

TWO APPROACHES TO THE NOMENCLATURE AND TERMINOLOGY
FOR BASIC CONCEPTIONS USED IN THERMAL ANALYSIS

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ABSTRACT

An amendment to the definition of "Thermal Analysis" given by the Nomenclature Committee of ICTA is proposed for the sake of scientific truth.

INTRODUCTION

The simplest questions are the most difficult ones to answer. What is Thermal Analysis? This is our daily occupation. But what, in fact, are we doing? A sample of substance is heated or cooled. And what is measured in this case? - Temperature (or/and the rate of its change, or/and the difference between two temperatures). Is the temperature a property of the substance? No, it is not. It is one of the thermodynamic parameters of state.

STATEMENT AND DISCUSSION

1. W.D.Kingery (1959): "Thermal and Differential Thermal Analysis. One of the most widely used method of studying phase changes has been the determination of changes (owing to heat evolution or absorption) in the rates of heating or cooling samples under specified conditions" (/1/, p.283).

2. The Encyclopedia of Inorganic Materials (1977): "Thermal Analysis is an analysis of transformations that occur in substance in heating or cooling. Thermal effects of transformations are detected from temperature changes caused by them.

... In the simplest case... temperature is recorded in smooth heating or cooling processes. The transformations in the substance can be seen as inflections, or arrests on the temperature-time curves.

In...Derivative TA heating rate (or the inverse value) is measured as a function of time or temperature...

... In Differential Thermal Analysis the temperature difference between the sample and reference material is recorded" (/2/, p.535).

Similar definitions may be found in many other references.

How could it happen that the Nomenclature Committee of ICTA has given the following definition: "Thermal Analysis. A group of techniques in which a physical property of a substance is measured as a function of temperature..." (/3/, p.18)? Should it be understood here "as a function of its own temperature (of the temperature of the substance under investigation)? Evidently, it should.

Then a rule is given: "On this basis the various techniques can be classified as in Table 2 and the following definition (may be given) in the form: (The techniques name) is a technique in which (the name of a property according to Table 2) is measured as a function of temperature whilst the substance is subjected to a controlled temperature programme" (/3/, p.18).

And in Table 2 (/3/, p.19) "Classification of Thermoanalytical Techniques" in the first column "Physical property" we read: "Temperature" (!?) and "on this basis" the simplest and oldest thermoanalytical technique, namely, heating (cooling) curves determination, has to be defined as "a technique in which temperature of a substance is measured as a function of (its own!) temperature", which is an evident nonsense. In the same Table, column 1, we find: "Mass", "Dimensions". But mass and dimensions are not "properties of a substance", these are properties of a given sample, and this is far from being the same, therefore, here again the contradiction to the above definition (/3/, p.18) is observed. This can not be anything but misunderstanding.

The Soviet National Committee on Thermal Analysis has accepted the following definition /4/:

1. Thermal Analysis (TA) is a method of investigation of transformations¹ in a substance from changes in heating (cooling) rate, caused by heat evolution or absorption², whilst the substance is subjected to a continuous programmed temperature change. By means of TA the fact of transformation and its temperature (temperature range) are determined, as well as the sign and the relative value of the transformation thermal effect; and transformation time are obtained.

2. Varieties of TA

2.1. Heating (cooling) curves determination (Direct TA) is a

technique in which the temperature of a substance is measured as a function of time.

2.2. Differential Thermal Analysis (DTA) is a technique in which the temperature difference between the substance under investigation (the sample) and the reference material is measured³.

2.3. Derivative Thermal Analysis is a technique in which the rate³ of heating (cooling) of a sample, dT/dt or its inverse value, dt/dT is measured⁴.

2.4. Multiple Thermal Analysis is a technique in which something else is measured simultaneously with performing one or more of above mentioned TA varieties (not only a physical property of a substance, but gas effluent, mass of the sample, etc. as well)⁵.

This definition may be assumed as a basis for the discussion to elaborate an acceptable definition for "Thermal Analysis".

NOTES

1. A transformation of any nature: physical, physico-chemical, chemical reactions both in the sample and between the sample substance and its environment as well.

2. I.e. enthalpy changes caused by the transformation taking place at that moment in the substance under investigation.

3. As a function of time or of the sample temperature.

4. Thus, there are only three varieties of "pure" TA: direct TA, differential TA and derivative TA.

5. It is said that the works and workers dealing with property changes when a substance is heated should not be excluded. Well, we include them in this paragraph 2.4, but not in the general definition of "Thermal Analysis".

REFERENCES

- 1 W.D. Kingery, Property Measurements at High Temperatures. Wiley, New York, Chapman & Hall, London 1959
- 2 Энциклопедия неорганических материалов. Том 2. Главная редакция Украинской Советской энциклопедии, Киев 1977
- 3 G. Lombardi, For Better Thermal Analysis. ICTA, Rome 1980
- 4 Журнал неорганической химии 29 (1984) 2170