Preface

Understanding and mitigating the effects of human activities on air quality and the earth's climate are among the most significant challenges facing mankind today and for future generations. A detailed understanding of the mechanisms of atmospheric chemistry, and the physical and chemical processes leading to aerosol and cloud formation, is necessary for accurate predictions of future air quality and climate. Steps towards mitigation of pollutants at the source set the stage for smart policy decisions. Some of the field's leaders in atmospheric chemistry, in both the gas and the aerosol phases, provide insights in this volume of *Topics in Current Chemistry*.

Sunlight, and specifically its ability to break several chemical bonds, is the major driving force of atmospheric chemistry, normally through generation of reactive radicals. In their chapter "Emerging Areas in Atmospheric Photochemistry," George and co-authors review new concepts in long-wavelength photochemistry in the gas phase, in condensed phases, and at environmental interfaces.

Isoprene emissions are the highest among all non-methane hydrocarbons. Their chemistry is critical for predicting atmospheric oxidant levels as well as organic aerosol loadings. Heard et al. in their chapter "New Insights into the Tropospheric Oxidation of Isoprene: Combining Field Measurements, Laboratory Studies, Chemical Modelling, and Quantum Theory" review recent advances in our understanding of the chemistry of isoprene in remote areas (i.e., regions of low NO_x) driven by surprising observations in the field.

Understanding aerosol volatility, i.e., the partitioning of chemical species between the gas and particulate phases, is important in order to determine atmospheric aerosol loadings accurately. The volatility of organic aerosol species evolves throughout the aerosol's lifetime due to chemical "aging" in the oxidizing environment of the atmosphere. Likewise, the phase of an organic species influences the rate and mechanisms of oxidative aging. In their chapter, Donahue and coauthors review the principles behind the linkages between "Volatility and Aging of Atmospheric Organic Aerosol."

One of the major predicaments of evaluation of the physical–chemical transformations of chemicals in the earth's atmosphere is their characterization at very low detection limits. Bio-organic chemicals are ubiquitous in the earth's atmosphere and at air–snow interfaces. Besides impacts on the oxidative potential of the atmosphere, aerosol–cloud interactions, and radiation, airborne biological substances play various roles in the transmission of disease in humans and in ecosystems, and are linked to bio-terrorism. Ariya et al. explore existing techniques and methods applicable to the physical characterization of bio-organic matter, and which provide information on gases, liquids, and aerosols in the atmosphere and at snow–air interfaces. They evaluate their strengths and weaknesses, and foresee future directions in the domain.

Atmospheric aerosol particles serve an important role in establishing the climate and in the hydrological cycle as nuclei in the formation of cloud droplets. The relationship between an aerosol particle's chemical composition and its ability to serve as a cloud condensation nucleus (CCN) is complex. Organic material, a ubiquitous component of tropospheric aerosols, is typically more hydrophobic and less hygroscopic, and therefore less CCN active, than inorganic salts. However, many common aerosol organics are amphiphilic and therefore surface-active. Surface-active organics can lower aerosol surface tension, thereby enhancing CCN activation. An organic surface film can also act as a kinetic barrier for uptake of water or reactive gases to the aerosol, or serve as a nucleus for freezing in aqueous droplets. In their chapter, McNeill et al. review the sources and impacts of "Surface-Active Organics in Atmospheric Aerosols."

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