What are the Key Specifications of a DSC?

Georg Widmann, Urs Jörimann and Rudolf Riesen
Mettler Toledo Analytical
CH-8603 Schwerzenbach

1. The Temperature Resolution

The resolution or separation of physical transitions occurring in a small temperature range depends on several parameters. Some of them can be optimized by the user (e. g. heating rate and sample mass), others are given by the instrument design:

- Thermal resistance between furnace and sample
- Heat capacity of sample plus pan
- Signal time constant.

Simple mathematics show how the shape of the melting peak depends on the above properties.
In addition the "TAWN Resolution Test" [1] using a liquid crystal as a test substance will be discussed.

2. The Ability to Detect Small Effects (= "Sensitivity")

The signal noise level is the ultimate detection limit. Two current definitions of noise are given (peak-peak and root mean square). Since it would be easy to achieve any low level by smoothing procedures (that would cut off small real effects of the sample, too) a low noise level isn't necessarily equal to a high sensitivity. In the "TAWN Sensitivity Test" a sample with a known small effect is measured and the found peak size is divided by the found noise level. This signal to noise ratio characterizes the sensitivity of a DSC.

3. Other Important Properties

Depending on the application many other properties can be significant:

- Reproducibility of blank curve, onset temperatures and peak areas
- Accuracy of temperature and quantity of heat
- Temperature range, range of heating (cooling) rates, availability of special temperature programs, e.g. isothermal steps or sinusoidal modulation.
- Practical aspects such as stability against decomposition products and oxygen (heat cleaning!) and availability of different pans for specific applications; sample robot.
- Last but not least, the software is important. It should comprise:
  - ✓ Basic evaluations such as onset and area determination
  - ✓ Choice of the baseline for curve integration
  - ✓ Calibration routines for temperature, quantities of heat and influence of heating rate, pan and purge gas
  - ✓ Mathematical operations such as smoothing, curve subtraction and multiplication
  - ✓ Special evaluations such as glass transition, specific heat capacity and enthalpy temperature function, conversion, content, purity and kinetics
  - ✓ Automatic evaluations and validation of results.

[1] P.J. van Ekeren, C.M. Hol and A.J. Witteveen, J. Thermal Analysis, 49 (1997), 1105.