Department of Chemical and Environmental Engineering

2014—2015 Seminar Series

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Photochemical and Dark Aging of Organic Aerosols

Atmospheric aerosols significantly affect air quality, visibility, and global climate. Organic compounds make up a significant, and often dominant, fraction of the atmospheric particulate matter (PM). Primary Organic Aerosol (POA) is emitted in the atmosphere directly by various sources such as traffic, ocean wave breaking, biomass burning, fossil-fuel combustion, cooking, and so on. The initial molecular make-up of POA usually reflects the specific environment it originated from. Secondary Organic Aerosol (SOA) is produced directly in the atmosphere as a result of a complex sequence of reactions that start with the oxidation of volatile organic compounds (VOC) by ozone (O3), hydroxyl radical (OH) and nitrate radical (NO3) and end with the condensation of the low-volatility products into particles. What makes the representation of organic aerosols in climate and air pollution models challenging is their astonishingly high degree of chemical complexity. For example, even SOA generated from a single precursor under controlled laboratory conditions typically contains thousands of different organic compounds. Furthermore, the chemical composition of organic aerosols is highly dynamic and continuously changes as a result of various “ageing” processes, such as photolysis, hydrolysis, oligomerization, oxidation, and other reactions involving aerosol constituents and atmospheric gases. This presentation will discuss the effects of ageing reactions on the molecular level chemical composition of organic aerosols, with a strong emphasis placed on biogenic SOA, which dominates global aerosol loading in the atmosphere. As aerosol ageing is a broad topic, we will focus on the following: 1. We will cover state-of-the-art analytical chemistry approaches, such a high-resolution mass spectrometry, which can be used to unravel the molecular level composition of organic aerosol. 2. We will examine the role of direct photolysis in the aerosol ageing, i.e., photochemical processes initiated by absorption of solar radiation by an organic compound within a particle. 3. We will discuss “dark” ageing processes, which occur without any involvement of solar radiation and free radicals, and result in the formation of compounds with unusual properties, such as organic compounds capable of absorbing visible radiation (so called “brown carbon”).

Biosketch: Sergey Nizkorodov received his undergraduate degree in biochemistry from Novosibirsk State University, Russia, in 1993 and graduate degree in chemical physics from Basel University, Switzerland, in 1997. After doing his postdoctoral research in chemical kinetics and reaction dynamics at the University of Colorado at Boulder, and in atmospheric chemistry at the California Institute of Technology, he joined the faculty of the Department of Chemistry, University of California, Irvine, in 2002. He teaches analytical, physical and atmospheric chemistry courses, and does research on chemistry of particulate matter in the ambient atmosphere and in indoor environments using state-of-the art spectroscopic and mass-spectrometric techniques. His primary areas of expertise are molecular spectroscopy, high resolution mass spectrometry, chemical reaction dynamics, and photochemistry. He has been a research mentor to 55 graduate, undergraduate and postdoctoral students including 30 female researchers. His research, education and public outreach work were recognized by several awards including Camille Dreyfus Teacher-Scholar Award, Ascent Award, Coblentz Award, and UCI Chancellor's Award for Excellence in Fostering Undergraduate Research.

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