SEMI P10 for Automated Mask Orders

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Mask Automation Workshop

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SEMI P10

- "Specification Of Data Structures For Photomask Orders"
  - Mask orders from mask customers to mask suppliers
  - Mask quality results from mask suppliers to mask customers
- P10 is NOT
  - Any arbitrary text file for mask orders
  - A software program to place mask orders
- The software user interface for P10 can be customized so long as the output data file is P10-compliant.
- SEMI P10 can include everything necessary for a complete and unambiguous mask order.

SEMI History and Development

- SEMI P10 was first published in 1990.
- Active participation includes
  - North America
  - Europe
  - Japan
  - Mask suppliers
  - Wafer fabs
  - Software developers
- P10 continues to be updated to support advancing requirements.
  - Revisions are being made annually.
  - Interim solutions are published on the SEMI P10 website.

Improvements Included in P10-0704

- XML Implementation for Mask Results
- Data manipulation expanded to facilitate calls to third-party software
- CD measurements restructured to allow “sets of groups” when CDs are to be analyzed as a variety of sub-groups
- CD X/Y specification and reporting enabled
- CD ISO/DENSE specification and reporting enabled
- CD “through pitch” specification and reporting enabled
- EUV substrate definition added
- Much more

Improvements Being Balloted for P10-0705

- XML Implementation for Mask Orders
- Facility to transfer of patterns back to the customer after data manipulation for customer review/approval
- EUV reticles
- Wafer exposure tool parameters
- AIMS tool measurement specifications
- Expanded Registration Specification and Reporting
- Much more

SEMI P10 Utilization

- All major merchant mask suppliers
  - Photronics
  - DuPont
  - Dai Nippon
  - Toppan
  - Compugraphics

SEMI P10 Utilization

- Many major mask customers
  - Agere (formerly Lucent, formerly AT&T Bell Labs)
  - Agilent
  - AMD
  - Motorola
  - National
  - Philips (MOS4 in Nijmegen and SSMC (Philips/TSMC JV) in Singapore
  - Texas Instruments
  - And many others not publicly known

SEMI P10 Objectives

- Shorten mask delivery time
- Reduce errors
- Lower costs
- Facilitate automation from design to wafer fab to
  - Define and/or view MDP processes upstream
  - Execute MDP operations downstream
  - Manage and control MDP complexity
  - Communicate mask parameters to the wafer fab
  - Correlate detailed mask quality data with specific mask order specifications.

SEMI P10 Ordering Capabilities

- Mask layout information
  - Pattern identification
  - Pattern placement
  - Mask titles
  - Barcodes
- Job decks for mask writing tools can be generated directly from P10.
- Business information (purchase order, prices, etc.)
- Delivery instructions
- Quality specifications
  - Registration
  - Critical dimensions
  - Defects
  - Materials (blanks, coatings, flatness, packaging, etc.)

SEMI P10 Ordering Capabilities

- P10 supports job deck creation for all mask types:
  - 1X full-field
  - 1X Ultratech reticles
  - 5X and 4X reticles (or any magnification)
  - Multi-product reticles (shuttle masks)
  - Multi-layer reticles (different layers of the same device on one mask)
  - Half tone reticles (AEPSM)
  - Multi-write reticles (AAPSM)
  - EUV reticles (submitted to SEMI for ballot in January 2005)

SEMI P10 Quality Results Capabilities

- SEMI P10 supports an integrated method for reporting mask quality which can be automatically correlated to any specific requirement in the mask order.
  - Registration
    - Individual measurement sites by location
    - Evaluation to specification by groups as defined by the customer
  - Critical dimensions
    - Individual measurement sites by location
    - Evaluation to specification by groups as defined by the customer
  - Defects
    - Binary defects (KLA)
    - Transmissive defects (Starlight)
    - Phase defects
  - Much more

P10 Data Specifically Useful in the Wafer Fab

- Reticle titles
- Reticle stepping distance
- Magnification
- Critical dimensions
  - Mean
  - Max error
  - Iso/Dense
  - X/Y
- Registration error
  - Scale
  - Orthogonality
  - Residual error (with scale and ortho removed)
- Percent of patterned area which is opaque/clear

Plans for Future Ballots

- Enable "Locally Variable Defect Criteria"
  - Multiple CD criteria within a single mask pattern file
  - See "Investigation of Smart Inspection™ of Critical Layer Reticles using Additional Designer Data to Determine Defect Significance" by KLA and Texas Instruments at BACUS 2003.
  - A likely capability to be implemented within SEMI OASIS (P39)
- The capability to include CD drawings within P10
- Maskless lithography in mix-and-match with masks

In Conclusion

- P10 provides the foundation for systems to automate, coordinate and control the entire design to wafer fab transfer.
- Participation in the SEMI P10 Task Force is welcomed from anyone with an interest and the time to contribute.