EXCITE: A MEDEA+ Extreme UV Consortium for Imaging Technology

Peter Zandbergen*, Wolf-Dieter Domke, Pietro Cantu, Philippe Thony, Sergei Postnikov, Jean-Yves Robic

ABSTRACT

In 2003, a new European initiative on EUV lithography process development was started through MEDEA+, named EXCITE (Extreme UV Consortium for Imaging Technology). The consortium consists of four IC makers (Infineon, Motorola, Philips, and STMicroelectronics), a group of equipment and materials companies (ASML, Carl Zeiss, Clariant, ELDIM, SAGEM, and LPICM) and four institutes (CEA-Leti, IMEC, LTM-CNRS and TASC-INFM).

The EXCITE project aims at developing EUV imaging capability for the 45nm technology node and beyond. In order to achieve this goal, a project was defined in which all aspects related to EUV lithography will come together to enable 45nm technology node patterning development on a full-field ASML alpha-tool by year-end 2005. The project has close links to other EUV based European projects, of which EXTATIC and EXTUMASK, developing the ASML alpha-tool and EUV mask infrastructure, respectively, are the two most important. The project has been set-up in such way to accommodate the individual pieces of EUV lithography through separate Work Packages (i.e. Resist, Mask, Modeling, and Metrology), all coming together in the "Patterning and Process Integration" Work Package, utilizing available EUV Litho Cells. The Grenoble, France based small field BEL EUV exposure tool plays a central role in the project.

PROJECT PARTNERS

PHILIPS, Infineon technologies, SAGEM, ELDIM, ST, Motorola, MEDEA+, ASML, TASC, CNRS, imec, Clariant, ZEISS, cea Leti

PROJECT SET-UP

Resist
Materials Characterization
EUV Resist Systems for < 45nm

Reticle
Shadowing Effects
Effects of Mask Imperfections

Metrology
CD, Profiling, Roughness
Overlay
Metrology Integration

Modeling
Imaging, Mask & Resist
Litho Simulator

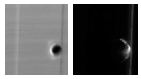
Patterning & Process
Process Development

EUV Litho Cell
BEL Grenoble 0.32NA
Support / Access
Performance Improvements

RESULTS

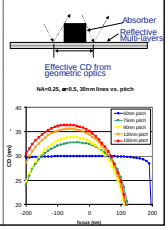
- Definition of EUV Resists specs
- Bulk litho characterization by open frame exposures at BESSY synchrotron gave insight to the impact of PAGs and polymers on sensitivity and contrast
- Balancing LER/sensitivity will be a major task in resist development
- Outgassing assessment BEL and α tool
- Solvent evaporation models during thin film spin coating result in a solvent gradient through film thickness
- Prototype resists available; still a large effort is required to reach production specs

Mask Imperfections:

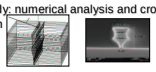


Bright and Dark field at-wavelength microscopy images of an EUV mask blank with programmed defect below the ML

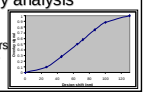
Shadowing Effects:



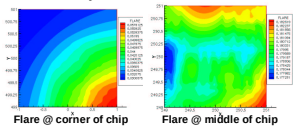
- CD and profiles
  - Notched gates study: numerical analysis and cross section comparison

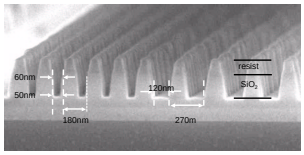


  - 3D structures analysis : preparation of wafers and simulation of parameter effects on scatterometry spectra (ex.: Y pitch of a grid)
- Overlay: scatterometry analysis
  - Simulations
  - Design and test wafers
  - Demonstrations by suppliers
  - Spectroscopic ellipsometry



- Development of 2D and 3D models for rigorous simulation EUV masks
- Simulating BEL tool image performance: flare, LER
- Buried defects printability simulation in multi-layer stack EUV masks





Etched SiO_2 with EUV resist
Ł 60nm trenches at 180nm pitch

BEL 0.32NA tool @ CEA-Leti

CONCLUSION

A European consortium on EUVL imaging technology named EXCITE has been established through MEDEA+ initiatives in 2003. The EXCITE project aims at developing EUV imaging capability for the 45nm technology node and beyond. Significant progress is being reported in all aspects of the project.

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CONTACT

Primary contact:

Peter Zandbergen
Philips Research Leuven
Kapeldreef 75
B-3001 Leuven, Belgium
e-mail: peter.zandbergen@philips.com

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