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Measurement of viscosity at low temperature from resonating droplet levitated in an electrodynamic balance

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Recent observations in the field measurements and laboratory studies suggest that organic aerosol particles may exist as highly viscous semi-solids or amorphous glassy solids under certain conditions, with important implications for atmospheric chemistry, climate, and air quality. A number of complementary techniques have been developed to probe the viscosity of aerosol particles in the last ten years. However, none of the available techniques is sufficiently versatile to determine aerosol viscosity at atmospherically relevant conditions for a range of particle sizes, chemical compositions, and sample sizes. Here we present a novel way to measure the viscosity of levitated droplets suspended in an electrodynamic balance under atmospheric conditions. Capillary oscillations are induced in a levitated droplet by the application of an external AC field. These oscillations are monitored using a high-speed camera or light scattering, and the viscosity is determined by fitting these oscillations using a suitable theoretical model. The model is based on the asymptotic analysis of surface oscillations of a charged drop, carried out using the viscous-potential flow theory.