
Book review

Handbook of Thermal Analysis and Calorimetry, Volume 2, Applications to Inorganic and Miscellaneous Materials, by Michael E. Brown and Patrick K. Gallagher (Editors). Elsevier B.V., Amsterdam, 2003, 905 pp, ISBN 0 444 82086 8

Thermal analysis and calorimetric methods have grown enormously in potential during the last decades resulting in practical applications of highly interdisciplinary nature. This book as the second part of a four-volume series summarizing state-of-the-art achievements in the field gives a most readable account of the progress made in the synthesis and characterization of inorganic materials organized in 15 chapters.

Chapter 1 (by P. L. Llewellyn) gives a brief survey of calorimetric methods used for adsorption and surface chemical studies, including immersion calorimetry, thermoporometry, and adsorption microcalorimetry. The discussion of SCTA techniques used to characterize the surface chemistry of catalysts and adsorbents completes the list of available methods.

Chapter 2 (by M. Odlyha) describes the contribution of thermal analysis to the preservation of art and archeological objects. The advantages and limitations of TA techniques are demonstrated through case studies. In addition to the characterization of materials and objects, attention has been devoted to the application of TA techniques for the evaluation of the effect of conservation treatments, a well.

Chapter 3 (by P. Phang and D. Dollimore) is devoted to the use of TG and DSC for the characterization of the various forms of carbon and carbon-containing composites, while Chapter 4 (by B. Pawelec and J. L. G. Fierro) deals with the application of TA in catalysis, an important field of science that contributed enormously to modern chemical technology. The complicated procedure of catalyst preparation and testing as well as the understanding of the thermodynamic, mechanistic and kinetic aspects of catalytic processes rely on the use of thermal methods, as well. While a great emphasis is placed on the use of thermogravimetry (and microcalorimetry in general), the necessity to combine microbalance, surface analysis and evolved gas analysis techniques is demonstrated elegantly through the discussion of application examples.

The inherent use of thermal treatment in the production of ceramics, glass and inorganic electronic mate-

rials makes the application of TA methods obvious in the evaluation of their composition, properties and reactivity. Chapter 5 (by P. K. Gallagher and J. P. Sanders) is devoted to a representative study of the synthesis, phase equilibria, solid-state reactivity and physical properties of these important materials via the use of TA techniques. The practical examples involving the use of complementary techniques represent the enormous diversity of applications in this important field.

Chapter 6 (by K. S. Meyers and R. F. Speyer) gives an overview of clay minerals with particular respect to their practical applications and thermal behaviour based especially on DTA studies.

The use of thermal analysis in the research and development of latent heat energy storage (Chapter 7 by T. Ozawa and M. Kamimoto), and that in the stability investigation of explosives (Chapter 8 by J. C. Oxley) opens new horizons especially in DSC and TGA applications.

Chapter 9 (by M. V. Kok) gives a survey of the application of TA methods in the study of fossil fuels. The chapter is focused on the description of pyrolysis, combustion and decomposition characteristics with special emphasis on kinetic analyses.

Chapter 10 (by H. J. Seifert) deals with a broad range of general inorganic and coordination compounds. The theoretical background of calorimetric methods and the thermodynamic properties of inorganic compounds are discussed in brief contributing substantially to the understanding of the thermal behaviour of binary and three-component systems on heating and to the preparation of phase diagrams. The application examples of TGA, TMA and miscellaneous methods in the field makes this review even more comprehensible.

The discussion of the application of TA methods in geosciences is one of the longest chapters of this book (Chapter 11 by W. Smykatz-Kloss, K. Heide and W. Klink). Since "geoscience is the cradle of thermal analysis", this is understandable. Following a brief review of the aspects of thermodynamics and kinetics, the influence of structural disorder on the thermal effects is discussed in details and the technical importance of minerals is emphasized. Another strong point of this chapter is the collection of a great amount of useful experimental data condensed in 30 tables.

Chapter 12 (by A. K. Galwey) on the dehydration of crystalline hydrates predominantly concerned with fundamental studies of water elimination reactions including characterization of the controls of reactivity as well as the discussion of kinetics and mechanism. The dehydration reactions of more than 20 compounds are discussed in detail.

The growing attention to the use of thermal analysis in metallurgy justifies the extent -118 pages- of Chapter 13 (by S. A. Mikhail and A. H. Webste.). In addition to summarizing the theoretical background of equilibrium phase diagrams, phase transitions and transformations involving non-equilibrium phases, the thermal behaviour of the most important systems of practical importance are surveyed. Special attention is paid to the use of the DSC technique for the description of solid-solid and solid-liquid transformations of alloys, why the usefulness of TGA is emphasized in the study of high-temperature oxidation and corrosion processes of metals and alloys. Special applications like the use of TGA under a magnetic field (thermomagnetometry) for the study of the changes of magnetic properties as a function of the temperature, the study of mechanochemically milled alloys and thin films makes the chapter even more attractive to the reader.

Chapter 14 (by E. L. Charsley, P. G. Laye and M. E. Brown) provides an excellent overview of pyrotechnics, a rather unique field for the use of TA methods. The main goal of TA studies is the understanding of the combustion process, but hazard evaluation, compatibility testing and life-time predictions have been in the center of interest, as well. The chapter is richly illustrated with practical examples, and the use of complementary methods to understand e.g. the role of additives or the mechanism of ageing is also emphasized.

The last part of the book (Chapter 15 by J. Valo and M. Leskelä) is devoted to thermoanalytical studies of high temperature superconductors. The most important topics covered are the thermal decomposition of precursors used in the syntheses, the formation and stability of the superconducting phases, and the analysis of oxygen stoichiometry. Practical examples on the most important types of high temperature superconductors are given based on the use of TGA and DTA, but the potential of other techniques like EGA, ETA, and high temperature XRD are also emphasized. The study of the preparation and the properties of superconducting thin films is an important part of the chapter.

The book written by recognized experts of each particular area is of very high standard and contains detailed scientific information. The clarity and style as well as the wealth of illustrations make the book an enjoyable reading. This is the book which should be on the shelf of every scientist dealing with inorganic chemistry and materials science.

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