The interaction between light and electrons in semiconductors forms the basis for many interesting and practically significant properties. This book examines the fundamental physics underlying this rich complexity of photoelectronic properties of semiconductors, and will familiarise the reader with the relatively simple models that are useful in describing these fundamentals. The basic physics is also illustrated with typical recent examples of experimental data and observations.

Following introductory material on the basic concepts, the book moves on to consider a wide range of phenomena, including photoconductivity, recombination effects, photoelectronic methods of defect analysis, photoeffects at grain boundaries, amorphous semiconductors, photovoltaic effects and photoeffects in quantum wells and superlattices. The author is Professor of Materials Science and Electrical Engineering at Stanford University, and has taught this material for many years. He is an experienced author, his earlier books having found wide acceptance and use. This book represents, as much as any one book can, his 44 years of research to date.

Readers will therefore find this volume to be an up-to-date and concise summary of the major concepts, models and results. It is intended as a text for graduate students, but will be an important resource for anyone researching in this interesting field.

Photoelectronic properties of semiconductors

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*Ever since the creation of the world
His invisible nature, namely, His eternal
    power and deity,
has been clearly perceived
in the things that have been made.*

Romans 1:20–(RSV)

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Preface

My earlier book, *Photoconductivity of solids,* published in 1960 and subsequently in print for 26 years, attempted to describe all of the previous work related to photoconductivity or any of its associated phenomena. From the response that it evoked it appears that this attempt was reasonably successful.

But the field continued to expand rapidly. If a thousand references were adequate to describe almost a century from Willoughby Smith's discovery of photoconductivity in selenium in 1873, tens of thousands of references have been added in recent years. A representative bibliography of books and reviews is included at the end of the text. In 1976 when *Photoconductivity and related phenomena,* edited by J. Mort and D. Pai was published, fifteen authors contributed to cover a wide variety of solids in addition to crystalline semiconductors, like molecular crystals, amorphous materials, polymeric photoconductors, and non-polar liquids, which had been mentioned either not at all or very little in *Photoconductivity of solids.* It is no longer possible for a single, reasonably long monograph to provide a complete discussion of the whole field.

So it is not the purpose of this book even to attempt to give an exhaustive treatment of all photoelectronic phenomena in semiconductors. Rather it is the purpose to provide a look at the fundamentals that underlie the rich complexity of phenomena, to provide the reader with some familiarity for relatively simple models that are useful in describing these fundamentals, and to give typical recent examples of experimental data and observations that illustrate them. The present book deliberately chooses to limit itself to photoelectronic properties of semiconductors, still a very large and rapidly growing field indeed,

especially when one realizes the potential of low-dimensional structures such as quantum wells and superlattice structures.

It has been a special thrill for me to be able to write this book, in a kind of way reliving and at the same time updating my professional research career. My purpose in writing the book is facilitated by the fact that for the past 30 years I have been teaching courses related to this subject area at Stanford University. I would like to express my gratitude toward all those friends and colleagues through the years who have contributed to my progress, and to all of my students (Ph.D. No. 50 graduated in 1990) involved in research with me, as well as to those many more who interacted in the courses taught at Stanford and thereby directly or indirectly contributed to the material of this book.

I was in the midst of the task of writing the book, when I learned of the death of Dr Albert Rose, who was my professional mentor and friend particularly during the 14 years I spent at the RCA Laboratories. I wish to acknowledge my special indebtedness to him.

My beloved wife Betty was by my side through the writing of the original *Photoconductivity of solids,* and I thank God that I have had her unfailing love and support through all the intervening years.

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