Quantum Technology

Quantum Well Lasers. PETER S. ZORY, JR., Ed. Academic Press, San Diego, CA, 1993. xvi, 504 pp., illus. $75 or £57. Quantum Electronics.

Semiconductor lasers play a central role in many new technologies that are changing our everyday lives. About a decade ago they started to appear in commercial systems, including compact disc players and long-haul fiber telecommunication links. These devices were based on a semiconductor active medium (the portion of the device that imparts energy to the lasing mode by way of stimulated emission) having transverse dimensions comparable to the wavelength of light. By the time these so-called bulk or three-dimensional laser structures were introduced, however, they were recognized as only one possible branch in a hierarchy of laser structures based on the dimensionality of electrons in the active medium. Continuing improvements in crystal growth technology made possible a new class of ultra-thin active media in which electrons and holes are confined in one direction to sizes comparable to their de Broglie wavelength at the desired operating temperature (typically about 10 nanometers for room-temperature operation). The result is a structure with quasi–two-dimensional properties which, for electrons in most direct wide-gap materials, can be modeled using simple particle-in-a-well quantum mechanics; hence the name "quantum wells." Quantum well lasers are semiconductor lasers that use these structures for their gain medium.

Because of the considerable advantages these devices offer over their conventional bulk counterparts, they are finding their way into many applications; they eventually could replace bulk devices everywhere. *Quantum Well Lasers* is the first book to review in detail the theory and properties of these important devices. It provides most of the physics needed to understand quantum wells at a basic level as well as how quantum wells affect laser performance. The editor has done an excellent job of holding the many contributors to a common theme and technical level. In addition, the chapters flow smoothly, with little overlap and few noticeable gaps.

The book's introductory chapters provide the basic theory needed to understand and carry out calculations of optical gain spectra in quantum well active layers. A series of chapters then systematically reviews, among other things, threshold current and modulation dynamics (including the importance of carrier capture and escape processes) as well as the continued evolution of quantum wells to lower dimensions. Two chapters are devoted solely to the important topic of strained quantum wells. The book should be accessible to anyone who has had introductory courses in quantum mechanics and solid-state physics; however, a course in laser physics is advisable for full appreciation of the material. In addition, someone unfamiliar with the basics of III–V semiconductor crystal growth by molecular beam epitaxy or organometallic vapor phase epitaxy might benefit from a brief overview of these topics as a supplement to this book.

Quantum Well Lasers will be useful as a reference source or as an introduction for anyone who requires more than a superficial understanding of what makes quantum well lasers special.

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Vignette: In Mid-History

No serious student of modern science will deny that it represents the closest thing we have to consensual, objective, international, "universal" knowledge. The claim to a special epistemological status for modern science—dare we call that an ideology of its own by now?—has been under assault for a generation or more, but no better alternative is yet in sight. Perhaps, however, in the post-Enlightenment world we are ready to acknowledge some degree of multiculturalism even in the case of science itself. Such a position may seem disturbing just now, when we see all about us the consequences—sometimes inspiring but too often horrific—of ethnic, religious, racial, and other cultural divides. Yet for good or ill, we are nowhere near "the end of History."... And if the history of science has any relation to cultural history in general, as surely it must, we are also nowhere near the end of the history of science.

—Gerald L. Geison, in *Research Schools: Historical Reappraisals* (Gerald L. Geison and Frederic L. Holmes, Eds.; *Osiris*, vol. 8)

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