Novel Peltier-Element-Based Adiabatic Scanning Calorimeter for the Measurement of Phase Transitions in Condensed Matter Systems

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Adiabatic scanning calorimetry (ASC) (introduced in the early 1980s) has received only limited attention because of the complexity in operating the old types of ASC set-ups [1]. Here we present a novel Peltier-element-based adiabatic scanning calorimeter (pASC), that eliminates this and also several issues of differential scanning calorimetry (DSC), while achieving accuracy close to that of adiabatic heat-step calorimeters and very high resolution in temperature[2]. The working concepts of ASC and DSC are based on the same expression for the heat capacity $C=P/(dT/dt)$, with P the applied or measured power and (dT/dt) the measured or applied temperature rate. The essential difference between ASC and DSC lies in the implementation of this expression. In an ASC, one applies constant power to the sample and derives the changing rate from the recorded temperature evolution $T(t)$ with time t. In a DSC, a constant rate is imposed and the changing power to comply with the constant rate requirement is measured: thus exactly the opposite. Moreover, the constant power in ASC simultaneously results in the temperature dependence of the enthalpy $H(T)=Pt$, including the latent heat when present. Investigations of some melting points will show that while ASC results in thermodynamic equilibrium data, DSC results are essentially rate dependent [3,4]. It will also be shown that pASC not only can run in the default constant power mode, but also in the classical heat-step or in DSC-type modes.

References

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