Determination of the Sublimation Vapor Pressure of Thermally Labile Compounds with Fast-scanning Calorimetry

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Knowledge of vapor pressure and the corresponding enthalpy of sublimation is of importance for science and industrial applications. These values directly connect to the intermolecular forces in the crystal state, provide the lattice energy and the change in order by going from the crystal to gas phase. In the present study, fast scanning calorimetry (FSC) was successfully applied for determination of vapor pressure and enthalpies of sublimation of organic substances. In many cases investigation of thermally labile systems, e.g. biomolecules, is accomplished with low thermal stability, and application of classic techniques to sublimation often fails. The FSC technique is based on the determination of the mass loss rate of the sample from the experimental total heat capacity and the previously determined specific heat capacity of the compound under study. Sublimation of the sample is carried out during repeated isotherms of pre-defined duration and at selected temperatures. The sample is heated to the needed temperatures at high heating rates accessible by this technique, which allows reaching the sublimation temperatures without detectable mass loss during heating. From the other side, in the proposed technique the sample's surface area is so big that the sublimation mass loss rate is incomparably higher than the decomposition rate. Thus, a sample of a few nanograms sublimes essentially without thermal degradation.