



Principles of Lithography, Second Edition (SPIE Press Monograph Vol. PM146)

By Harry J. Levinson

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Lithography is a field in which advances proceed at a swift pace. This book was written to address several needs, and the revisions for the second edition were made with those original objectives in mind. Many new topics have been included in this text commensurate with the progress that has taken place during the past few years, and several subjects are discussed in more detail. This book is intended to serve as an introduction to the science of microlithography for people who are unfamiliar with the subject. Topics directly related to the tools used to manufacture integrated circuits are addressed in depth, including such topics as overlay, the stages of exposure, tools, and light sources. This text also contains numerous references for students who want to investigate particular topics in more detail, and they provide the experienced lithographer with lists of references by topic as well. It is expected that the reader of this book will have a foundation in basic physics and chemistry. No topics will require knowledge of mathematics beyond elementary calculus.

Contents

- Preface
- Overview of lithography
- Optical pattern formation
- Photoresists
- Modeling and thin film effects
- Wafer steppers
- Color Plates overlay
- Masks and reticles
- Overcoming the diffraction limit
- Metrology

- The limits of optical lithography
- Lithography costs
- Alternative lithography techniques
- Appendix A: Coherence
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Editorial Review

From the Author

This book is intended as an introduction to the science of microlithography for those new to the subject, and it covers advanced topics useful to experienced lithographers who seek information outside their own areas of expertise. Numerous references to the literature in optical lithography will guide both novice and experienced lithographers who want greater detail in specific areas.

A number of discussions--such as thin-resist modeling, metrics for imaging, thin-film optics, and the modeling of focus effects--first appeared in Advanced Micro Design internal reports. Eventually, parts of these reports were published elsewhere. Their tutorial nature is not coincidental, as they were analyses that I used to develop my own understanding of lithography. Complex situations often are best comprehended through simple models that describe the relevant physics, with remaining effects considered as perturbations. This is the approach I used in learning lithography and it is the method used here.

Students in my classes on lithography science will recognize many of the figures and equations. Several also appear in the first chapter of the SPIE Handbook on Microlithography, Micromachining, and Microfabrication, Volume I: Microlithography, which I coauthored with Bill Arnold of ASM Lithography. Other topics have been added or significantly expanded, especially those concerning light sources, photomasks, and next-generation lithography. The chapter on photoresists is approached from the perspective of the practicing lithographer, rather than the resist chemist. Some knowledge of resist chemistry is essential for using resists properly, but the emphasis here is on operational considerations.

About the Author

Dr. Harry J. Levinson has worked in microlithography for nearly two decades, at companies such as IBM, Sierra Semiconductor, and Advanced Micro Devices. He has published many articles on lithography science, from thin film optical effects and metrics for imaging to overlay and process control. He teaches courses in lithography science, process control, and total quality management.

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