

THERMODYNAMIC AND KINETIC EFFECTS OF DICARBOXYLIC ACIDS ON
INORGANIC SALT PARTICLES

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Atmospheric aerosols in continental air contain a significant fraction (20-50 percent) of organic compounds. Organic compounds covering a wide range of carbon numbers and functional groups have been identified in smog chamber experiments and field studies. Dicarboxylic acids, such as succinic acid, are observed to be common, relatively water soluble species. Originating from natural and anthropogenic sources, these acids range in size from C₂-C₁₀ and in solubility. Because of their low vapor pressure they tend to condense on pre-existing atmospheric particles, such as inorganic acid or salt particles. As the inorganic fraction deliquesces to form a droplet the less soluble organic acids remain as solid inclusions within the droplet or coat the particle by forming a film over the surface. Recent studies indicate that the organic fraction has an impact on the hygroscopic nature of atmospheric aerosols. The amount of water taken up by a particle directly influences the light scattering properties and chemistry, such as the gas-particle partitioning of nitrate. In addition, the organic components may influence the deliquescence and efflorescence of inorganic acid and salt particles.

We have investigated the effects of succinic acid (SA) on the thermodynamics and kinetics of ammonium nitrate (AN) particles. SA is a slightly soluble, 8.6g per 100g H₂O at 298 K, C₄ dicarboxylic acid. Because of its low solubility, SA remains solid after the AN has deliquesced. We observed a pronounced reduction in the particle growth factor at deliquescence due to the presence of solid SA, and conclude that the SA takes up a minor but not insignificant amount of water. A slight decrease in the deliquescence relative humidity was observed as the mass percent of SA was increased from 12.5-50. Furthermore, the solid SA acts to catalyze efflorescence of AN. The heterogeneous efflorescence of AN has been investigated as a function of the surface area of solid SA present in the particles. In addition, at high relative humidities it is possible to completely dissolve the SA to produce a homogeneous solution droplet supersaturated with respect to both AN and SA. We also present data on the hygroscopicity and phase transitions of internally mixed AN-SA-water solution droplets.