Update from More Moore
Serge Tedesco CEA-LETI

High resolution and low LER EUV resist
Best achieved results on CAR with IL-EUV at PSI

Film thickness 55 nm. Resolution 32.5 nm dense lines.

Few improvements achieved in 2005
Resist status vs ITRS roadmap for the 32 nm hp

Resolution and sensitivity meet the requirements, LER remain the critical issue.

- ITRS Roadmap for 3 nm Node EUV Resist, normalized \( \sim 1 \)
- MMO 2004 Resist G
- MMO 2005 Resist EUV25
- PMMA

Resolution

Sensitivity

LER (3Sigma)
Resist status vs ITRS roadmap for the 22 nm hp

CAR doesn't fulfill Resolution, sensitivity and LER requirements for 22 nm hp

Resolution

Sensitivity

LER (3Sigma)

- ITRS Roadmap for 22nm Node
- EUV Resist, normalized to 1
- MMO 2004 Resist G
- MMO 2005 Resist EUV25
- PMMA
More Moore orientation for 22 nm hp

Because of the lack of improvement during 2005 the resist has been ranked issue number one for EUV-lithography at the international EUV symposium at San Diego.

As a consequence the decision to reinforce the resist activity in more Moore has been decided. The orientation is to study alternative to CAR by looking at new resist platform.

Two new specific tasks have been introduced one will be carried out by IMEL and the other by introducing a new partner the University of Birmingham.

IMEL Demokritos will work on molecular resists based on polycarbocycle derivatives: material optimization and lithographic evaluation.

University of Birmingham is involved to develop and optimise new molecular photoresists based on Fullerences and Triphenylenes.
More Moore Partners for Resist evaluation

Université of Birmingham
Alex Robinson

imec
Peter Leunissen

CEA Leti
Cyril Vannuffel

CEFIR
Jean-Hervé Tortain

elettra Synchrotron Light Laboratory
Michele Bertolo

eNLR
David Nijkerk

Electronic Materials
Karl van Werden

IMEL
Evangelos Gogolides

ITWG meeting San Jose February 2003, 2006
Newly-synthesized Polycarbocycles, under Evaluation as components of Molecular Resists

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ITWG meeting San Jose February 2003, 2006
Lithographic Results at EUV
(Evaluation at Sandia and Sematech North)

Sub 40nm lithographic features obtained under EUV exposure
(at Sematech North) for the M21-based resist formulations. Dose: 48 mJ/cm²

M17-based material
80/90/100nm (1:1)
Dose: 10.5mJ/cm²
(EUV SematechNorth)
Fullerene and Triphenylene Patterning

Both the fullerene derivatives (a) and the triphenylenes (b & c) are capable of sub 20 nm patterning.
Initially we used hexamethylmethoxy melamine crosslinker and triphenylsulfonium triflate photoacid generator to amplify the sensitivity.

Significant sensitivity improvements were seen (for instance from 650 to 7.5 µC/cm².)
Conclusions

• 32.5 nm resolution was reached by CAR resist which give hope that CAR could be pushed for the 32 nm hp but LER is still a critical issue.
• But we don’t expect CAR could reached resolution, sensitivity and LER for the 22nm node.
• Research on „New“ resist has been introduced in More Moore
Rocks to the 22 nm?

- CAR improvement:
  - Polymer matrix type, Mw decreasing
  - PAG/Quencher concentration and type
  - ....

- LER could be improved through process resist smoothing:
  - Surface conditioning
  - CO2 supercritical
  - Etching
  - ....

- Molecular resist with added CA functionalities
- Copolymer self assembled resist
- ....