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EBEAM INITIATIVE SURVEYS REPORT PHOTOMASKS BEING WRITTEN WITH MULTI-BEAM MASK WRITERS AND GROWING IMPACT OF DEEP LEARNING ON SEMICONDUCTOR FAB OPERATIONS

Results of annual Perceptions and Mask Makers' Surveys to be presented at SPIE Photomask Technology Conference

SAN JOSE, Calif., September 16, 2019—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 eighth annual eBeam Initiative perceptions survey. Industry luminaries representing 42 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 fifth annual mask makers' survey with feedback from 11 captive and merchant photomask manufacturers.

Results from the perceptions survey show that deep learning will likely be a purchasing criterion soon for semiconductor operations, with a strong majority (61 percent) reporting it is somewhat likely to very likely that they will purchase products or services based on its deep learning content by the end of 2020. When asked how likely deep learning would be a purchasing criterion for their customers, an overwhelming majority (76 percent) reported somewhat likely to very likely. In addition, the outlook for actinic mask inspection for EUV as well as the availability of EUV pellicles for high-volume manufacturing (HVM) is positive. Among the results of the mask makers' survey, 30 percent of masks reported were written using eBeam variable shaped beam (VSB) technology, while some masks were also being written using multi-beam technology. In addition, EUV mask yield was at 74 percent, and the use of mask process correction (MPC) was at 44 percent for ground rules below 11 nm. Mask turnaround time (TAT) continues to be significantly higher for advanced 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 tomorrow 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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Additional Highlights from the Mask Makers' Survey (data from July 2018 to June 2019)

- 599,536 masks were reported by 11 companies during the 12-month period of the survey
- The average mask write time reported for VSB writers was at 8.64 hours
- 2,789 EUV masks were reported
- The average mask TAT for 7-nm up to 11-nm ground rules was 11.07 hours, more than twice as long as mask TAT for 32-nm up to 45-nm ground rules

Additional Highlights from the eBeam Initiative Perceptions Survey

- 82 percent of respondents predict that EUV pellicles will be available for HVM by 2022
- The outlook on actinic inspection remains positive with only 5 percent of respondents predicting that it will never be used in HVM
- 75 percent of participants predict that inverse lithography technology (ILT) will be used in conjunction with EUV lithography on at least one layer of a high-volume production chip by 2022
- Usage of ILT in production today is perceived to have increased compared with last year's survey, while the number of respondents indicating that no layers are using ILT yet has gone down from 22 percent to only 12 percent
- Multi-beam mask writers as a percentage of all new eBeam mask writers purchased is predicted to rise to 50 percent by the end of 2022

According to Fujimura, "Every year, the annual eBeam Initiative surveys provide valuable insight into the key trends that are shaping the semiconductor industry. This year's surveys are no different, with results showing continued strong sentiment with EUV lithography, ILT and multi-beam mask writing. In addition, this year is the first time the survey results show multi-beam as a pattern generator. Multi-beam technology is expected to play a major role in tackling many of the industry challenges that were also highlighted in the survey, such as longer VSB write times, mask turn-around times, and the growing use of mask process correction at leading-edge ground rules. Thanks to several new questions introduced in this year's perceptions survey, we also have interesting insight into perceptions regarding deep learning, with feedback indicating it will have a strong influence on future purchasing decisions."



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; ASML; 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; 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-Metrix; Tela Innovations; Tokyo Electron Ltd. (TEL); 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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