FAST SCANNING CALORIMETRY AS A TOOL FOR THERMODYNAMIC MEASUREMENTS – ADVANTAGES AND LIMITATIONS

Mukhametzyanov T.A.
Kazan Federal University
420008, Kazan, Kremlevskaya st., 18

Fast scanning calorimetry (FSC) is an advanced development of the widely used differential scanning calorimetry (DSC) technique. It allows rapid heating and cooling (up to 10^6 K/s and above) of nanogram-scale samples. Rapid heating and cooling enable the probing of processes and states on much shorter time scales than conventional DSC and provide significant advantages. These include the prevention of thermal degradation in thermally labile compounds, the suppression of reorganization during heating, the inhibition of crystallization during cooling, and many others.

The application of FSC has allowed, for the first time, the measurement of melting temperatures, enthalpies, and heat capacities in the supercooled liquid state for various compounds. These range from small organic molecules to biological polymers, including metastable polymorphs. Tremendous progress has been achieved in studying the properties of supercooled amorphous phases and the processes occurring within them, including their associated thermodynamic parameters. Other applications of FSC in thermodynamics include measuring vaporization and sublimation parameters, accessing the thermodynamics of folding intermediates, and evaluating the effects of confinement and surfaces on thermodynamic properties, among others.

However, like any instrument, FSC has its own limitations. These include the impossibility of direct sample mass measurement, the need to account for thermal gradients, the avoidance of unwanted vaporization, and size effects.

This presentation outlines the experience gained from applying FSC at Kazan Federal University, as well as recent developments reported in the literature.

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