Oxidative aging of mixed component single aerosol particles

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Atmospheric aerosol is formed from a variety of organic and inorganic components. Heterogeneous reactions with gas phase oxidants, such as ozone, leads to the oxidative aging of atmospheric aerosol and changes in the optical properties and hygroscopicity due to changes in composition, phase, morphology and partitioning of components between gaseous and condensed phases. We present measurements of the oxidative aging of single aerosol particles trapped using optical tweezers.

Mixed component particles containing organic and inorganic components have been oxidatively aged by exposure to ozone over a range of relative humidities (RHs). Cavity Enhanced Raman Spectroscopy has been used to probe changes in particle composition, phase, morphology, volume and refractive index (RI). We have studied the oxidative aging of oleic acid (*cis*-9-octadecenoic acid; OL) and maleic acid (*cis*-butenedioic acid; MEA) by ozone in single aerosol particles formed of organic, inorganic and aqueous components.

Aerosol optical tweezers use a tightly focused laser beam to optically trap single aerosol particles within an environment in which the RH and ozone concentration experienced by the trapped particle can be controlled. We have previously used optical tweezers to probe the phase, morphology and hygroscopicity of mixed component aerosol formed of sodium chloride (NaCl) and OL.(1) In these measurements we have extended this work to investigate oxidative aging of both effloresced and deliquesced NaCl/OL particles over a range of RHs and also particles containing MEA and mixtures with inorganic and organic components.

Figure 1 shows the volume and RI of the organic phase of an effloresced mixed NaCl/OL particle during exposure to ozone and the evolving intensity of a Raman peak characteristic of OL which allows the loss of OL to be quantitatively measured. The organic volume reduces due to the formation of volatile products from the ozonolysis of OL. The timescales for the formation of these products from the reaction of OL and their partitioning into the gas phase can be compared. The formation of involatile reaction products is also observed, with greater than 50 % of the organic volume remaining involatile after oxidative aging.

Studying the oxidative aging of MEA in particles containing a variety of inorganic or organic components over a range of RHs allows us to study how changes in the host matrix, such as increasing viscosity, can affect the rates of oxidative aging and changes in particle properties.

References

(1) Dennis-Smither, B.J.; Hanford, K.L.; Kwamena, N.-O.A.; Miles R.E.H.; Reid, J.P. *J. Phys. Chem. A* **2012**, Article ASAP

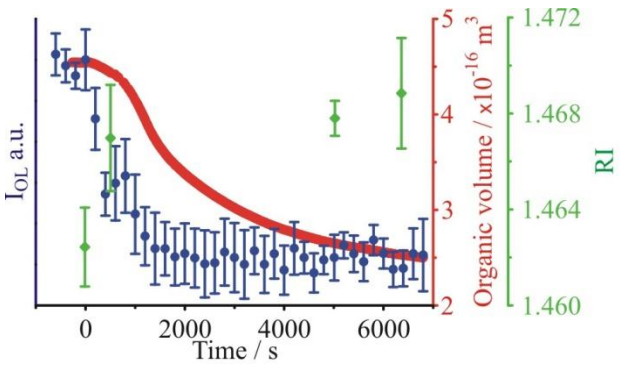

Figure 1: Temporal evolution of the intensity of Raman peak characteristic of OL (I_{OL}), volume of the organic phase, and RI of the organic phase during oxidative aging of an effloresced NaCl/OL particle. Start of ozone exposure is at t = 0 s.

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