In-situ Surface Tension Measurements of Atmospheric Aerosol Particles

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The surface tension of aerosol particles can potentially affect aerosols' growth (activation) into cloud droplets. Hence, the challenge of directly measuring the surface tensions of aerosol particles is essential. Here, we report in-situ surface tension measurements based on a linear quadrupole electrodynamic balance (EDB) coupled with the quasi-elastic light scattering (QELS) method. The EDB-QELS is validated using surface tension measurements of atmospherically relevant inorganic and organic droplets. The surface tension results are in reasonable agreement with the reference values in the range of ~50–90 mN m^{-1}. We find a significant size dependence for sodium chloride droplets containing surface-active species (sodium dodecyl sulfate) in the size range of ~5–18 μm. The surface tension increases from ~55 to 80 mN m^{-1} with decreased size. Dynamic surface tensions of droplets during changing relative humidity reveal the onset of liquid-liquid phase separation. The approach can offer systematic surface tension measurements of atmospheric aerosol particles, which is needed to predict the surface tensions of droplets until activation.

Keywords: Aerosol, Surface tension, Cloud formation