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Morphology and Optical Properties of Mixed Aerosol Particles

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Experiments and modeling studies have shown that deliquesced aerosols can be present not only as one-phase system containing organics, inorganic salts and water, but often as two-phase systems consisting of a predominantly organic and a predominantly inorganic aqueous phase 1,2. Recent laboratory studies conducted with model mixtures representing tropospheric aerosols1,2,3, secondary organic aerosol (SOA) from smog chamber experiments4, and field measurements5 suggest that liquid- liquid phase separations (LLPS) is indeed a common phenomenon in mixed organic/ ammonium sulfate (AS) particles.
During LLPS, particles may adopt different morphologies mainly core- shell and partially engulfed. A core- shell configuration will have consequences for heterogeneous chemistry and hygroscopicity and as a result will alter the optical properties of the particles since the aqueous inorganic-rich phase will be totally enclosed by a probably highly viscous organic coating with low diffusivity for reactants and water.
The primary objective of this project is to establish a method for investigating the morphology of mixed inorganic and absorbing organic compounds of atmospheric relevance and study their radiative properties before, during, and after phase transitions mainly during LLPS. This will be the first study looking into the radiative effect of LLPS in detail. In this first experiment, the behavior of single droplets of carminic acid (CA)/ AS/ H_2O mixture was monitored during relative humidity (RH) cycles using optical microscopy.
The same mixture particle was levitated in an electrodynamic balance (EDB) and the change in its absorption properties was measured at varying RH.
We also intend to determine the occurrence of LLPS in accumulation- sized particles and the change in their absorption using a cavity ring down aerosol spectrometer. If LLPS alters the absorptive properties of the suggested model aerosols significantly, absorption measurements of accumulation mode particles of the same composition would allow proving that LLPS indeed occurs in particles of atmospheric relevant size ranges. Up to now this prove is missing.

References:
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