Special Section Guest Editorial: Masks and Lithography in the Era of Multi-beam Mask Writers

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Multi-beam mask writers are no longer a novelty and are now mainstream. This has resulted in improved mask quality and new capabilities. These include lower LER, CD control, registration, and curvilinear features. This special section of JM^3 highlights the new multi-beam mask writers and the capabilities they enable.

High-end mask writing lithography is printing complex mask patterns on different absorber stacks. Two papers in this special section focus on the material optimization during exposure to electron radiation. Hudek et al. compare the response of an e-beam resist with simulation on different EUV absorbers and multi-layer stacks. The prediction and correction of resist surface charging which can be an error source of image placement is described in the paper by Nomura et al.

Multi-beam mask writers are moving the industry from trapezoidal inputs to complex curvilinear shapes, which is the topic of the other two papers. Recognizing the limitations due to the size of data files, Choi et al. evaluate curvilinear format options in reducing data volume and the effect on the accuracy on a photomask using curvilinear compared to conventional linear representations. Pang et al. describe a new ILT (inverse lithography lithography) approach to improve accuracy and the wafer process window, including a new stitchless full-chip curvilinear ILT.

In closing, our intent was to provide you with a consolidation of information on multi-beam mask writers and hope that you will benefit from this information. Of course this would not have been possible without the time and effort of the authors and reviewers. We would like for you all to know how much we appreciate that. We would also like to thank the JM^3 editorial team for their patience and time in guiding us. And finally, many thanks to JM^3 Editor-in-Chief Harry Levinson who spent his time and effort on this special section. It was a pleasure working with him.

The JM^3 Special Series on EUV Masks (three-part series, October–December 2020, April–June 2021, July–September 2021, edited by Martin Burkhardt and Vicky Philipsen) can be referred to for information on EUV mask materials and challenges for high-volume manufacturing.