

Supporting Information for:

## **Phase Separation in Organic Aerosol**

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### **Summary:**

This supporting information contains brief discussions of challenges with measuring aerosol surface tension and viscosity.

### **Surface Tension:**

Many traditional techniques can be used to measure surface/interfacial tension of bulk systems (e.g. using a Wilhelmy plate or Du Noüy ring). A few issues arise when applying these techniques to atmospheric particles: 1) concentrations of solutes are often supersaturated under atmospherically relevant conditions, and 2) for small particles  $< 100$  nm, surface curvature will start to be important in the calculation of surface tension (as described by the Tolman length).<sup>1</sup> To overcome the first challenge, some papers have extrapolated from results obtained using traditional techniques to estimate surface tensions under supersaturated solute conditions.<sup>2</sup> The deformation of droplets and air bubbles in a fluid phase within a microfluidic device have also been used to determine the interfacial tension.<sup>3</sup> To address the second challenge, two recent papers have developed the use of AFM for the measurement of surface tension of atmospherically relevant systems such as particles composed of single component salts and organic acids in water and a film of  $\alpha$ -pinene ozonolysis products.<sup>4,5</sup> These studies insert a nanoneedle attached to an AFM tip (NaugaNeedle) into the system of interest and extract it to obtain a force curve that describes the force of the liquid on the AFM tip, which can be converted to a value for surface tension.

Studies on single component systems have shown that the surface tensions of submicron particles (> 200 nm) agree well with bulk measurements.<sup>4</sup> While this technique allows for the use of submicron particles, it may still be difficult to measure supersaturated solutions as the insertion of the AFM tip could induce crystallization.

### **Viscosity:**

Because of the importance of viscosity to the chemical and physical properties of aerosol particles, many different methods have been developed to measure particle viscosity, though few methods have been proposed for submicron particles. Both indirect and direct methods have been used to investigate the viscosity of particles including: particle bounce,<sup>6</sup> poking or cracking glassy particles,<sup>7</sup> watching poked particles re-equilibrate,<sup>8</sup> tracking the motion of solid particles within an aerosol particle,<sup>7</sup> monitoring the diffusion of D<sub>2</sub>O,<sup>9</sup> measuring water transport in particles,<sup>10</sup> watching the timescale on which colliding particles coalesce into a single particle,<sup>11</sup> using fluorescence recovery after photobleaching,<sup>12</sup> and monitoring the change in shape with RH of freshly generated secondary organic material.<sup>13</sup> Of these techniques, only particle bounce and monitoring the shape of secondary organic material with RH have been used to determine the viscosity of submicron particles. Note also that only one example reference has been given for each technique, though some of them have been widely used.

### **References:**

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