

Stochastic Temperature Modulation: a New Technique in Temperature-Modulated DSC

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A new temperature-modulated differential scanning calorimetry (TMDSC) technique is introduced. The technique is based on stochastic temperature modulation and has been developed as a consequence of a generalized theory of a temperature-modulated DSC. By analyzing the correlation between the stochastic heating rate and the measured heat flow, information on the dynamic behavior of the sample and the instrument are determined. This analysis yields the quasi-static heat capacity $C_{p,0}$ and the frequency-dependent complex heat capacity $C_p^*\omega$ without the need for additional calibration procedures. $C_p^*\omega$ can be determined over a wide frequency range. A second result of the correlation analysis is the non-reversing heat flow Φ_{non} . This is the non-correlated heat flow component. The reversing heat flow is calculated from the quasi-static heat capacity. All these quantities and their frequency dependency can be determined in one single measurement. At sufficiently low underlying heating rates and small temperature perturbations, the resulting reversing and non-reversing heat flows become identical to the sensible and latent heat flow components for the underlying heating rate. Examples show the frequency dependence of different thermal relaxation processes and phase transitions. The concept of stochastic temperature-modulated DSC has been recently realized in TOPEM[®] by METTLER TOLEDO.