

Book Review

THERMAL ANALYSIS

by Bernhard Wunderlich

Academic Press, 1990, 464 pp. Price \$49.50.

Professor Wunderlich has written a truly unique text on thermal analysis, as only he can do. This book is for all students and practioners of thermal analysis, be they undergraduate students, graduate students, teachers, or professional scientists or engineers. The subject is described in seven chapters starting with the relevant thermodynamic and kinetic theories and covering five basic techniques, thermometry, differential thermal analysis, calorimetry, thermomechanical analysis and dilatometry, and thermogravimetry. A common theme throughout this book is the quantitative linking of macroscopic measurements and microscopic origins. Each technique is treated from basic principles and historic perspective to instrumentation and applications, with most applications coming from the field of macromolecular science. Extensive references are given throughout which allow the reader to dig into specific topics if desired. Problems are given at the end of each chapter to reinforce the subject matter; solutions to numerical problems are given at the end of the book. This text contains a unique presentation of figures, equations and brief summaries on separate pages of *blackboard material* which simplifies review by the student and allows the teacher to prepare overhead foils. The book serves as an aide in the study of thermal analysis by illustrating numerous applications, reviewing instrumentation and techniques, and presenting the theory which forms the basic for interpretation and application. The topics are treated such that each represents a separate point of entry into the book. As Professor Wunderlich illustrates with several samples in the Preface, a person may tailor his or her use of this book to specific objectives, e. g. for a complete understanding of thermal analysis from the ground up; for sufficient background to set up and run a thermal analysis laboratory; or for the experienced thermal analyst to "brush up". Prerequisites for the study of this book have been kept to a minimum some knowledge of undergraduate chemistry and materials science.

The book begins with an **Introduction** which is filled with many historical perspectives on, for example, thermometry, calorimetry and the states of matter. Relevant background

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material on physical chemistry, thermodynamics and kinetics is reviewed with simplicity and clarity. It continues to **The Basis of Thermal Analysis** where the theories of equilibrium thermodynamics, irreversible thermodynamics and kinetics are presented, providing the foundation for the practice of thermal analysis. **Thermometry** contains a discussion of the simple and oldest of the thermal analysis techniques, including a summary of the international temperature scale and temperature measuring techniques. Professor Wunderlich argues convincingly for the value of simple yet precise time-temperature measurements. The discussion in **Differential Thermal Analysis** centers on the derivation of the flow of the heat from measurement of the temperature difference between a reference material and the sample; DTA is treated as the global term covering all differential thermal techniques, while DSC is reserved for the DTA that yields calorimetric information. This chapter abounds with excellent description of modern instrumentation, calibration and standardization techniques and analysis of DTA melting and glass transition curves. **Calorimetry** describes the effort to measure heat directly. The discussion focuses on specific calorimeters: isothermal and isoperibol, adiabatic, compensating, and twin and scanning. This chapter contains an excellent presentation of calorimetric data. **Thermomechanical Analysis and Dilatometry** covers the basic functions of these measurements, i. e. length and volume dependencies on stress, pressure and temperature, and also dynamic mechanical analysis which includes the additional variable of time dependency. In **Thermogravimetry** Professor Wunderlich describes the evolution to modern instrumentation, qualitative thermogravimetry and quantitative thermogravimetry, i. e. measurements yielding kinetic information. He emphasizes the value of simultaneous measurement of thermogravimetry and DTA for complete material characterization.

The stated goal of this book is "to help the reader along the road to becoming a professional thermal analyst". In this reviewer's opinion this goal has been met and far exceeded in this first of a kind text on thermal analysis.

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