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Deliquescence behavior of salts confined in small pores

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The relative humidity at which a salt absorbs water vapor from the atmosphere spontaneously to form a saturated solution is called the deliquescence relative humidity (DRH) of the salt. In comparison to the DRH of bulk salt crystals, the DRH of levitated salt nanocrystals increases with decreasing crystal size[1,2]. Even in case of salts confined in pores smaller than 100 nm the DRH is no more equivalent to that of bulk crystals. It is strongly affected by the curvature of the liquid-vapor interface, when the pore size of the porous material gets smaller than 100 nm. To our knowledge, experimental investigations about the influence of confinement below 100 nm in diameter on the deliquescence humidity of a salt are not yet carried out.

The experimental work focuses on the water uptake behavior of different salt-silica-composites with pores smaller than 100 nm carried out to investigate the deliquescence behavior of confined salt. Porous materials like mesoporous SBA-15 and controlled porous glasses are impregnated with NaCl- and KNO₃-solutions preventing over-filling of the available pore volumes. The experimental results of the water sorption measurements of bulk salts, pure host materials and the composites reveal a significant decrease of the deliquescence humidity (DRH) of the salt with decreasing pore size. A thermodynamic model approach, based on combined use of the Young-Laplace equation, the Kelvin equation and the Pitzer ion-interaction model, is used to predict the sorption behavior of salts confined in the respective pore sizes. The calculations match well with the experimental results that the main reason for the decrease of the relative vapor pressure over the salt solution in the unsaturated pore is the concave curvature of the liquid-vapor interface. Similarly, this model approach shows, that the increase in DRH of levitated nano-sized salt crystals[1,2] is due to the convex curvature of the liquid-vapor interface, whereas the effect of increase in solubility with decreasing crystal size is low. Further experimental work focuses on the water uptake behavior of porous materials containing salts, which form higher hydrated phases before they deliquesce.

References

- [1] Biskos, G.; Malinowski, A.; Russell, L. M.; Buseck, P. R.; Martin, S. T. Nanosize Effect on the Deliquescence and the Efflorescence of Sodium Chloride Particles. *Aerosol Science and Technology* 2006, 40, 97–106.
- [2] Hämeri, K.; Laaksonen, A.; Väkevä, M.; Suni, T. Hygroscopic growth of ultrafine sodium chloride particles. *Journal of Geophysical Research* 2001, 106, 20,749-20,757

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