Journal of Thermal Analysis, Vol. 35 (1989) 2065–2067

Book Review

INTRODUCTION TO THERMAL ANALYSIS/ TECHNIQUES AND APPLICATIONS

Brown, Michael E.

211 + x pages, hard cover, £ 17.50, Chapman and Hall, London, New York, 1988.
ISBN 0–412–30230–6, index

The preface sets out the aim of the book "to help someone with little or no knowledge of what thermal analysis can do". This goal is admirably reached in the 17 well written, short chapters and three appendices (number of pages in parentheses): Introduction (4), Thermal events (2), Thermogravimetry (16), DTA and DSC (17), Thermooptometry (6), Thermodilatometry (7), TMA (6), DMA (12), Combinations (5), EGA (13), Less-common techniques (18), Microcomputers (19), Reaction kinetics (25), Purity determination using DSC (11), Literature and nomenclature (5), Thermal analysis equipment (2), Conclusions (1), Introductory experiments (4), Thermal Analysis software (29), and Explanation of the symbols (2). The book is well produced, remarkably free of miss-prints (I found only one on pg. 204) and illustrated with 116 figures and 10 tables of about 1/2 page each. Reference to the literature is made in 240 citations, mainly to other textbooks, the J. Thermal Analysis, Thermochim. Acta and the *Proc.* of the various ICTA meetings.

The approach in this book is very basic, to the result of occasional slight inaccuracies. Some examples are: pg. 3 "If the intramolecular forces are weaker than the intermolecular forces, the substance many decompose..." (Decomposition is *only* governed by ΔG of the process, and intramolecular forces are *always* stronger then intermolecular forces); Table 2.1, listing possible thermal events, is rather incomplete; pg. 23 in the description of DTA, furnace and reference temperature are assumed to be about equal, while in reality they are quite different and only the heating rates of furnace and reference are equal after steady state is reached; pg. 32 "Abrupt changes in slope or position of the baseline usually indicate second-order transitions. Examples of this type of transitions are the glass transition in polymers..." (A baseline-slope change can only give rise to a third-order transition and since the *order* of a transition is a term from equilibrium thermodynamics, the glass transition, as a non-equilibrium, kinetic change, can at

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best *resemble* a second order transition under the stringent conditions of close to equal cooling and heating rates); pg. 35 "Exostermic processes are not usually readily reversible, if at all, in contrast to melting and many solid-solid transitions." (Any reversible transition is endothermic in one direction and exothermic in the other, i.e. reversibility cannot be judged in this way. In addition, there is usually a distinct supercooling on crystallization and solid-solid transitions, so that melting and solid-solid transitions can *not* be considered as readily reversible, especially not in the field of polymers); pg. 45 "Most polymers... are thus initially in the glassy state." (This is not true, crystalline polymers are quite frequent, how else could Fig. 4.20, that shows the identificaton of six polymers in a mixture via their melting temperature, be useful?); pg. 63 "Thermodilatometry is carried out by measuring expansion and contraction under negligible loads." (This is not a good definition. The condition is constant hydrostatic load, either atmospheric pressure or higher pressure, to establish pVT-diagrams.)

The selection of instruments chosen to illustrate the various techniques is adequate, although even in the year of publication, it was already out-of-date. A minor problem, if one knows that the principles of the techniques have not changed. Very much out-of-date is the chapter microcomputers that refers in its hardware section to a book dating from 1981. Much has changed since then. The appendix with the simple software printout is similarly dated. In our laboratory we had, since introduced a similar set of programs in 1975. [*J. Thermal Anal.* 13, 71 (1978)], to update twice with considerable loss of time and money. I would not recommend the same route to anyone else, in particular since the more modern computers and programs are not necessarily more expensive.

A major complaint about the book is that in the selection of examples, usually illustrated with a thermal analysis curve, the conditions of the experiments are missing. Heating rate, mass, sample condition, thermal history, instrument type, etc. are usually omitted, neglecting thus one of the important teaching functions the book should have had.

Two chapters, one on *reaction kinetics* and one on *purity determination,* go beyond the basic level of the book and transmit the proper flavor of the problems of thermal analysis. Both chapters are, however, almost entirely illustrated with computed curves and not actual measurements.

Returning to the beginning of the book, one can get an answer to the question posed in the introduction: "What do bread and chocolate, hair and finger-nail clippings, coal and rubber, ointment and suppositories, explosives, kidney stones and ancient Egyptian papyri have in common?" As such, it is a valuable book and should be in the hand of everyone who needs a quick, first overview of the field. It is hoped that reading this book leads then to a deeper study of *thermal analysis*

"... the measurement of changes in physical properties of a substance as a function of *temperature* whilst the substance is subjected to a controlled temperature programme."

Bernhard Wunderlich
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