



Optical Diagnostics for Thin Film Processing

By Irving P. Herman Ph.D. Massachusetts Institute of Technology

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Massachusetts Institute of Technology

This volume describes the increasing role of *in situ* optical diagnostics in thin film processing for applications ranging from fundamental science studies to process development to control during manufacturing. The key advantage of optical diagnostics in these applications is that they are usually noninvasive and nonintrusive. Optical probes of the surface, film, wafer, and gas above the wafer are described for many processes, including plasma etching, MBE, MOCVD, and rapid thermal processing. For each optical technique, the underlying principles are presented, modes of experimental implementation are described, and applications of the diagnostic in thin film processing are analyzed, with examples drawn from microelectronics and optoelectronics. Special attention is paid to real-time probing of the surface, to the noninvasive measurement of temperature, and to the use of optical probes for process control.

Optical Diagnostics for Thin Film Processing is unique. No other volume explores the real-time application of optical techniques in all modes of thin film processing. The text can be used by students and those new to the topic as an introduction and review of the subject. It also serves as a comprehensive resource for engineers, technicians, researchers, and scientists already working in the field.

- The only volume that comprehensively explores *in situ*, real-time, optical probes for all types of thin film processing
- Useful as an introduction to the subject or as a resource handbook
- Covers a wide range of thin film processes including plasma etching, MBE, MOCVD, and rapid thermal processing
- Examples emphasize applications in microelectronics and optoelectronics
- Introductory chapter serves as a guide to all optical diagnostics and their applications
- Each chapter presents the underlying principles, experimental implementation, and applications for a specific optical diagnostic

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- Sales Rank: #4536750 in Books
- Published on: 1995-10-28
- Ingredients: Example Ingredients
- Original language: English
- Number of items: 1
- Dimensions: 9.29" h x 1.70" w x 6.25" l, 2.67 pounds
- Binding: Hardcover
- 783 pages

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Editorial Review

Review

"The greatest value of *Optical Diagnostics for Thin Film Processing* is a comprehensive reference text. I highly recommend it to anyone who wants to seriously delve into the field of thin film optical diagnostics or wants a single source book of well-organized and very high-density information on this subject." --**William G. Breiland, Sandia National Laboratories, OPTICAL ENGINEERING.**

From the Back Cover

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About the Author

Irving Herman graduated with S.B. and Ph.D. degrees in physics from M.I.T. in 1972 and 1977. From 1977-1986 he was a member and section leader in O-group within the Physics Department at the Lawrence Livermore National Laboratory, where he was engaged in research in laser isotope separation of deuterium and tritium, and the use of direct laser writing in thin film processing. In 1986, he joined the faculty of Columbia University, where he is now Professor of Applied Physics and a member of the Columbia Center for Integrated Science and Engineering (CISE), the Energy Frontiers Research Center (EFRC), and the Center for Electron Transport in Molecular Nanostructures (NSEC). From 2006-2012 he was chair of the Department of Applied Physics and Applied Mathematics. From 1998-2010 he was Director of the Columbia Materials Research Science and Engineering Center (MRSEC) [The Center for Nanostructured Materials], and as part of this he led an extensive education outreach program. He oversees the Shared Materials Characterization Laboratory and is a member of the Clean Room Committee. He is a fellow of the American Physical Society and the Optical Society of America. His research concentrates on the fundamental aspects and applications of laser interactions with matter and nanoscience. This includes properties of nanocrystals and films composed of nanocrystals, optical physics of the solid state, molecular and chemical physics, thin film processing, and optical spectroscopy.

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