DEPARTMENTS

BOOK REVIEWS

Guided Wave Acousto-Optics: Interactions, Devices, and Applications

Chen S. Tsai, Ed., 317 pages, illus., subject index, references. Vol 23 in the Springer Series in Electro-Optics. ISBN 0-387-51898-3. Springer-Verlag, 44 Hartz Way, Secaucus, NJ 07096-2491 (1990) $69.50 hardbound.

Reviewed by Joseph T. Boyd, University of Cincinnati, Department of Electrical and Computer Engineering, Cincinnati, OH 45221-0030.

The book *Guided Wave Acousto-Optics: Interactions, Devices, and Applications,* edited by Chen S. Tsai, is a worthwhile compilation of chapters by individual authors on subjects related to the title. For the most part the discussions are clear and well referenced, and very good quality figures are included. It is satisfying to see that the experimental data is widely presented to clarify and sharpen discussion and to provide examples of the limits of performance achieved.

The book is characterized by many of the advantages and disadvantages of a volume with one editor and different authors for each chapter. The major advantages are that each chapter is written by experts and/or major contributors to the specific subject of the chapter and that the editor is experienced and has contributed broadly to the entire field. Disadvantages include some overlap in the discussions, different notations and coordinate systems for each chapter, and greater time delays between when the material was written and publication achieved. I believe the advantages significantly overshadow the disadvantages for this particular book.

The book represents the technological capability of guided wave acousto-optics in a very thorough manner. The extent to which this capability is being used in systems is not clearly delineated, and occasionally, as in the introduction, there is an overstatement of extent of use. However, the significant capabilities associated with guided wave acousto-optics and the possibilities for various applications are presented, and for the most part the extent of eventual use is still being determined.

The order of the chapters is logical. Following a succinct and extensively referenced introduction by the editor, three chapters that provide worthwhile background are included. G. Wade presents a chapter on bulk wave acousto-optic Bragg diffraction that provides a good basis for understanding the corresponding guided wave process. Initially, the chapter is intuitive in a very helpful way and then becomes more mathematical as a coupled-mode theoretical approach is introduced. In the following chapter, R. C. Alferness and P. K. Tien present information on optical waveguides theory and technology. Their chapter contributes to the purpose of the book and is a reasonable presentation of its subject matter. Minor criticisms are that the vector notation seems awkward and the extensive use of the potential well analogy is only useful to those having a fairly thorough knowledge of potential well problems. The last in this group of background chapters is by T. M. Reeder on excitation of surface acoustic waves by use of interdigital electrode transducers. This chapter is an especially clear and logically written presentation of the behavior of these structures. Enough information is provided to allow understanding of more complicated transducer configurations presented in later chapters.

With background established in bulk wave acousto-optics, optical waveguides, and surface elastic wave transducers, the remainder of the book concentrates on guided wave acousto-optics and applications. Tsai presents a chapter on wideband acousto-optic Bragg diffraction in $LiNbO_3$ waveguide and applications. This chapter is the most extensive in the book. It begins with a coupled mode analysis of guided wave acousto-optic deflection. From this analysis many performance parameters are derived and limitations discussed. The discussion to this point sets the stage for considering the value of the wideband devices using multiple surface waves. A thorough discussion of several multiple surface wave transducers (with titled, phased, and curved electrode configurations) then follows. Enough detail is included in this material to provide a basis for the initial design of such structures. The chapter concludes with a discussion of a wide range of possible applications. The reader will likely find this discussion stimulating, but there is not as much depth here as in the early part of the chapter.

To complement the discussion that emphasizes $LiNbO_3$ devices, N. Mikoshiba presents a chapter on guided wave acousto-optic interaction in a ZnO thin film on a nonpiezoelectric substrate. The emphasis in this chapter is on ZnO technology, although the reader will find a coupled-mode theory description of guided wave acousto-optic deflection from another point of view.

Those two chapter are followed by one on spectrum analysis with integrated optics by M. C. Hamilton and A. E. Spezio. This sequence is a logical progression in that the integrated optical spectrum analyzer uses guided wave acousto-optic deflection and has undergone considerable development. The presentation in this chapter is very clear and straightforward, building on material presented earlier. The chapter begins by considering briefly a bulk wave acousto-optic spectrum analyzer and establishing some performance parameters. The integrated version is then discussed. A practical assessment of component issues is included.

The book concludes with a chapter on integrated acousto-optic device modules and applications by Tsai. This chapter presents many stimulating device concepts, but does include some repetition of device concepts presented in earlier chapters.

In this reviewer's opinion, the book is successful and valuable both for people working in closely related fields and for those beginning to work in areas covered by the text. Both groups will appreciate the clarity, the extensive reference lists, and the high-quality figures.

Laser Technology: Laser Driven Processes

Stjepan Lugomer, xiv + 449 pp., illus., subject index, references, and appendixes. ISBN 0-13-523671. Prentice Hall., Englewood Cliffs, NJ 07632 (1990) $55.40 hardbound.

Reviewed by Hollace L. Cox, Jr., University of Louisville, Department of Electrical Engineering, Louisville, KY 40292.

Laser Technology: Laser Driven Processes covers a wide range of laser-assisted industrial and commercial processing techniques. These processing applications cover a wide dynamic area ranging from low-power laser-induced photolytic and photothermal processes through high-power laser technology applications, including laser machining techniques and the contribu-

tion of laser fusion to power technology. The laser-material interaction is described as energy being deposited into condensed matter in both resonant and nonresonant interaction mechanisms. The author has succeeded in bringing together processing information from a wide range of literature, including citations from Russian and Eastern European sources that are frequently overlooked by American readers. In a unified style, Lugomer describes laser interactions that occur on time scales varying from picoseconds to continuous wave processes, on power scales from microwatts to more than 100 terawatts, and with wavelengths from the ultraviolet to the visible (VIS) and the infrared. The author claims that the book is primarily written for the industrial research worker, who is actively applying laser processing technology to a wide scope of manufacturing operations. In my opinion, the book would also be useful to the advanced graduate student in several engineering areas. Although the book lacks the standard set of practice problems at the end of each chapter, this omission does not limit its usefulness as a graduate level textbook. Properly used, this book could serve as the primary text in a course on laser processing techniques.

Chapter 1 deals with laser chemical technology and is a well-documented account of relatively low-power laser processing, covering what the author refers to as a λ-scale of the UV-VIS-IR spectral regions. The details of the processing steps are supported by an abundance of tables and graphs, many of which are reproduced from the original papers cited in support of the text. Information describing the chemical processing steps, contained in Chap. 1, does stand alone. The author is extremely thorough in the area of laser etching and laser oxidation. Most of the literature cited is from the early and middle 1980s with an abundance of references from the Russian literature in laser heating and annealing.

Chapter 2 is an extremely interesting look at semiconductor processing with a special focus on laser annealing of the ion implantation process. Removal of the damage done by ion implantation is extremely important, and Lugomer provides thorough coverage of laser annealing for both Si and Ge as well as annealing of GaAs materials. I found of particular interest in the semiconductor chapter a section on the modification of optical properties by laser annealing of thin film dielectric waveguides formed on semiconductor substrates to reduce light scattering and propagating beam loss. This additional processing step in producing an integrated optical device would reduce scattering loss and greatly enhance the overall performance of the device. Laser-assisted processing in the rapidly maturing field of integrated optical device processing is proving to be an extremely important technique, and an abundance of these techniques has been reported during the past year, all of which are too recent to be included in this book. Nevertheless, the author goes into a great deal of depth in the descriptions of the many processing techniques covered. This indicates that the author has either had a considerable amount of first-hand experience in laser processing or has been very thorough in searching and analyzing the literature. In either case, Chap. 2 is extremely well written, and I have found the material very useful.

Chapters 3 and 4 describe the laser as a machine tool. Laser metal technology is covered in Chap. 3 and laser mechanical technology is covered in Chap. 4, which includes material on laser welding, brazing, soldering, drilling, and cutting. These two chapters cover many of the topics included in John F. Ready's *Effects of High-Power Laser Radiation*, (Academic Press, 2nd edition, 1978), only Lugomer has brought the material up to date and has drawn heavily on Russian literature on laser processing techniques. Here again, Lugomer's charts, graphs, and mathematical formalism, are thoroughly presented and would meet the needs of most research workers designing laser processing systems.

Chapter 5 runs for 120 pages and describes several commercial laser processing systems in great detail. Many of the processing units are pictured, and their working parts are shown in well-drawn schematic diagrams. The operating descriptions of the equipment are clear and easy to follow, and the reader is brought up to the state of the art in laser processing equipment. The author has again used the Russian literature extensively, and this gives the reader an insight into laser processing equipment used in Russian and Eastern European countries.

Chapter 6 presents a detailed description of laser power technology as presented in the literature of the early and middle 1980s. This chapter deals primarily with the development of laser-induced fusion as a power source. Lasers described in this section are the extremely high-power Nd: Glass, CO_2, and HF lasers, which have been designed to initiate nuclear fusion reactions and serve as a power source. For those of us who believe that laser-induced nuclear fusion will someday be a reality, this chapter provides some delightful reading. All principal laboratories presently engaged in laser fusion research are covered. The author does an excellent job of describing the fusion programs at the Lawrence Livermore National Laboratory as well as the fusion research at the University of Rochester's laboratory for Laser Energetics. Los Alamos Scientific Laboratory's CO_2 laser fusion research is also covered along with similar research at other laboratories. There is an extremely detailed description of the target systems used in these fusion projects. Here again, the author's descriptions are accompanied by a number of charts, graphs, and excellent drawings showing these target systems.

In summary, *Laser Technology; Laser Driven Processes* is a very well-written book, which was a pleasure to review. In my opinion, this book would serve as an excellent text in a graduate level course in laser processing methods or a supplementary text in a course on semiconductor device processing. The amount of descriptive processing information is more than adequate for the industrial research worker as well as the graduate student. I would recommend *Laser Technology* as a worthwhile addition to the library of any laser scientist.

This book was also reviewed in the November 1990 issue of Optical Engineering *by John A. Detrio of the University of Dayton Research Institute.*

BOOKS RECEIVED

Fiber Optic Sensors: an Introduction for Engineers, edited by Eric Udd. 476 pp., illus., references, subject index, ISBN 0-12-470951-6. John Wiley & Son Inc., 1 Wiley Dr., Somerset, NJ 08875-1272 (1991). $69.95 hardbound. Covers the emergence of fiber optic sensor technology, optical fibers, optical detectors, multimode grating sensors, fiber optic sensors based on the Sagnac interferometer and passive ring resonator, and industrial applications of fiber optic sensors.

Theory of Dielectric Optical Waveguides, edited by Dietrich Marcuse. 381 pp., illus., references, subject index, ISBN 0-12-470951-6. Academic Press Inc., 1250 Sixth Avenue, San Diego, CA 92101 (1991). $59.95 hardbound. Covers asymmetric slab waveguide, weakly guiding optical fibers, coupled power theory, grating-assisted direction couplers, and nonlinear effects.

Object Recognition by Computer, edited by W. Eric L. Grimson. 515 pp., illus., references, subject and author index, appendixes. ISBN 0-262-07130-4. The MIT Press, 55 Hayward Street, Cambridge, MA 02142 (1990). $45.00 hardbound. Covers searching for correspondences, two-dimensional constraints, verifying hypotheses, controlling the search explosion, selecting subspaces of the search space, empirical testing, combinatorics of the matching process and Hough tranforms, and sensing strategies.