Equilibrium Melting of Water and Water +Sodium Chloride in a Novel Peltier-Element-Based Adiabatic Scanning Calorimeter

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Water and sodium chloride form a eutectic system. However, there are in literature only a limited amount of high-resolution thermal data on its phase behavior, although such information is quite relevant, e.g. for food engineering or cryobiology. We present high-resolution enthalpy and heat capacity data on sodium chloride solutions, ranging from pure water to the eutectic composition, in the temperature range between -30 °C to +10 °C. The measurements have been performed by means of a novel Peltier-element-based implementation of the adiabatic scanning calorimeter (ASC) concept [1,2]. The new instrument is capable of achieving, on mg size samples, accuracy (1 to 2 %) close to that of classical adiabatic heat-step calorimeters (on samples of several grams) and very high temperature resolution. ASC relies on the application of constant power to the sample, and measures the resulting temperature rate. This is exactly the opposite as in DSC, where a fixed temperature rate is enforced on the sample by varying the power. ASC leads naturally to high-resolution equilibrium data, in contrasts to inherently rate-dependent DSC data [3,4]. In addition, ASC also measures the enthalpy simultaneously with the heat capacity. We present specific heat capacity and enthalpy data for the melting of the ice and of the eutectic phase transition, around -21 °C. Accurate latent heat values are obtained for both transitions, as well as the melting point depression. A novel approach for purity determination on the basis of the data obtained by pASC will be discussed. These data will be used in a discussion of the colligative nature of the solutions and the dissociation of the salt.

References

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