

# GUEST EDITORIAL

## EXTREME ULTRAVIOLET LITHOGRAPHY

Lithography continues to drive progress in the integrated circuit (IC) industry by allowing increases in density of devices while reducing the costs on a per-transistor basis. However, the continued lithographic shrink that comes from the increasing numerical aperture of current-day ArF immersion scanners has reached its end, and attempts to continue shrink with these systems involve rapidly increasing complexity in lithography and associated costs. Single-exposure lithography is the most cost-effective means of achieving critical-level exposures, and extreme ultraviolet lithography (EUVL) is poised to become the next cost-effective IC manufacturing solution for multiple generations of lithographic shrinks. With the first generation of full-field EUVL scanners now available, critical elements of the technology are being evaluated at a level not previously possible.

The term EUVL has been with us for more than 15 years, but the fundamental work on the technologies needed for successful EUVL can be traced back another 10 years as soft x-ray projection lithography, before the term EUVL was adopted. Starting with the invention of multilayer reflectors for x rays in the mid-1980s through many proof-of-concept activities over the next decades, EUVL has moved from a laboratory curiosity, through the highly criticized proposals of EUVL, successful creation of EUVL mirrors, < 0.1- $\mu\text{m}$  features in resist, simple working devices, and finally to the full-field prototype tools of today. These EUVL tools are creating exposures used to produce state-of-the-art levels on working integrated test

circuits. In parallel, related infrastructure such as masks, blanks, electronic design automation (EDA) tools, and resists are being improved. The pace of EUVL development has increased dramatically in recent years, and it is clear that this pace will continue to accelerate as the next generation of pilot and high-volume manufacturing tools become available. Consequently, this special section on EUVL is especially timely.

To begin this special section we have an article that reviews activities in EUVL starting from laboratory experiments and leading to still-needed technology for manufacturing solutions. In addition, we have articles that touch on key technical issues for EUVL to be implemented into manufacturing (EUV sources), as well as articles on flare, optics, masks, and an assessment of the current status of integrating these components together for lithography.

We hope you enjoy this special section on EUVL.

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**Guest Editors**