Thermochimica Acta, 13 (1975) 471–473

Note

On the nomenclature of thermoanalytical methods associated with energy changes

PAVEL HOLBA AND JAROSLAV ŠESTÁK

Institute of Solid State Physics of the Czechoslovak Academy of Sciences, Cukrovarnická str. 10, 162 53 Prague (Czechoslovakia)

(Received 29 May 1975)

The increasing number of commercial devices for thermoanalytical methods indicating the changes of enthalpy has created a situation in which the existing nomenclature permits the utilization of the same terms for apparatuses functioning on different principles. The term Differential Scanning Calorimetry is used for all methods where a heat flux is measured. This promising term is mis-used also for Calvet microcalorimetry by some manufacturers because the temperature is also scanned in the dynamic modification of this method. Even the reaction of the Nomenclature Committee of the ICTA[1] on this situation has not been completely successful in eliminating this confusion by recommending the replacement of both terms Differential Dynamic Calorimetry and Calvet microcalorimetry by the term Quantitative Differential Thermal Analysis.

Despite the large amount of articles dealing with the theoretical background of DTA[2] there is no systematical treatment about the dynamic calorimetric measurements in general. The recent analyses based on the balances of heat fluxes[3–6] have been devoted to deriving fundamental so-called calorimetric equations. Some of these analyses, however, do not explain sufficiently to what system the derived equations can be applied adequately, e.g., the equation for the DSC curve derived in ref. 3 is more valid for a modification of Calvet microcalorimetry.

From the authors' recent contribution[7] to the theory of dynamic calorimetric measurements follows the plausibility of the classification of thermoanalytical methods according to what quantity is recorded during the measurements. The dynamic methods associated with energy changes can thus be differentiated into the three following classes: (1) thermometric measurements; (2) spontaneous heat flux measurements; and (3) compensating heat flux measurements.

(1) Thermometric measurements (T-methods) are based on the indication of the sample temperature (straight method) or on the indication of the temperature difference between the sample and the reference specimen (differential method).

(2) Spontaneous heat flux measurements (SHF-methods) are based on the indirect indication of spontaneous heat flux from (or into) the sample or on the indication of the difference between spontaneous heat fluxes in the sample and the reference specimen.

(3) Compensating heat flux measurements (CHF-methods) are based on the indication of heat flux compensating the sample temperature to correspond to the predetermined time-dependence of temperature or on the indication of the difference of heat fluxes compensating the temperature difference between the sample and the reference to be zero.

Each of these three classes involves its appropriate set of instrumentation and presents special interpretation problems related to the methods of the given class[7]. For a quantitative use of T-methods this problem is, for example, the establishment of the temperature dependence of the so-called apparatus constant. For the T- and SHF-methods the problem is, e.g., to know the baseline behavior on the moment when energy change is detected.

The suggested classification does not consider the measurements of derived quantities, e.g., the inverse heating rate curve and the derivative differential thermal analysis, as individual methods.

The nomenclature recommended by the ICTA offers for the twin systems the terms DTA, which fits well into the scope of T-methods where the temperature difference between the sample and the reference specimen is measured, and DSC, which may be retained for the (not entirely exact) description of the differential measurements of compensating heat fluxes (DCHFM). However, an appropriate name for the differential spontaneous heat flux measurements (DSHFM) belonging to the family of Calvet microcalorimetry is missing. The term Quantitative DTA is not suitable as it interferes with the class of T-methods and their quantitative applications. As to the rejected name Differential Dynamic Calorimetry (DDK), it seems to be more acceptable but its exact meaning would include all twin techniques used for calorimetric measurements[8].

It shoud be stressed once more that the principle of the DSHFM technique is completely different from that represented so far by DSC. The difference between the interpretation of their curves is fundamental; as in DSC measurements the term of thermal inertia is absent[7]. Therefore the difference between DSC and DSHFM type measurements ought to be clearly mentioned in all advertising materials in order to avoid misinterpretations of curves obtained from the respective instruments.

For more details see the article *Fundamental equations in dynamic calorimetry* to be published in the English version of the *Czechoslovak Journal for Physics.*

REFERENCES

1 Report of the Nomenclature Committee of the ICTA in *The Abstracts of the 4th ICTA in Budapest, Hungary, 1974.*
2 See e.g. monograph J. Šesták, V. Šatava and W. W. Wendlandt, *The study of heterogeneous processes by thermal analysis, Thermochim. Acta*, 7 (1953) 333.
3 A. P. Gray, the lecture at the *3rd ICTA in Davos, Switzerland 1971*; and in *Analytical Calorimetry* (R. J. Porter and J. F. Johnson, eds.), Vol. 1, Plenum Press, New York, 1968, p. 209.
4 M. M. Faktor and R. Hanks, *Trans. Faraday Soc.*, 63 (1967) 1122.
5 P. Holba, the lecture at the *National Conference on Calorimetry in Tbilisi, U.S.S.R. 1973*, and at the *4th ICTA in Budapest, Hungary 1974*; and *Silikáty*, (1976) in press.

6 M. Nevřiva, P. Holba and J. Šesták. The lecture at the *4th ICTA in Budapest, Hungary 1974*; and in *Silikáty*, (1976) in press.
7 P. Holba and J. Šesták, the lecture at the *Seminar on Calorimetry, Prague, Czechoslovakia 1975*; and in *Czech. J. Phys.*, (1976) in press.
8 J. Šesták, P. Holba and R. Bárta, The theory and the practice of thermoanalytical methods based on the indication of enthalpy changes. A review in *Silikáty*, (1976) in press.