I shall present laboratory investigations of the selected atmospheric chemistry research problems. Temperature and pressure-dependent rate coefficients for the gas-phase reactions of maleic anhydride ($C_4H_2O_3$), a biomass-burning related pollutant chemical, with OH radical and Cl atom, were measured in a gas flow reactor using Pulsed Laser Photolysis-Laser-Induced fluorescence (PLP-LIF) and Pulsed Laser Photolysis-Resonance-Fluorescence (PLP-RF) methods respectively. The results from these kinetics experiments were useful in determining the atmospheric lifetime of this compound and will improve air quality forecast modeling. On the other hand, perfluoroheptene (C_7F_{14}) compounds are being considered replacements for ozone-depleting and potent greenhouse gases, which have various industrial uses. Stereoisomer-specific OH reaction rate coefficients for 2-C_7F_{14} and 3-C_7F_{14} were measured using a relative rate (RR) method with gas chromatography (GC) separation and electron capture detection (ECD) as well as by absolute rate method using PLP-LIF technique. Based on the measured OH reactivity, and gas-phase infrared spectra, we determined key climate metrics, i.e., radiative efficiency and global warming potential which will be useful in environmental policymaking. The atmospheric degradation mechanism of these compounds corroborated by an experimental reaction products study will be presented. I shall also discuss a new experimental technique based on time-resolved mid-infrared absorption spectroscopy which was used to measure the infrared absorption spectrum of methyl peroxy (CH_3O_2) radical and its reaction kinetics with nitrogen dioxide (NO_2). I shall also discuss the photochemistry of atmospherically relevant volatile organic compounds. Future research plans that include studies on the role of catalysis on atmospherically relevant reactions, atmospheric chemistry of air pollutants, isomer-specific reaction kinetics, and atmospheric photochemistry will be discussed in this talk.