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Semiconductors Probed by Ultrafast Laser Spectroscopy, Volumes I and II

Edited by R. R. Alfano

(Academic Press)

This two-volume set presents a new review of recent progress in understanding the ultrafast (nanosecond to picosecond and faster) electronic processes in semiconductors. It summarizes work in a field which has expanded rapidly in the past decade. The text focuses on ultrafast semiconductor physics from both theoretical and experimental viewpoints. Because of the narrower focus of this review, it is unique from previous reviews such as *Ultrashort Light Pulses*, (edited by S. L. Shapiro, Springer-Verlag, New York, 1977), even though discussions of many of the experimental techniques are very similar. There are 30 chapters, grouped (sometimes loosely) into nine sections that provide overviews of major topics. Much of the work presented in these volumes has appeared previously in the form of shorter papers in journals and conference proceedings such as the Picosecond Phenomena series (Volumes I, II, and III, Springer-Verlag, New York, 1978, 1980, and 1982). However, most of the chapters are written in an expanded, pedagogical format appropriate for nonspecialist readers. Thus the two volumes should serve not only as a useful reference compendium, but also as an introduction to ultrafast physics of semiconductors.

The published material spans a wide range of topics which should appeal to a broad audience. The chapters in Volume I contain theoretical discussions of energy and momentum relaxation times for carriers, time evolution of the carrier distribution function, and time-dependent thermodynamics of dense plasmas. These chapters are interspersed with experimental results on relaxation, transport, and diffusion of carriers and plasmas. Also included are experimental studies of phonon relaxation, excitonic polaritons, and excitonic molecules. The volume ends with a theoretical section on hot carrier diffusion and transport.

The topics in Volume II are more specialized subfields of ultrafast laser spectroscopy. The first section deals with amorphous semiconductors (mainly amorphous silicon), presenting picosecond photoconductivity and picosecond photoinduced absorption data. The next section discusses transient phenomena occurring during pulsed laser annealing. Both the thermal annealing and plasma annealing viewpoints are represented. The following sections discuss relaxation of magnetoproperties of carriers and transient pulse propagation. The second volume concludes with seven chapters on experimental techniques. These chapters include discussions on streak cameras, Kerr gates, and other picosecond sampling methods. Time correlated photon counting, picosecond modulated reflectance, and subpicosecond laser design are also discussed adequately in previous books, substantially new material is found in several of these chapters.

One of the shortcomings of these volumes is the appreciable overlap among some of the chapters. In Volume I, for example, the same qualitative discussion of relaxation processes is repeated several times. In fact, the same or nearly identical equations and figures are repeated in different chapters. This leaves the reader with the impression that little attention was given to continuity between the chapters. Among the topics notably absent in these volumes is semiconductor layered structures such as superlattices and quantum wells probed by ultrafast laser spectroscopy. However, this is a newer topic which could take a volume in itself (perhaps Volume III?)

Finally, several key contributors to this field are noticeably missing, so that the volumes may not be regarded as the definitive survey of ultrafast laser spectroscopy of semiconductors. Nevertheless, this two-volume set represents a very broad range of expertise in this field, and it is therefore likely to become a welcome addition to many libraries.

Reviewer: Paul Gourley, member of the technical staff, Sandia National Laboratories, Albuquerque, NM.

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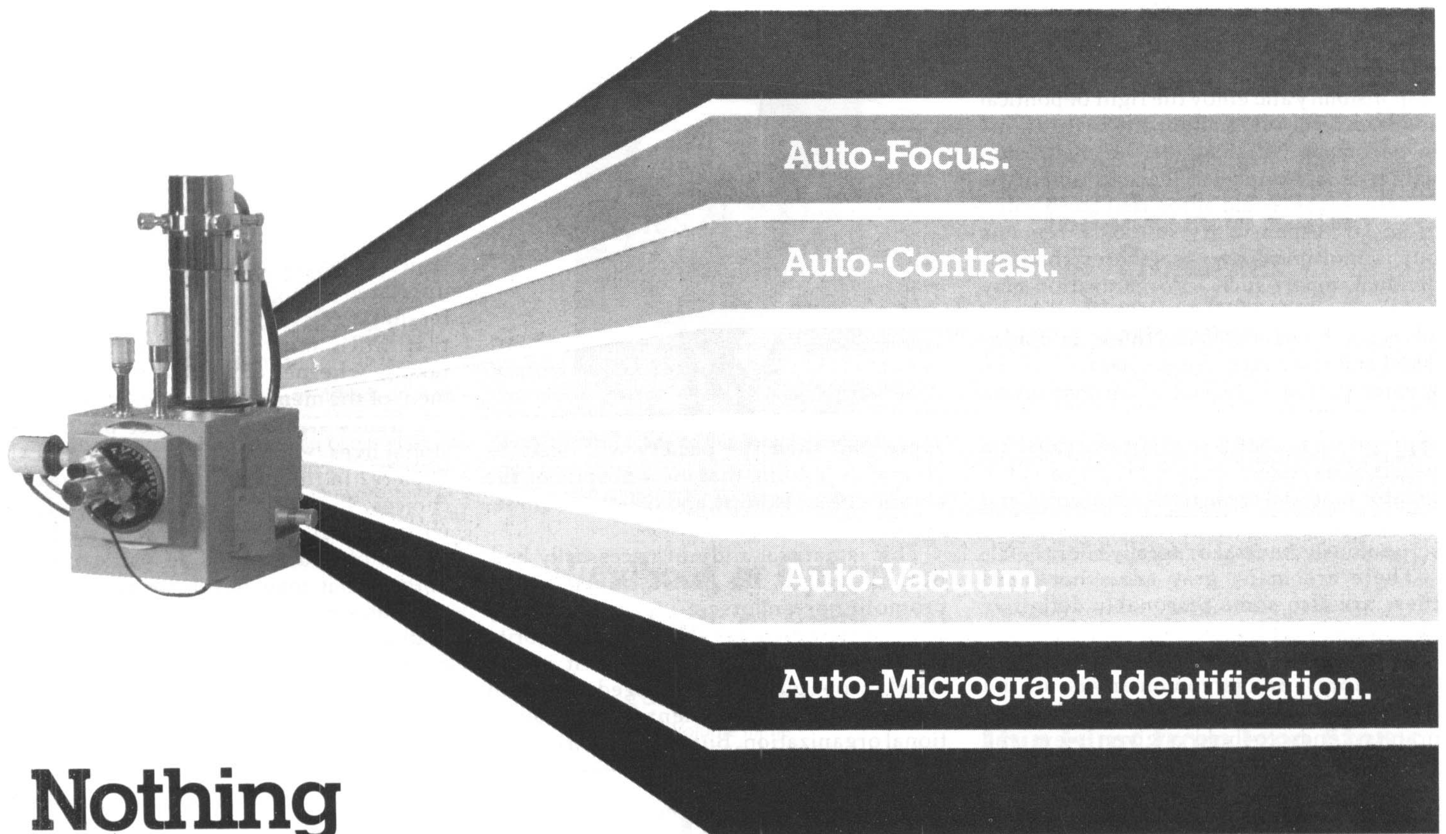

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