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A Review of "The Physical Chemist's Toolbox"

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Book Review

The Physical Chemist's Toolbox by Robert M. Metzger, John Wiley & Sons, Inc., 2012, ISBN 978-0-470-88925-1, vii + 949 pp., $165.00.

Metzger has written a very unique and exciting book. It will serve as an excellent reference for university and college professors who teach the subject and for researchers in physical chemistry and materials science. Less clear is where it could be used in the curriculum. The great strength of this book is that it discusses modern applications and examples of traditional physical chemistry topics, but its limitation, naturally with such a broad range of coverage, is that it cannot go into great depth into any of them.

The book begins with a brief review of physics and mathematics. This includes topics such as Fourier transforms, statistics, atomic structure, electromagnetics, and optics. This is a real highlight of the book, especially the treatment related to the basics of ellipsometry. Subsequent chapters summarize key results of quantum mechanics (Chapter 3), thermodynamics (Chapter 4), statistical mechanics (Chapter 5), kinetics, equilibria, and electrochemistry (Chapter 6), group theory and crystallography (Chapter 7), and solid-state physics (Chapter 8). The general philosophy followed by the author is to present the key starting and final equations related to a topic and to point the reader toward the steps that would be used to fill in the gaps. This is a reasonable approach, and achievable by anyone who has had undergraduate calculus-based physics and physical chemistry.

Chapter 9 presents a succinct summary of electronics and computers, and to its credit provides historical, as well as modern, practical information. For example, a figure and discussion related to the first transistor is provided. Somewhat less useful are included Fortran programs and instructions for accessing different computer accounts. Chapter 10 presents an excellent summary of light-emitting sources (e.g., lasers), detectors, sensors, and electron energy analyzers. Chapter 11 provides an overview of analytical instrumentation (e.g., mass spectrometers, infrared spectrometers, and calorimeters), and Chapter 12 attempts to summarize recent developments in organic superconductors, carbon-based electronics, and molecular electronics.

In many ways, this book has the flavor of the classic *Building Scientific Apparatus* by Moore et al., except that it is perfect for physical and materials chemists instead of those attempting to build and design scientific equipment. While it certainly will be a favorite reference book for practicing physical chemists, it would be a perfect textbook for a one or two semester graduate course in Advanced Physical Chemistry in which a wide range of topics, including spectroscopy and instrumentation, are covered. Each chapter contains a number of problems that help to reinforce the discussion. In summary, the book is exactly as its title says: an excellent reference resource or "toolbox" for those working in the field. It will likely become a classic in its own right.

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