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**EBEAM INITIATIVE SURVEYS REPORT GREATLY INCREASED OPTIMISM FOR EUV LITHOGRAPHY AND
NEW PHOTOMASK TRENDS AT LEADING-EDGE PROCESS NODES**

Survey results to be presented at 2017 Photomask Technology Symposium

SAN JOSE, Calif., September 11, 2017—The eBeam Initiative, a forum dedicated to the education and promotion of new semiconductor manufacturing approaches based on electron beam (eBeam) technologies, today announced the completion of its sixth annual eBeam Initiative perceptions survey. Industry luminaries representing 40 companies from across the semiconductor ecosystem—including photomasks, electronic design automation (EDA), chip design, equipment, materials, manufacturing and research—participated in this year’s survey. The eBeam Initiative also completed its third annual mask makers’ survey with feedback from 10 captive and merchant photomask manufacturers.

Among the results of the perceptions survey, respondents are notably more optimistic about the implementation of EUV lithography for semiconductor high-volume manufacturing (HVM). In addition, expectations on the use of multi-beam mask writing technology for HVM remain high. At the same time, a solid majority of respondents believe that the throughput of variable shaped beam (VSB) mask writing systems is still adequate for the next few years. Results from the eBeam Initiative’s third annual mask makers’ survey indicate that mask write times remain consistent compared with last year’s survey, while responses to several new survey questions pointed to new requirements and challenges for mask makers. These include significantly greater mask data preparation time for finer masks, and a significant rise in the use of mask process correction (MPC) below 16-nm ground rules.

Aki Fujimura, CEO of D2S, the managing company sponsor of the eBeam Initiative, will present the results of the mask makers’ survey in an invited talk this morning at the SPIE Photomask Technology Symposium in Monterey, Calif. In addition, the complete results of both surveys will be discussed by an expert panel later today during the eBeam Initiative’s annual members meeting held in conjunction with the SPIE Photomask Technology Symposium, and will be available for download following the meeting at www.ebeam.org.

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Highlights from eBeam Initiative Perceptions Survey

- 75 percent of respondents predict that EUV will be used in HVM by the end of 2020.
- The belief that actinic mask inspection for EUV will eventually be used grew significantly, with only 7 percent of respondents indicating it would never be used in HVM, compared to 21 percent of respondents in last year’s survey.
- 74 percent of respondents predicted that multi-beam technology will be used in mask writing for HVM by the end of 2019. While the weighted average of the expected time for HVM implementation shifted 10 months compared to what last year’s respondents predicted, expectation of multi-beam adoption increased over last year’s survey.
- While the majority of respondents agree that multi-beam mask writing will be adopted soon, 61 percent also believe that the throughput of current VSB mask writing systems is still adequate for the next few years.
- 70 percent of respondents believe that inverse lithography technology (ILT) is being used in at least a few critical layers of leading-edge-node production chips today (2017).

Highlights from Mask Makers Survey (data from July 2016 to June 2017)

- Mask write times have remained consistent compared with last year.
- At the same time, the weighted average of the mask turnaround time (TAT) is significantly greater for more critical layers, approaching 12 days for 7-nm to 10-nm ground rules.
- Data prep error was the leading cause of mask returns (28 percent) identified by respondents.
- The weighted average of mask data preparation time is also significantly greater for finer masks, exceeding 21 hours for 7-nm to 10-nm ground rules.
- MPC is being applied to over one-third of all masks at 11-nm to 15-nm ground rules. With sub-7-nm ground rules, this increased to 72 percent of all masks reported by respondents.

“We would like to thank everyone for their participation in this year’s annual perceptions survey and mask makers’ survey,” stated Fujimura. “Every year, interest in these surveys continue to grow from throughout the mask-making and semiconductor ecosystem. Participation in the perceptions survey grew from 30 to 40 companies this year, while the mask makers’ survey continues to include leading-edge mask makers from around the globe.”

Added Fujimura, “In the perceptions survey, feedback clearly indicates that EUV has turned a corner, with nearly all respondents anticipating that it will be used in semiconductor HVM at some point in the future. This marks a sizeable shift from only three years ago, when one-third of survey respondents believed that EUV would never see HVM adoption. Also interesting are the responses related to multi-beam technology, where confidence remains high but predictions of its expected insertion point have been extended by nearly a year. In the mask makers’ survey, a new question validated a clear trend on the use of MPC below 16-nm ground rules, partially resulting in the significant increases in data preparation time for masks with finer ground rules.”

About The eBeam Initiative

The eBeam Initiative provides a forum for educational and promotional activities regarding new semiconductor manufacturing approaches based on electron beam (eBeam) technologies. The goals of the Initiative are to reduce the barriers to adoption to enable more integrated circuit (IC) design starts and faster time-to-market while increasing the investment in eBeam technologies throughout the semiconductor ecosystem. Members, which span the semiconductor ecosystem, include: aBeam Technologies; Advantest; Alchip Technologies; AMTC; Applied Materials; Artwork Conversion; Aselta Nanographics; Cadence Design Systems; Canon; CEA-Leti; D2S; Dai Nippon Printing; EQUIcon Software GmbH Jena; eSilicon Corporation; Fraunhofer CNT; Fujitsu Semiconductor Limited; GenISys GmbH; GLOBALFOUNDRIES; Grenon Consulting; Hitachi High-Technologies; HOLON CO., LTD; HOYA Corporation; imec; IMS CHIPS; IMS Nanofabrication AG; JEOL; KLA-Tencor; Maglen; Mentor, a Siemens Business; Multibeam Corporation; NCS; NuFlare Technology; Petersen Advanced Lithography; Photonics; Sage Design Automation; Samsung Electronics; Semiconductor Manufacturing International (Shanghai) Corporation (SMIC); STMicroelectronics; Synopsys; tau-Matrix; Tela Innovations; TOOL Corporation; Toppan Printing; Toshiba; UBC Microelectronics; Vistec Electron Beam GmbH; Xilinx and ZEISS. Membership is open to all companies and institutions throughout the electronics industry. To find out more, please visit www.ebeam.org.

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