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Book Review

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Comprehensive handbook of calorimetry and thermal analysis

Wiley, 2004,
534 pp; price 185 euro
ISBN 0-470-85152-X

The book is an updated English language edition of a 1998 Japanese text edited by The Japan Society of Calorimetry and Thermal Analysis. The Japanese have a strong interest in this area and all 90 contributors appear to be Japanese, with only three not based in Japan. However, a high proportion of the over 600 references are in non-Japanese publications and have non-Japanese authors. They include many post-1998 references.

Part I of the book deals with the principles of calorimetry and thermal analysis. Part II surveys modern experimental methods in these areas over a range from liquid helium temperatures to 8000 K. This part reflects modern advances in methodology such as microthermal analysis by scanning probe microscopy and micromechanical calorimetry. Part III deals with data analysis. Part IV covers the use of the modern thermodynamic database and will be welcomed by all whose interest is in applying thermodynamic and related data rather than measuring it. The application of chemical potential diagrams regarding the stability of selected elements or compounds in given chemical environments has been well developed for high-temperature materials, corrosion and geology, but stability of solid–solid interfaces and the reactive diffusion path is relatively new. Material compatibility is important for modern electrochemical devices such as solid oxide fuel cells, batteries and sensors. Thermodynamic data on the conformational stability of proteins are essential for understanding protein folding and stability and for design of desirable proteins. Databases for wild-type and mutant proteins contained 15 300 thermodynamic data for 470 proteins (about 6000 for wild type and 9300 for mutant) in March 2004 and the rate of increase was reported as 2000–3000 per year. Protein–nucleic acid interaction thermodynamic data are needed to understand gene regulation processes and the ProNIT database contained over 3800 data for 190 proteins as long ago as 2000.

All physical and chemical changes are accompanied by the adsorption and emission of heat and the direction of those changes can be quantified only by change in the Gibbs free energy. Microcalorimetry with 10 000 times the sensitivity of differential scanning calorimetry can be applied over an impressively wide range of problems and the final section (Part V) begins with actual applications of the methodology to metals and alloys, inorganic materials and ceramics and organic materials and polymers. The section continues with examples of applications to biomaterials such as thermal stability of mutant lysozymes, providing a guide to enhancing protein stabilization by amino acid substitutions and applying isothermal titration calorimetry to measure fungal cellulase activity without need for an alien spectroscopic probe in the substrate. Applications to medicines follow, including long-term stability of drugs with a 17 year half-life determination in 3 h and drug interactions with human blood. Applications to food and biomaterials including establishing conditions for long-term preservation of genetic material in plant material complete this section.

Five useful appendices on temperature scales, thermocouple characteristics reference standards, symbols and notations and result presentation complete a book which is well worth consulting both by specialists and those who have not yet thought of applying the techniques.

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