Extreme Ultraviolet Lithography

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Preface

While writing the chapter on EUV lithography for *Principles of Lithography*, I found myself challenged with covering many key topics while limiting the length of the chapter to something appropriate for a book that surveyed all major aspects of lithography. It seemed that a book fully dedicated to EUV lithography might be useful. Although there are already a number of fine books that survey the various aspects of EUV lithography, these books are generally compilations of chapters written by multiple experts in individual subjects. I thought that it might be useful to have a book where every chapter is written from a single perspective: that of the practicing lithographer in a wafer fab.

To bring EUV lithography to full readiness for high-volume manufacturing, considerable development (and a fair amount of research) was needed in nearly facet of lithographic technology—equipment, resists, masks, metrology, and computational methods. Each of these topics is discussed in this book, with an emphasis on those aspects that are unique to EUV lithography. It is assumed that the reader has familiarity with optical lithography, since many of the concepts relevant to EUV lithography were developed and brought to maturity in the context of lithography at optical wavelengths.

For many years, it has been my privilege and a pleasure to have worked with numerous outstanding and inspiring engineers and scientists on EUV lithography. Many of these people were co-workers at Advanced Micro Devices (AMD), the Advanced Mask Technology Center (AMTC), and GLOBALFOUNDRIES, while I engaged with others through consortia, such as Sematech, the EUV LLC, INVENT, and Imec. I also benefitted from interactions with engineers, managers, and executives from companies who supply equipment or materials for lithography. Much of the material in this book originated with colleagues and co-workers whose names appear in the references. I hope that this book does justice to their work.

Numerous people provided material for this book, many through their publications, while others were kind enough to provide figures specifically for this book. I would like to thank the following people who provided figures and gave permission for their use: Dr. Bruno La Fontaine of ASML (Figs. 1.1 and 1.3); Mr. Kevin Nguyen and Ms. Shannon Austin of SEMI (Fig. 1.7);

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