

EUV Mask Handling, Chucking, and Standards Workshop
October 3, 2003
Antwerp Hilton, Antwerp, Belgium

Minutes

High-visibility issues with EUV mask technology include concern over stray electrostatic fields in chucking, grounding the mask front to the backside, and establishing particle budgets.

Scott Hector (ISMT/Motorola) presented the current status of SEMI standards efforts. The new revision of SEMI P38 (mask blank) and a new standard, SEMI P40 (EUV mask chuck), were approved for publication in late September, and will be published in November. SEMI P10 (mask ordering information) should be considered for revision to include EUV requirements.

Thomas White (ISMT) gave an update on North America and some of the projects ongoing at International SEMATECH. The mask carrier needs to be evolved to meet the ultra-low defectivity requirements of EUV masks.

Christian Holfeld (AMTC) gave an update on advances in Europe. An AIXUV tool will be installed at Schott Lithotec in Q1'04, and an EUV AIMS tool in Q3'05. The new mask shop in Dresden, Germany, Advanced Mask Technology Center (AMTC, a JV with DuPont Photomasks, Infineon, and AMD), has most tool on-site, including a Toshiba ESM-4000; first deliveries are expected by YE'04.

Nishiyama-san (ASET) provided an update on Japan. There is concern about maintaining the homogeneity of chucking pressure and achieving the chuck flatness. Also, CTE metrology is very challenging, as is flatness metrology. Methods are being researched at AIST, but a reference flat is needed, and for CTE a 1nm measurement resolution is necessary. Ohara has an experimental Clearceram material with very promising CTE characteristics, nearly flat. Asahi is working to reduce striae for TiO₂ doped glass, trying for an order of magnitude in delta-n.

Chris Walton (LLNL) reported that 77nm flatness on a mask substrate had been achieved, with defect values <0.1/cm². Defects are still 16X of specification.

Lutz Aschke (Schott Lithotec) reported that CTE of 1 ppb/K (1 σ) measurement capability, with 2 ppb/K accuracy, is needed; current best is <5 ppb/K, with <1 ppb/K homogeneity. Capability of 1 ppb/K is needed for 120°C resist baking.

Dick Eandi (Zygo) provided a list of critical issues: reticle flatness, better CCD resolution, special resolution down to 0.15 nm/pixel, location coordinates, reticle metrology approach (free-standing or chucked, horizontal or vertical), and the need for a standard electrostatic chuck.

Mike Sogard (Nikon) reported internal interest in thermophoresis as a defect mitigation solution on masks. Inspection and cleaning capability are needed at each handling step unless a mitigation approach is used throughout a given mask's lifetime. Licensing of thermophoretic patents may

require a collective bargaining approach; as an example SMIF was incorporated into SEMI standards even though it was patented. More work on thermophoretic technology is needed.

Henk Meijer (ASML) presented their approach to EUV mask carriers. The basic strategy is to minimize contact with the mask, and have actual contact points as far away from the pattern area as possible. Appropriate contact area materials must be chosen. The current ASML design, using a frame and cover inside a SMIF carrier, has a 5 mm separation between the frame and the pattern side of the mask. Mechanical design tolerances of the contacting effectors matches the tolerances of the mask.

Gerhard Kalkowski (Fraunhofer-IOF) reported on the effects of humidity on electrostatic chucking; the presence of humidity degrades the clamping force. Bipolar chucks have a zero-force region between the electrodes that needs to be addressed in understanding and standards.

Tom Coleman (Etec) reported that they prefer having the mask front, back, and sides grounded during e-beam writing. With proper grounding design to eliminate noise, beam deflection should not be a concern. Existing tool designs can accommodate some change in mask thickness.

Ken Racette (IBM) provided some data, presented by T. White. Carriers are being benchmarked, both RSP200 (SMIF) models and a variety of clamshell carriers. Earlier data was collated, showing that there is need for improved control even under storage (static) conditions.

Bernard Fay (representing Incam Solutions and Alcatel) reported on joint work in developing a FOUP style, "Next Generation Pod" carrier for EUV and EPL mask requirements.

T. White presented two topics for consideration: permanent fiducial marks, primarily intended for defect location on blanks (but could be used elsewhere downstream), and changing the mask substrate thickness to a value better optimized for EUV masks. Modeling work conducted by the University of Wisconsin indicates that a thickness of approximately 4.0 mm may be better suited to achieving 50 nm p-v flatness. The industry needs to consider and evaluate these options for technical merit, improvements, and tradeoffs, and economic impact.

After a productive discussion session (comments available in separate document), the workshop was adjourned on time.