

## EDITORIAL BOARD

**MINKO BALKANSKI**, University of Pierre and Marie Curie, Laboratoire de Physique des Solides, 4 Place Jussieu, Tour 13, 75230 Paris Cedex 05, France, telephone: 336-25-25

**RICHARD B. FAIR**, Vice President, Research Program Management, Microelectronics Center of North Carolina, P.O. Box 12889, Research Triangle Park, NC 27709, telephone: (919) 248-1800

**FRANK Y. FRADIN**, Director, Materials Science and Technology Division, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL 60439, telephone: (312) 972-4925

**SHU-EN HSU**, Director, Materials R&D Center, Chung Shan Institute of Science and Technology, P.O. Box 1-26, Lung-Tan, Taiwan, China. Cable: CHUNSHANINST SHIMEN, TAIWAN

**RALPH J. JACCODINE**, Sherman Fairchild Professor of Solid State Studies, Sherman Fairchild Laboratory 161, Lehigh University, Bethlehem, PA 18015, telephone: (215) 862-3950

**HIROSHI KAMIMURA**, Department of Physics, Faculty of Science, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113 Japan, telephone: 03-812-2111, telex: UTPHYSIC J23472

**ELTON N. KAUFMANN**, Lawrence Livermore National Laboratory, P.O. Box 808 L-217, Livermore, CA 94550, telephone: (415) 423-2640

**HARRY J. LEAMY**, (Chairperson), AT&T Bell Laboratories, Room 2D-346, 600 Mountain Avenue, Murray Hill, NJ 07974, telephone: (201) 582-2628

**JAMES L. MERZ**, Associate Dean for Research Development, College of Engineering, University of California, Santa Barbara, CA 93106, telephone: (805) 961-4446

**SUSUMU NAMBA**, Professor of Electrical Engineering, Faculty of Engineering Science, Osaka University, Toyonaka, Osaka, Japan 560

**JULIA M. PHILLIPS**, AT&T Bell Laboratories, Room 1E-431, 600 Mountain Avenue, Murray Hill, NJ 07974, telephone: (201) 582-4428

**EMANUELE RIMINI**, University of Catania, Department of Physics, 57 Corso Italia, I 95129 Catania, Italy, telephone: 37-70-61, telex 911554 INFNCT I

**RUSTUM ROY**, Director, Materials Research Laboratory, Pennsylvania State University, University Park, PA 16802, telephone: (814) 865-3424

**RICHARD L. SCHWOEBEL**, Directorate 1800, Sandia National Laboratories, P.O. Box 5800, Albuquerque, NM 87185, telephone: (505) 844-9273

**G. D. W. SMITH**, University of Oxford, Department of Metallurgy and Science of Materials, Parks Road, Oxford OX1 3PH, England

**TAKUO SUGANO**, Professor of Engineering, Department of Electronic Engineering, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113 Japan, telephone: 03-812-2111, ext. 6675

**C. W. WHITE**, Solid State Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831, telephone: (615) 574-6295

**XIE XIDE**, Professor of Physics and President, Fudan University, Shanghai, China

## Theory and Practice of Scanning Optical Microscopy

By Tony Wilson and Colin J. R. Sheppard

1984, 224 pp., \$39.50., Academic Press, 6277 Sea Harbor Drive, Orlando, FL 32821.

The commercial availability of reliable and inexpensive lasers, along with a current wealth of potential applications, has generated in the past few years increased interest in the scanning optical microscope. Simple versions of such instruments have already been commercialized in inspection equipment used in the semiconductor industry and no doubt will expand in that area and extend into other areas in the near future. This reason and the fact that no other complete text exists on this subject make this work timely and a valuable addition.

Chapter 1 introduces the concept of sequential imaging used in the scanning microscope and discusses its advantages over parallel processing. An overview of applications is presented, numerous references cited, and several examples illustrated.

Chapters 2 and 3 review, respectively, the theory of Fourier optics and its specific application to image formation in scanning microscopes. The fundamental concepts of transfer functions, coherent and incoherent imaging, aberrations, etc., are discussed. Those unfamiliar with the basic principles of imaging optics may want to first review a basic text, such as Jenkins and White's "Fundamentals of Optics," before reading Chapters 2 and 3. Chapter 4 deals in more detail with specific imaging modes such as dark field, interference, and differential microscopy. Synthetic aperture imaging and stereoscopic microscopy are also discussed. Interesting illustrations demonstrate several of the techniques.

The first four chapters of the text are basically theoretical in emphasis. Chapter 5 begins an orientation toward practical applications which the remaining chapters treat in detail. In Chapter 5, a discussion of depth discrimination and extended depth of field imaging is presented. Chapter 6, titled "Super-Resolution in Microscopy," treats one of the major advantages in sequential imaging, namely, digital signal processing.

Auto-focus, contrast and edge enhancement are explained and illustrated. An interesting configuration, referred to as the "scanning incoherent confocal fluorescence microscope," offers the possibility of a fourfold improvement in spatial frequency bandwidth over a conventional microscope and is reviewed in some detail. The direct view scanning microscope, where the source and detector are both scanned together, is treated in Chapter 7. Although difficult to realize in practice, it offers interesting applications possibilities for large depth discrimination.

Chapters 8 and 9 will probably be the most interesting for those readers working on or contemplating specific applications. Chapter 8 discusses the major components incorporated in any scanned microscope; namely, the light source, objective lenses, detectors, image processing electronics and scanning hardware. For a thorough treatment, the reference list could be expanded considerably. However, the detail in the text is adequate and consistent with the detail in the book in general. Chapter 9 concentrates on applications to semiconductors. An entire text could be written on this area alone. However, the authors treat the subject well, discussing OBIC, photoluminescence, electroreflectance, etc., with useful comparisons to SEM images and the EBIC technique. The reference list is complete although already somewhat dated.

The text concludes with Chapter 10, reviewing non-linear scanning microscopy, discussing the possibilities of image enhancement by stimulating non-linear effects in the objects under examination.

In general, the book provides both a good theoretical and practical overview of a timely and expanding technology. The background and theoretical discussions will prove useful for many years to come. The chapters emphasizing applications could easily become dated; however this is a problem for any text treating a rapidly expanding area. I recommend the book without reservation.

*Reviewer: Vincent J. Zaleckas is research leader, optics and optoelectronics, at AT&T's Engineering Research Center, Princeton, NJ, responsible for R&D of optical technologies and their applications in semiconductor device manufacture.*