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Nano-size confinement effect on phase transition of NaCl and (NH4)2SO4 aqueous droplets reveal the vital role of solution non-ideality

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Understanding the fundamental role of interaction between water molecular and nanoparticles in new-particle formation, particle initial growth by condensation and coagulation, and thereby visibility degradation, cloud formation, radiative forcing is of great significance in the atmospheric researches. But current knowledge about fundamental physical, chemical properties of nanoparticles is still very limited. Here we measured the hygroscopic behavior of atmospheric relevant nanoparticles, such as (NH4)2SO4 and NaCl in the dry size range from 100 nm down to ∼4-6 nm using a hygroscopic tandem nano-differential mobility analyzer (nano-HTDMA). The diameter growth factors of AS and NaCl decrease with decreasing dry mobility diameter and both show a prompt deliquescence in the range of 100 - 6 nm, which are in a good agreement with Biskos et al. (2006a, 2006b). However, no significant nano-size effect on the deliquescence point of ammonium sulfate observed down to 6 nm, which is consistent with Biskos et al. (2006a). The observed hygroscopic growth of AS and NaCl can be well explained by the concentration dependent water activity and surface tensions retrieved from Differential Köhler analysis (DKA) (Cheng et al. 2015). Our study on the different nano-size confinement effect on phase transition of NaCl and AS aqueous droplets provides further insight on the vital role of the non-ideality of solution properties.

references:
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