Reggiani has selected two specialized topics for inclusion in the book. Marion Asche discusses the symmetry breaking induced by high electric fields among equivalent valleys. And Susumu Komiyama, Tatsumi Kurosawa and Taizo Masumi review the "streaming" of particles in crossed electric and magnetic fields when optical-phonon scattering is the dominant scattering mechanism.

The final two sections of the book address spatially inhomogeneous materials but are unfortunately too short to do the subject justice. One increasingly important type of spatial inhomogeneity is the layering of III–V semiconductor compounds to form superlattices or heterostructures. Karl Hess and Gerry Iafrate briefly review this vast area. Their treatments of both real-space transfer (the transfer of electrons between layers of different materials) and capture of electrons by heterojunction lasers stand out as these topics are not usually covered in treatments of superlattices. Eugène Constant's chapter provides a link between bulk transport theory and submicron devices. He concentrates on results of applying Monte Carlo techniques to pulses of the electric field in time and space. How to transfer information from Monte Carlo simulations to simpler models of structures (in particular, how to extract relaxation rates) receives some attention. Unfortunately, Constant mentions true space-dependent phenomena—those that depend on an inhomogeneous self-consistent electric field—only briefly, at the end. A discussion of this crucial topic would have benefited both the chapter and the book.

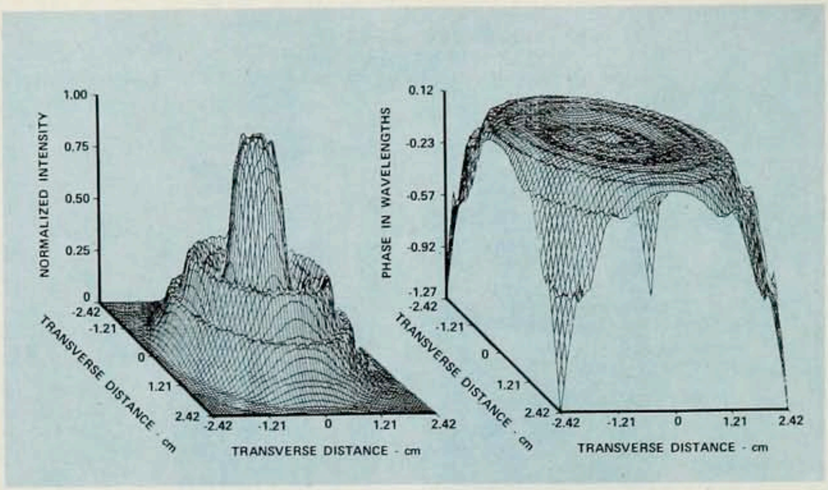
Hot-Electron Transport in Semiconductors was written for starting graduate students who need a foundation in bulk hot-electron transport, and for researchers to use as a reference. Reggiani and his coauthors have by and large hit their marks.

HAROLD U. BARANGER
AT&T Bell Labs, Holmdel, New Jersey

Lasers

Anthony E. Siegman
University Science Books, Mill Valley, Calif., 1986. 1283 pp. $65.00 hc ISBN 0-935702-11-5

Since the first laser was built, more than a quarter of a century ago, laser physics has undergone tremendous advances. Lasers have been finding applications in areas unthinkable just a few years back. The intense research activity and the many applications have generated a need for many



Near-field intensity and phase profiles from a large-scale computer simulation of a gas-dynamic CO_2 laser. The illustrations show a bare resonator for the lowest-order eigenmode. (Reproduced from *Lasers* by permission of the publisher.)

advanced as well as elementary texts: The continuously evolving field demands new books that explain the principles and applications of lasers in the wake of exciting new developments.

Siegman's *Lasers* is an excellent exposition of laser theory and some applications, by a stalwart in the field. Intended as a text for graduate students and well-prepared seniors in science or engineering, the book will find a place on the shelves of all students and researchers in quantum electronics and modern optics. "The unique feature of this book," as Siegman points out, "is that it removes much of the quantum mystique from the 'quantum electronics,'" thus making lasers understandable to those who have very little background in quantum mechanics. The book comprises three parts. The first part of the book, entitled "Basic Laser Physics," should be valuable to beginning students. In this part the basic operating mechanisms of the laser are described in detail. The topics discussed include rate equations, laser amplification, optical pulse propagation and some recent developments such as the soliton laser and optical bistability. The second part, "Optical Beams and Resonators," provides a systematic and lucid treatment of resonator optics and mathematics. This deserves to become the classic pedagogical treatment of the subject. I found chapter 22 on unstable resonators and chapter 23 on advanced analysis of unstable resonators especially interesting. The book finishes with more advanced topics in laser physics, such as mode locking (that is, passive locking), injection locking and applications to such systems as the ring laser gyro.

The book deals with a vast number of topics, many of them in great detail. There are, however, some gaps. To me, the most obvious is the omission of a coherent discussion of certain topics in nonlinear optics such as second-harmonic generation and optical phase conjugation.

Siegman has done a masterful job of organizing information and communicating it in a most effective way. Almost every section starts with a brief introduction outlining the objectives and ends with a set of references and problems that bring new insight to the text. And complex concepts are elucidated by means of a large number of illustrative figures.

It is safe to say that Siegman's latest book will stand the test of time.

Marlan O. Scully
University of New Mexico

Transition Metal Impurities in Semiconductors

E. M. Omel'yanovskii and V. I. Fistul'
Adam Hilger, Bristol, UK (US dist. Taylor and Francis, Philadelphia), 1986 [1983]. 243 pp. $77.00 hc ISBN 0-85274-493-5

Transition metal impurities, particularly those from the 3d series, are perhaps the best studied defects with deep energy levels in semiconductor physics. Aside from their technological importance as centers that control carrier lifetimes, as luminescence centers and as agents of semi-insulating behavior, these impurities exhibit a rich repertoire of fascinating physical phenomena associated with the coexistence of both localized, magnetically active d orbitals and delocalized ("resonating") s–p states. By providing a natural extension of the classic theoretical tools of crystal-field and ligand-field models (originally developed for ionic transition metal coordination compounds) into the realm of covalent structures, this research field has naturally bridged the otherwise disparate disciplines of coordination chemistry, semiconductor technology and impurity physics. The concomitant application of a large number of optical, electrical and magnetic probes to study experimentally 3d impurities ranging from Ti to Cu in virtually all III–V and II–VI semiconductors, coupled with the recent development of theoretical techniques for studying deep, d orbital centers, has created an urgent need for a comprehensive text summarizing the status of the field, offering perspective and identifying new challenges.

Transition Metal Impurities in Semiconductors is a response to this challenge. On the side of theoretical approaches, E. M. Omel'yanovskii and V. I. Fistul' review the phenomenological, classical crystal-field and ligand-field models but do not tell the reader how these models should be modified in a covalent semiconductor. They then describe the effective-mass method (with and without pseudopotential central-cell corrections) but acknowledge its irrelevance to impurities that introduce a fundamentally new type of orbital into the system (such as d orbital impurities in an s–p bonded host crystal). Next they discuss early applications of crystal models. The authors conclude pessimistically that impurity theory was capable merely of confirming the existence of deep levels without being able to reliably predict their positions or other measurable properties of such systems. My review (*Solid State Phys.* **39**, 275, 1986) of more recent theoretical work suggests that their pessimism is unwarranted.

On the experimental side, this book contains a detailed review of the data on 3d impurities in Si, Ge and III–V semiconductors. A reader entering the field will find it very useful. Regrettably, the abundant data on 3d impurities in II–VI compounds are omitted. While the experimental section of the book, suitable both as an introductory and advanced level text, describes clearly the substantial progress made in the 1970s, it sorely lacks more recent material: Although the book was updated in 1986, only 5% of