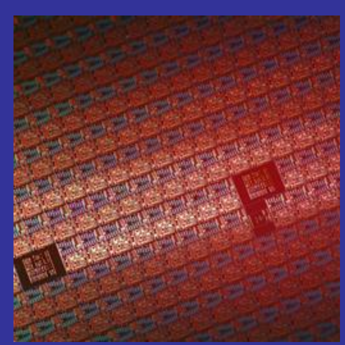
Accelerating the next technology revolution

2012 Resist TWG

Karen Petrillo

Serge Tedesco



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Introduction

1. Follow-on from Resist TWG meeting in Miami, Oct 2011
2. Introduce some exploratory EUV research with the primary focus on LWR reduction

- **Review from last meeting:**

Outgas testing

- Major area of concern
  - Limited testing capabilities available
  - Limited throughput on existing tools
  - Questions regarding the test procedures still exist within the litho community

EUV and e-beam exposure for witness plate testing

- Published data showing that there is little to no correlation between e-beam and EUV lithographic results for some materials
- Should we be concerned that e-beam exposures during witness plate testing is giving us an accurate assessment of reflectivity loss?

E-beam and EUV Lithography Performance Comparison, Greg Wallraff

- Significant performance differences seen between e-beam and EUV litho performance
  - Differences in sensitivity and imaging
  - General conclusion: E-beam can't be used to predict EUV performance

Imaging comparison

IBM

Resist	EUV 30nm	E-beam 30nm	Comment
Resist A1	10.66 mJ	65 uC/cm^2	E-Beam results consistently show top skin and defects not present in EUV
Resist A2	9.23 mJ	60 uC/cm^2	E-beam doesn't predict correctly relative dose for EUV
Resist A3	10.50 mJ	90 uC/cm^2	Resist A1 highest EUV dose Resist A3 highest e-beam dose

Outgas from Resist Irradiated with EUV & 2keV electrons, Seiichi Tagawa

- E-beam and EUV radiation effects expected to be similar on resist polymers
- PAG is believed to be primary contributor to outgas contamination – believed to be similar for both e-beam and EUV
- Similar conclusion for some metal containing resists: Hafnium oxide in particular

Resist Outgas Testing for NXE, Noreen Harned

- Review of tester protocols
- 3 qualified tools available as of Oct 2011, 1 more in progress, 1 planned
  - 4 consortium owned
  - 1 privately owned
- All resists and process conditions need to be tested
- Correlation between e-beam and EUV found based on a 4 sample test
  - Correlation to ~30 additional samples
- Outgas tool can use any combination of EUV and e-beam as long as specs are met
- Outgas test can be based on direct EUV reflectivity loss instead of XPS

EIDEC plans, Soichi Inoue

- LTJ tool purchased
  - Expected availability 1Q2012
  - Gate may be XPS delivery
- E-beam – e-beam exposures
- Planning to check validity of e-beam and EUV contamination using University of Hyogo beam line

ROX Tool update, Greg Denbeaux

- Exposure: EUV on wafer, e-beam on witness plate
- Certified just prior to Oct meeting
- Limited throughput, ~10 - 14 samples per month at current time
  - Shared metrology tools
    - Being addressed to enhance throughput

NIST update, Charles Tarrio

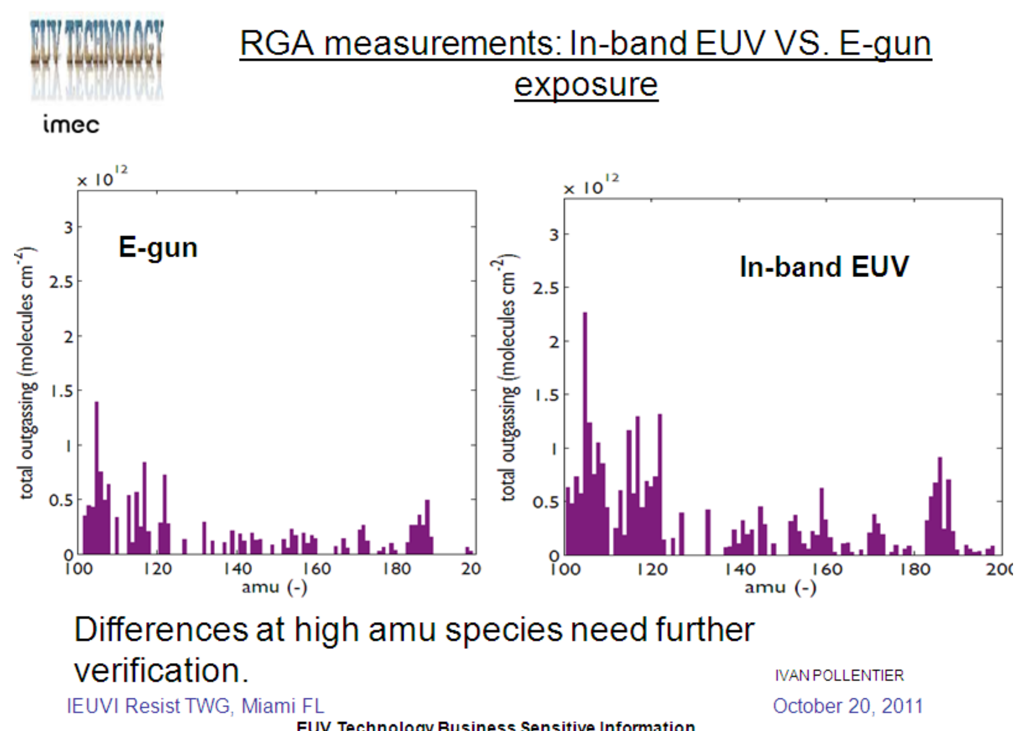
- Exposure: EUV on wafer, EUV on witness plate
- Certified Aug/Sept time frame, just completed 1st customer test as of Oct meeting
- Govt owned: Freedom of information act, data can be requested from outside source.
  - Took time to get NDA's in place
- Throughput 4 – 10 samples per month

IMEC update, Ivan Pollentier

- EUV and e-beam system
- Certification in progress
- RGA analysis of underlayer testing
  - Underlayers can have small impact on resist outgassing
- RGA analysis of topcoats
  - 2 tested, and shown to mitigate outgas products
  - No data on topcoat impact on litho performance
  - ASML said they would accept total stack outgassing as acceptable

EUVL Technology Update, Rupert Perera

- EUV – EUV tool
  - Can add e-beam if desired
- Direct comparison of EUV and e-beam outgassing using RGA
  - Differences at high amu where we see the correlation to witness sample contamination



Summary of Oct 2011 Meeting and Future Actions

- **Very interactive meeting with lots of questions and discussion**
- **Suggestions for future work:**
  - Round robin testing to be sure all tools are giving the same answer. Suggest 2X per year
- **Future actions that require data driven solutions:**
  - E-beam vs. EUV contamination
  - Role of process parameters in contamination
  - Testing by families
- **Additional requests from litho community:**
  - Agreement from resist suppliers not to duplicate tests
  - Underlayer and topcoat testing protocols
- **Limited test capacity is still an issue for all of the suggested actions, even with combined consortia capabilities**

Agenda

8:00 AM – 8:15 AM	Welcome and Introductions	*K. Petrillo, SEMATECH*
8:15 AM – 12:00 PM	Outgas Testing with an Update on the e-beam vs. EUV Exposures:	

- *Rupert Perera – EUV Technology*
- *Toshiya Takahashi – EIDEC*
- *Roel Gronheid – IMEC*
- *Shannon Hill – NIST*
- *Greg Denbeaux – CNSE*

Break

Exploratory EUV Research with Primary Focus on LWR Reduction:

- *Shinichiro Kawakami - TEL*
- *Alessandro Vaglio Pret – IMEC/KUL*
- *Chris Ober – Cornell University*
- *Robert Brainard – CNSE*

12:00 PM – 1:00 PM Lunch

Winchester room

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