

Secondary Organic Aerosol Composition Studies
Using Mass Spectrometry

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ABSTRACT

Trace volatile organic compounds emitted by biogenic and anthropogenic sources into the atmosphere can undergo extensive photooxidation to form species with lower volatility. By equilibrium partitioning or reactive uptake, these compounds can nucleate into new aerosol particles or deposit onto already-existing particles to form secondary organic aerosol (SOA). SOA and other atmospheric particulate matter have measurable effects on global climate and public health, making understanding SOA formation a needed field of scientific inquiry. SOA formation can be done in a laboratory setting, using an environmental chamber; under these controlled conditions it is possible to generate SOA from a single parent compound and study the chemical composition of the gas and particle phases. By studying the SOA composition, it is possible to gain understanding of the chemical reactions that occur in the gas phase and particle phase, and identify potential heterogeneous processes that occur at the surface of SOA particles. In this thesis, mass spectrometric methods are used to identify qualitatively and quantitatively the chemical components of SOA derived from the photooxidation of important anthropogenic volatile organic compounds that are associated with gasoline and diesel fuels and industrial activity (C_{12} alkanes, toluene, and *o*-, *m*-, and *p*-cresols). The conditions under which SOA was generated in each system were varied to explore the effect of NO_x and inorganic seed composition on SOA chemical composition. The structure of the parent alkane was varied to investigate the effect on the functionalization and fragmentation of the resulting oxidation products. Relative humidity was varied in the alkane system as well to measure the effect of increased particle-phase water on condensed-phase reactions. In all systems, oligomeric species, resulting potentially from particle-phase and heterogeneous processes, were identified. Imines produced by reactions between $(NH_4)_2SO_4$ seed and carbonyl compounds were identified in all systems. Multigenerational photochemistry producing low- and extremely low-volatility organic compounds (LVOC and ELVOC) was reflected strongly in the particle-phase composition as well.

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