

Photochemical and Dark Ageing of Organic Aerosols

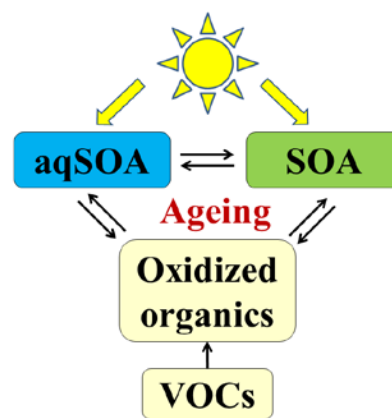
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Abstract: Atmospheric aerosols significantly affect air quality, visibility, and global climate. Organic compounds make up a significant, and often dominant, fraction of the atmospheric particulate matter (PM). Primary Organic Aerosol (POA) is emitted 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.

Our group has been investigating mechanisms of chemical and photochemical ageing in SOA using a combination of spectroscopic and mass spectrometric techniques. This presentation will discuss the effects of ageing reactions on the molecular level chemical composition of organic aerosols, with a strong emphasis on biogenic SOA, which dominates global aerosol loading in the atmosphere. We will cover state-of-the-art analytical chemistry approaches, such as high-resolution mass spectrometry, which can be used to unravel the molecular level composition of organic aerosol. We will then 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 or cloud/fog droplet. Finally, if time permits, 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”). The take-home point of this presentation will be that the condensed-phase dark and photochemical processes in atmospheric organic particles occur on relevant time scales and change not only the chemical composition but also key physical properties of the particles.



Biography: Sergey Nizkorodov is a full professor in the Department of Chemistry at the University of California, Irvine (UCI). He received his BS in biochemistry from Novosibirsk State University and PhD degree in chemical physics from Basel University. Before joining UCI in 2002, he did postdoctoral research in chemical kinetics at the University of Colorado at Boulder and in atmospheric chemistry at the California Institute of Technology. His group at UCI 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. He published over 110 papers, with the majority of them being in the area of atmospheric chemistry and aerosol research. He has been a research mentor to 79 interns, undergraduates, graduates, and postdoctorals in their research projects at UCI, including 47 female researchers. His research, education and outreach work were recognized by several awards including Ascent Award from AGU, Camille Dreyfus Teacher-Scholar Award, Coblentz Award, and UCI Chancellor's Award for Excellence in Fostering Undergraduate Research.