Journal of
Micro/Nanolithography, MEMS, and MOEMS

SPIEDigitalLibrary.org/jm3

Special Section on Optical Lithography Extension Beyond the 14-nm Node

Chris Mack

SPIE

Special Section on Optical Lithography Extension Beyond the 14-nm Node

While extreme ultraviolet lithography is still maturing, optical lithography is continuing as the primary lithographic technology for manufacturing over the next several years. Extension of water-based immersion lithography to the 20-nm half-pitch and below (10-nm logic node) requires the use of innovative resolution enhancement techniques, solutions to complexities introduced by hyper-NA optics, and extensive use of double or multiple sequential exposure and patterning techniques, and possibly even complementary use of optical lithography with non-traditional techniques. In addition to resolution, very tight overlay control and high quality photomasks are also necessary. The successful use of optics to provide viable working solutions for these device nodes will require fundamental integration of all aspects of the patterning process. For the 14-nm node and beyond, early design technology co-optimization is also necessary to ensure the patterning solution can enable design for products.

The seven papers found in this issue's Special Section on Optical Lithography Extension Beyond the 14-nm Node, compiled by guest editors Will Conley of Cymer LLC and Kafai Lai of IBM Corp., cover a variety of topics that are advancing the field of optical nano- and microlithography that extend optical lithography beyond the 14-nm technology node and enable circuit scaling. Two papers describe how greater understanding and predictability of the photomask is required at the 14-nm node. One paper emphasizes the interaction of lithography and etch for profile control in multiple patterning. Five out of seven papers are centered on the use of lithography modeling, indicating the central role of computation lithography in pushing any lithography technique to its ultimate limits. Finally, the important role of metrology and its integral use in lithography process control rounds out this interesting collection of papers.

Several important lessons emerge from these papers, and from the overall efforts of the semiconductor lithography community towards extending optical lithography beyond the 14-nm node. First and foremost, it can be done. The challenges are legion, but they are being met. Second, almost every detail is important (and bordering on the critical). Many effects once considered second or third order are now important enough to command considerable attention. But finally, an important question still remains: is it worth it? While we can extend optical lithography beyond the 14-nm node, should we? Will our companies remain profitable while trying to do so? This last question still awaits an answer. In the meantime, lithographers continue to do what they do best: push on.

Chris Mack
Editor-in-Chief