Calorimetry on time scales from microseconds to days

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Many materials are created or used far from thermodynamic equilibrium. Knowledge about the phase transitions on fast cooling is therefore required. Calorimetry is a powerful tool in this respect and it takes a special place among other methods. In addition to its simplicity and universality, the energy characteristics (heat capacity Cp and its integral over temperature - enthalpy H), measured via calorimetry, have a clear physical meaning even though sometimes interpretation may be difficult. Fast scanning calorimetry, especially on cooling, allows for the in situ investigation of structure formation, which is of particular interest in a wide range of materials like polymers, metals, and pharmaceuticals to name a few. Free standing silicon nitride membranes are commonly used as low addenda heat capacity fast scanning calorimetric sensors. The gauges consist of a film-thermopile and a film-heater which are both located in the central part of the membrane. At non adiabatic conditions controlled fast cooling up to 10^6 K/s is possible as well as fast heating at the same high rates [1, 2]. In addition to fast linear scanning the calorimeters allow also high frequency AC calorimetric investigations of the glass transition [3].

The calorimeters were used in combination with conventional DSCs, including Calvet type DSCs, to study many different processes like melting of proteins [4], evaporation of ionic liquids [5], solidification of polymers [6, 7] and metals [8] on cooling, isothermal crystallization after fast quenches [9], and the frequency dependence of the glass transition in a wide frequency range [10].

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