Electronic Materials

From Silicon to Organics

Electronic Materials

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Springer Science+Business Media, LLC

Library of Congress Cataloging-in-Publication Data

Electronic materials : from silicon to organics / edited by L.S.
Miller and J.B. Mullin.

p. cm.

Includes bibliographical references and index.

ISBN 978-1-4613-6703-1 ISBN 978-1-4615-3818-9 (eBook)

DOI 10.1007/978-1-4615-3818-9

1. Electronics--Materials. I. Miller, L. S. II. Mullin, J. B.

TK7871.E437 1991

621.381--dc20

91-11190

CIP

ISBN 978-1-4613-6703-1

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Originally published by Plenum Press, New York in 1991

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Preface

Electronic materials are a dominant factor in many areas of modern technology. The need to understand them is paramount; this book addresses that need. The main aim of this volume is to provide a broad unified view of electronic materials, including key aspects of their science and technology and also, in many cases, their commercial implications. It was considered important that much of the contents of such an overview should be intelligible by a broad audience of graduates and industrial scientists, and relevant to advanced undergraduate studies. It should also be up to date and even looking forward to the future. Although more extensive, and written specifically as a text, the resulting book has much in common with a short course of the same name given at Coventry Polytechnic.

The interpretation of the term “electronic materials” used in this volume is a very broad one, in line with the initial aim. The principal restriction is that, with one or two minor exceptions relating to aspects of device processing, for example, the materials dealt with are all active materials. Materials such as simple insulators or simple conductors, playing only a passive role, are not singled out for consideration. Active materials might be defined as those involved in the processing of signals in a way that depends crucially on some specific property of those materials, and the immediate question then concerns the types of signals that might be considered. This has been interpreted very generally, in particular to include optical as well as electronic functions, but also to include chemical sensing (though other sensor types would also have been of interest if space had permitted).

Having defined the range of functions that the materials under consideration might have, it becomes necessary to consider whether restrictions should be placed on the types of materials to be considered for those functions. From the outset, the view was taken that organic materials, already dominant for displays, may well bring about the greatest revolution in electronic materials since silicon, and attention is specifically given to organics in many of the chapters. It therefore becomes of interest to discuss both simple and compound semiconductors and both inorganic and organic materials.

In terms of the range of relevant science and technology, again a broad interpretation has been used. The chemistry, physics, and materials science relating to fabrication and processing steps, material properties, and device properties are all considered of relevance. Commercial, historical, and other aspects were also considered of interest.

There is then the question of the ordering of the material. Here the decision has been taken to begin with some important aspects of the basic science relevant

to a wide range of electronic and optical materials and devices (though this does not include organics), then to look at some key devices in the light of this science. This provides pointers to the material types of greatest interest, and is followed by chapters discussing principally the science and technology of semiconductors, electrophotographic receptors, and nonlinear optical materials and liquid crystals. These are all areas considered to be of clear present or early relevance. Additional chapters discuss high-temperature superconductors, Langmuir-Blodgett films, electrically conducting polymers, and photochromics as examples of areas expected to play an important role in the medium term. Finally, three chapters on chemical (principally gas) sensing materials (and applications) reflect their present relevance and great future importance. But there is a good additional reason for putting sensors at the end: for many of them a proper treatment requires an understanding of much of what has gone before; they are a perfect example, true to a significant extent for many of the areas discussed in this text, of the need for scientists and technologists with wide-ranging knowledge and expertise to work together if the many new and exciting possibilities are to be properly realized.

Finally, of course, it has to be said that in a book of this scope there are bound to be omissions. Any attempt to be encyclopedic would have increased the book's length (and price) manyfold. This brings us to another organizational aspect: to give authors moderate freedom concerning the level of technical or scientific difficulty, whether they discussed commercial relevance, and so on. In this way, we have achieved a text which spotlights all these aspects in certain ways, and we hope gets across the overall scope and excitement, for the scientist, for the technologist, for the educationalist, and for the business man, of this demanding area of human endeavor.

L. S. Miller
J. B. Mullin

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