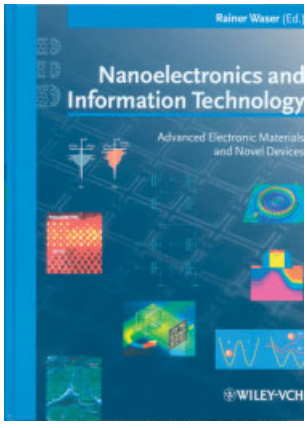
ADVANCED MATERIALS

Book Reviews

Rainer Waser (Ed.)

Nanoelectronics and Information Technology

Advanced Electronic Materials and Novel Devices. Wiley-VCH, Berlin 2003, 1001 pp., hardcover, Euro 74.90, ISBN 3-527-40363-9.



As nanoelectronics and information technology is a very broad and fast-developing field, it is not easy to come up with a good textbook that will last. The editor and contributing authors obviously did an excellent job in compiling this book. The volume focuses on the fundamental concepts and key technologies related to advanced electronic materials and devices, which are illustrated and explained using the latest materials and devices. The physics, chemistry, materials science, and device physics presented in this book will still be valuable even when future technology surpasses today's wildest imaginings. Primary target readers of this book are graduate students in physics, electrical engineering, and materials science, and researchers who are interested in entering the fields of advanced electronic materials and devices. Experts in the relevant fields would also find the book useful in refreshing their memories on fundamentals and principles as well as learning about other sub-fields.

This book—whose content is better described by the subtitle: advanced electronic materials and novel devices—is composed of forty chapters (20–30 pages per chapter), grouped into eight sections. The first section, "Fundamentals", comprises seven chapters, six focusing on physical properties of electronic materials: dielectrics, ferroelectrics, electronic properties and quantum effects, magnetoelectronics, electronic organic molecules, and neurons. The last chapter in the first section is on circuit and system design. Five chapters in the second section, "Technology and Analysis", focus on material processing and characterization methods that are most relevant to device fabrication: film deposition, lithography, etching and chemical mechanical polishing, diffraction and fluorescence methods, and scanning probe techniques. The remaining 28 chapters discuss various devices and relevant materials used in device fabrication, and are grouped into six sections based on the primary functionalities of the devices: logic devices, random access memories, mass storage, data transmission, sensors, and displays. Eight chapters on logic devices introduce devices with new materials, such as ferroelectrics, superconductors, and carbon nanotubes, that are integrated into the silicon-based semiconductor technology. The section on random access memories comprises three chapters based on three groups of materials: high permittivity oxides, ferroelectrics, and magnetoresistive materials. The next four chapters ("Mass Storage Devices") review the current materials and devices for the state-of the-art technologies: hard disc drives, magneto-optical discs, rewritable DVDs based on phase-change materials, and holographic data storage, and the fifth chapter in this part presents new concepts for three-dimensional (3D) and nanoscale data storage devices. Four chapters on data transmission focus on interfaces and system integration: transmission on chip and board level, photonic networks, microwave communication systems, and neuroelectronic interfaces. Four chapters on sensors describe optical 3D time-of-flight imaging system, pyroelectric IR imaging arrays, electronic noses, and 2D tactile sensors. The last part of the book summarizes various display technologies: liquid-crystal displays, organic light-emitting devices, field-emission and plasma displays, and electronic paper.

This is a well-written textbook covering a very broad spectrum of topics related to materials and devices. The editor brought together an impressive group of experts to write on their own fields. Therefore, it is not surprising that each chapter provides a concise yet in-depth and comprehensive description of fundamentals and key technologies in a given topic. It is also highly commendable that all chapters are well coordinated so that there is neither obvious repetition nor omission of significant materials and technologies. The book is very well structured. Each section starts with a general introduction to prepare readers with general background and concepts as well as a guide to the following individual chapters.

Each chapter starts with a brief introduction to the most basic fundamentals and quickly leads the readers to the topic of the chapter. So readers having no specific background in a given topic but with a good knowledge of general physics, chemistry, materials science, and device physics can read the book without the need to find and finish other books first. Each chapter is self-contained on a given topic and provides a complete set of information. Mathematics and equations are kept to a minimum; a great many colored schematic drawings are used to illustrate and explain fundamentals and key concepts, which is particularly valuable for self-study. Examples from contemporary literature are presented to demonstrate the state-of-the-art development of technologies. The authors are very conscientious about

references; there is no excessive list of publications.

It is obviously not possible for a book to cover in a balanced way all the topics in nanoelectronics and information technology. This book significantly emphasizes devices over materials. Although processing and properties of various materials are described, discussion is often embedded in device fabrication, except in the first six chapters. In spite of very readable text, it is a challenge for anyone to finish reading the entirety of this volume—not only because the coverage of topics is very broad, but also because a wide range of basic knowledge is required to understand the fundamentals and key technologies presented in the book. I am very happy to have this book in my office and have learned a great deal by reading through it; I am sure that I shall consult this book frequently for both research and teaching.

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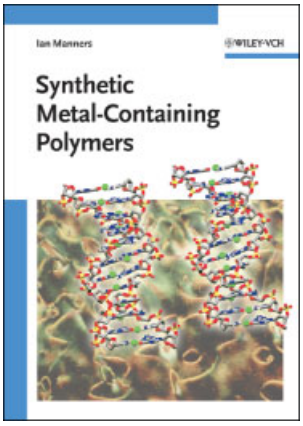
Ian Manners

Synthetic Metal-Containing Polymers

Wiley-VCH, Weinheim 2003,
xiii + 275 pp., hardcover, Euro 149.00,
ISBN 3-527-29463-5.



Synthetic Metal-Containing Polymers by Ian Manners is a highly topical treatise covering broadly the subject of polymers that contain main-group and transition-metal elements. As the title indicates, the focus is generally on the synthesis of these materials; however, the nature of this area dictates that properties and applications are equally important, and these significant aspects are also described in the book. The incredible structural variation in polymers that take advantage of all the periodic table has to offer is stunningly clear, and it is apparent that full exploration of the properties of these materials must keep pace with the synthetic explosion that has occurred.

The book begins with an introduction to polymer science and chemistry that allows the uninitiated reader to come up to speed quickly, and makes the volume useful for novices as well as experts in the area. The motivations for incorporation of metals into polymer structures are discussed, and a brief section describing the historical development of the field is included. Subsequent chapters cover all the major areas, including side-chain metal-containing polymers, polymetallocenes, main-chain metallopolymers, and metallodendrimers; overall the field is represented extremely well with a great many of the synthetic materials described in some detail. Throughout, molecular weights are included where possible, and relevant properties such as absorption wavelengths, conductivities, magnetic properties, thermal properties, and morphology are all discussed. The section on ring-opening polymerization and polyferrocenylsilanes, developed in large part by Manners himself, is particularly well written and includes some visually stunning images of microspheres and copolymer films that have been made from this class of materials. The only missing feature in the book that would perhaps be appreciated by the reader is a summary chapter pointing out new directions for the field. Coming from an expert such as Manners, this would have been insightful. However, close reading does reveal that future directions, areas of controversy, and areas needing work are identified throughout. The writing style is clear and concise, the introduction gentle but complete, and the illustrations appropriate and useful. The work described is up-to-date, and the referencing is complete.

Although aspects of the book have previously appeared in reviews and book chapters by Manners and others, this is the first comprehensive collection of the work that has been done. For any worker in this field, Manner's *Synthetic Metal-Containing Polymers* will be indispensable, and for anyone interested in the area it will serve as an outstanding resource.

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