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Low temperature thermodynamics of water clusters studied by nanocalorimetry

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Water exhibits many unusual properties, which mirror the complexity of its hydrogen network structure. It is therefore not surprising that water clusters and nanoparticles are special in many aspects as well. We have recently shown that negatively charged water clusters exhibit a melting-like transition at surprisingly low temperatures (at about 120 K for $H_20^-_{118}$) [1]. Further studies have shown that this behavior depends only weakly on the charge state of the cluster or on the type of impurity incorporated [2]. Furthermore the size dependence indicates that the transition does not extrapolate to the melting transition of normal ice, but rather to the glass transition of amorphous ice, which occurs at about 136 K. This can be rationalized by the fact that water clusters with few hundred molecules do not form a crystalline network like bulk ice, but exhibit structures much closer to that of the amorphous forms of solid water.

[1] C. Hock, M. Schmidt, R. Kuhnen, C. Bartels, L. Ma, H. Haberland, and B. v.Issendorff, Phys. Rev. Lett. 103, 073401 (2009)

[2] M. Schmidt and B. v. Issendorff, J. Chem. Phys. 136, 164307 (2012)