New Techniques for Studying Droplet Drying Kinetics

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Quantifying the evaporation kinetics of droplets is an important step towards controlling the formation of amorphous, crystalline or micro-structured particles. We will describe the application of a new technique for examining the drying kinetics of individual droplets, <50 μm in diameter, on sub-second timescales using a combination of electrodynamic trapping and light scattering. High accuracy measurements of evolving particle size with a time-resolution of <10 ms can yield insights into the competition between slow diffusion within the particle bulk, mass and heat transfer at the liquid-gas surface, and diffusion in the gas phase. The formation of crystalline or amorphous phases can then be identified. In addition, we will demonstrate that insights can be gained into the mechanism for the formation of amorphous or crystalline phases by comparing the kinetic drying studies with direct measurements the viscosity of particles spanning the range 10^{-3} to 10^{9} Pa s along with determinations of the compositional dependence of diffusion constants of solvents and solutes within a particle.