Thermal Characterization of Thin Polymer Films by Chip-based AC-Calorimetry

Christoph Schick [C, S], Heiko Huth and Mathias Ahrenberg
Institute of Physics, University of Rostock, Rostock, Germany

Knowledge about thermal properties of thin polymer films is needed for a better understanding of structure-property-relationships. Calorimetry has proven to provide useful information about glass transition, melting, crystallization and recrystallization in thin films, because it establishes a direct link to an energetic characterization of the material. In calorimetry two types of experiments are common: (i) scanning at constant or variable rate or (ii) periodic temperature oscillations (AC-calorimetry). For sample mass in the nanogram range and thin films in the µm…nm range standard calorimetric methods are mostly not applicable. In the recent years there are new developments in the field of calorimetry which overcome these limitations. One is the measure with high heating and cooling rates. This is realized by the use of chip calorimeters. These calorimeters are using thin film techniques to avoid large heat capacities of the calorimeter. We have developed a differential AC chip calorimeter capable to measure thermal properties in micro- and nanometer thin films at rates in the order of K/min comparable to standard DSC. Due to the differential setup pJ/K sensitivity is achieved. Changes in heat capacity can be measured for sample masses below one nanogram. The calorimeter allows for the frequency dependent measurement of complex heat capacity in the relative broad frequency range from 1 Hz to 1 kHz.