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A New Hot-Stage Microscopy Method for Measuring Temperature-Dependent Viscosities of Secondary Organic Aerosol

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The viscosity of secondary organic aerosols (SOA) is needed to predict their influence on air quality, climate, and atmospheric chemistry. Many techniques have been developed to measure the viscosity of micrometer-sized materials at room temperature, however, few techniques are able to measure viscosity as a function of temperature for these small sample sizes. SOA in the troposphere experience a wide range of temperatures, so measurement of viscosity as a function of temperature is needed. To address this need, a new method was developed based on hot-stage microscopy (HSM) combined with fluid dynamics simulations. To validate our technique, the viscosity of a literature standard was reproduced with good accuracy. As an application to atmospheric aerosols, the viscosity as a function of temperature for lab-generated farnesene SOA was measured, with values ranging from 3.4×10^6 Pa s at 51°C to 2.6×10^4 Pa s at 67°C.