Thermal Physics

Thermodynamics and Statistical Mechanics for Scientists and Engineers

Robert F. Sekerka

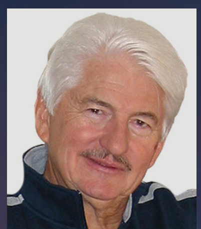
University Professor Emeritus, Physics and Mathematics, Carnegie Mellon University

A comprehensive exposition of thermodynamics and statistical mechanics serving as a complete single source for thermal science

The fundamental laws of thermodynamics are stated precisely as postulates and subsequently connected to historical context and developed mathematically. These laws are applied systematically to topics such as phase equilibria, chemical reactions, external forces, fluid-fluid surfaces and interfaces, and anisotropic crystal-fluid interfaces. Statistical mechanics is presented in the context of information theory to quantify entropy, followed by development of the most important ensembles: microcanonical, canonical, and grand canonical. A unified treatment of ideal classical, Fermi and Bose gases is presented, including Bose condensation, degenerate Fermi gases, and classical gases with internal structure. Additional topics include paramagnetism, adsorption on dilute sites, point defects in crystals, thermal aspects of intrinsic and extrinsic semiconductors, density matrix formalism, the Ising model, and an introduction to Monte Carlo simulation. Throughout the book, problems are posed and solved to illustrate specific results and problem-solving techniques.

KEY FEATURES

- Includes applications of interest to physicists, physical chemists, and materials scientists as well as materials, chemical, and mechanical engineers
- Suitable as a textbook for advanced undergraduates and graduate students, and as a reference for practicing researchers
- Develops content systematically with increasing order of complexity
- Self-contained, including nine appendices to handle necessary background and technical details



Robert Floyd Sekerka is University Professor Emeritus, Physics and Mathematics, Carnegie Mellon University. He received his bachelor's degree summa cum laude in physics from the University of Pittsburgh in 1960 and his AM (1961) and PhD (1965) degrees from Harvard University where he was a Woodrow Wilson Fellow. He worked as a senior engineer at Westinghouse Research Laboratories until 1969 when he joined the faculty of Carnegie Mellon in the Materials Science and Engineering Department; he was promoted to Professor in 1972 and was Department Head from 1976–82. He served as Dean of the Mellon College of Science from 1982 through 1991. Subsequently he was named University Professor of Physics and Mathematics with a courtesy appointment in Materials Science and Engineering. He retired in 2011 but continues to do scientific research and writing. He is a Fellow of the American Society for Metals, the American Physical Society, and the Japanese Society for the Promotion of Science, and a consultant to NIST for over forty years. Honors include the Phillip M. McKenna Award, the Frank Prize of the International Organization for Crystal Growth (President for six years) and the Bruce Chalmers Award of TMS.

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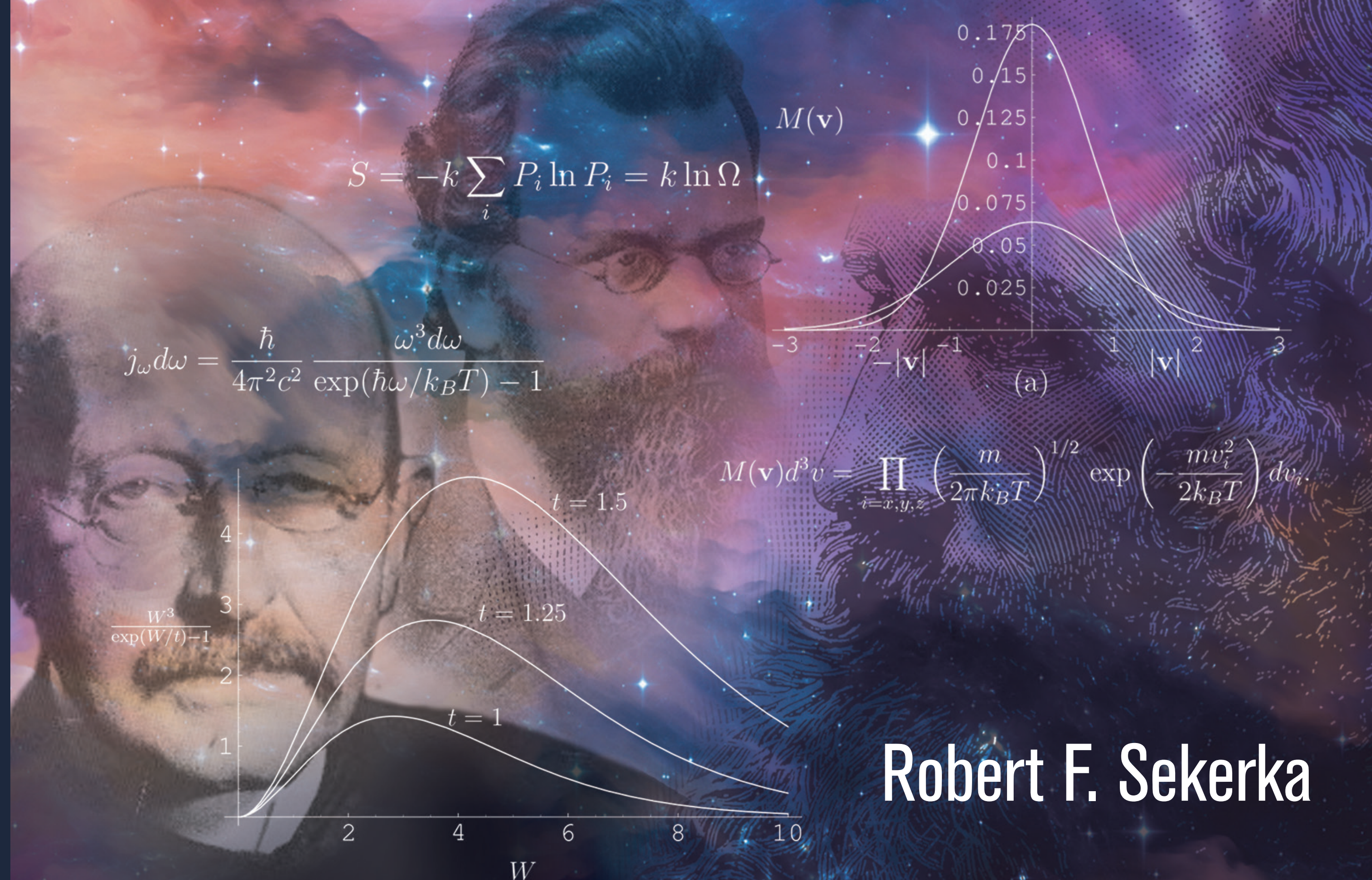

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