



SEMATECH Outgas Update

Yu-Jen Fan

February 22nd, 2015

IEUVI Resist TWG

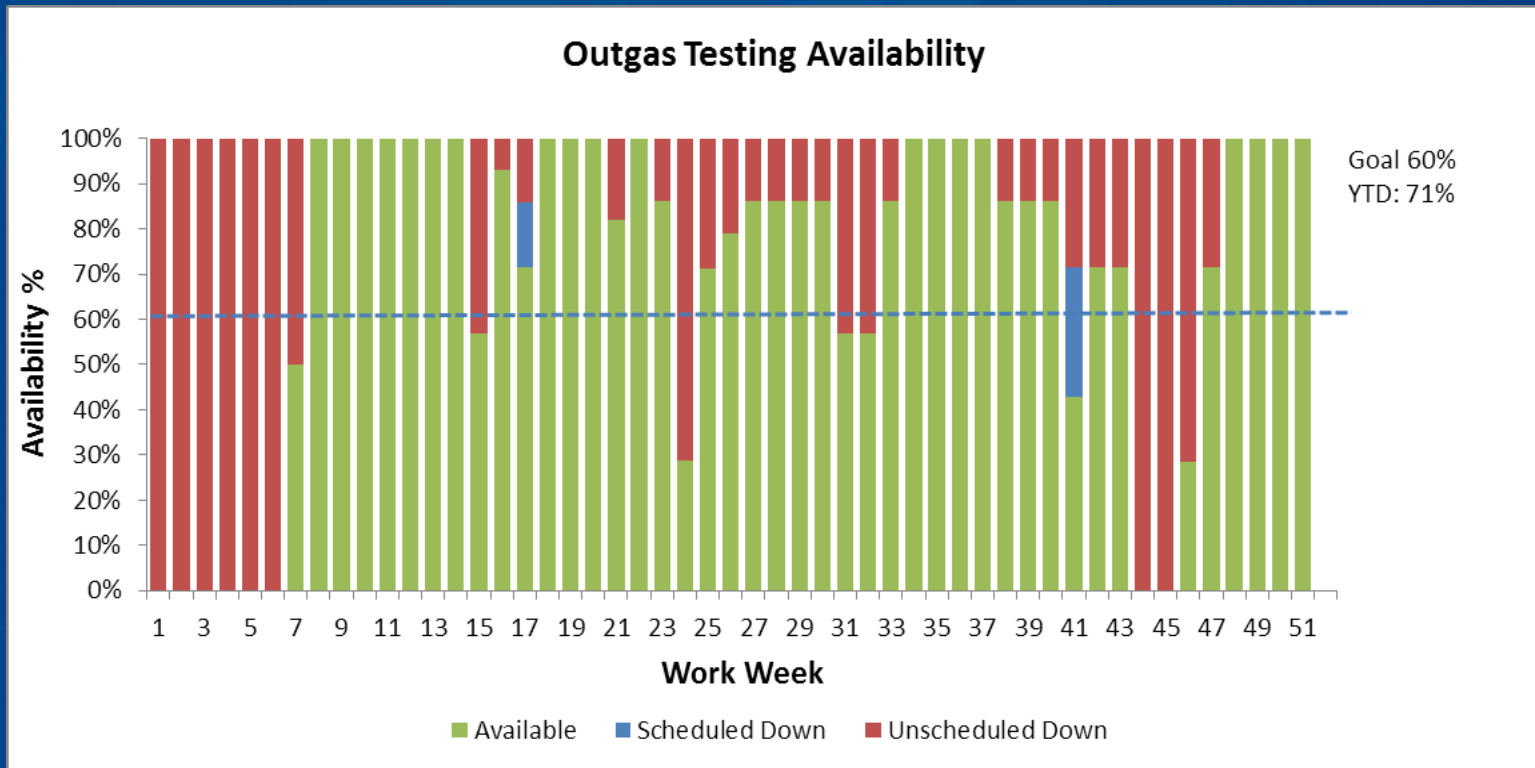
SEMATECH outgas tasks in 2014

- Maintain tool uptime and deliver reliable outgas testing support to member companies
- Support round robin test and work with outgas test houses for site variation reduction
- Verify family outgas test with multi-suppliers
- Facilitate novel resists outgas testing

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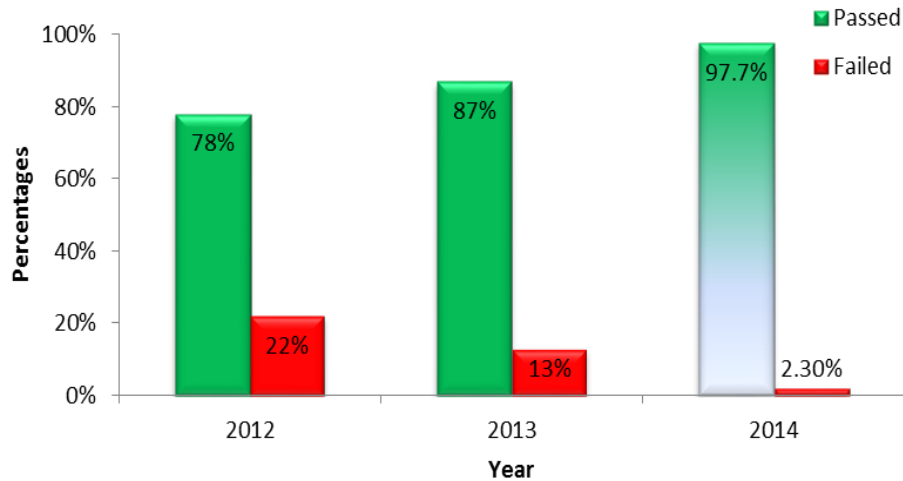
2014 EUVT availability and uptime



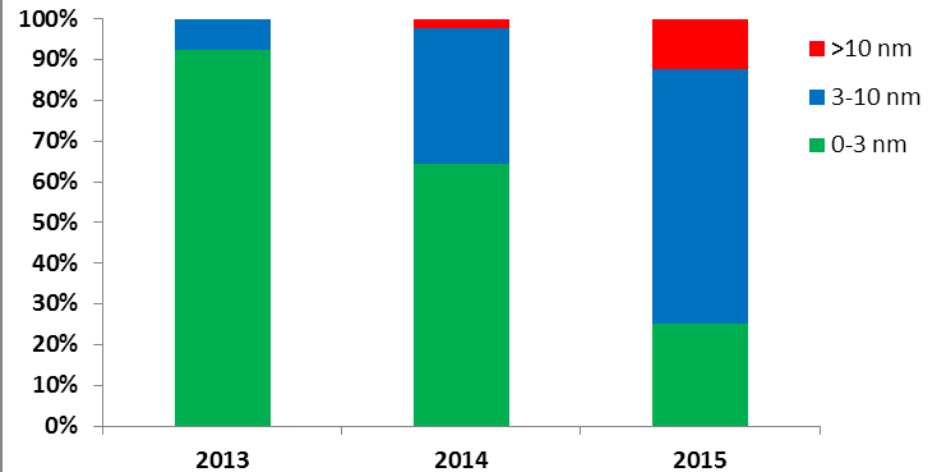
- Overall tool uptime: 71%
- Sample completed: 221

Outgas spec relaxation

Cleable sample passed rate



Outgas testing results



- Outgas cleanable specification changed in 2014
- Cleanable pass rate: 97.7%
- Non-cleanable pass rate: 100%

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Round robin test

- Model resist experiments for tool matching
- Temperature monitoring using SensArray
- Common ratio of pumping speed vs. exposure area
- Contamination limited regime (CLR) test
- Commercial EUV resists for outgas results comparison

Team effort

- EIDEC – Soichi Inoue, Eishi Shiobara
- imec – Ivan Pollentier
- NIST – Robert Berg, Shannon Hill, Charles Tarrío, Thomas Lucatorto

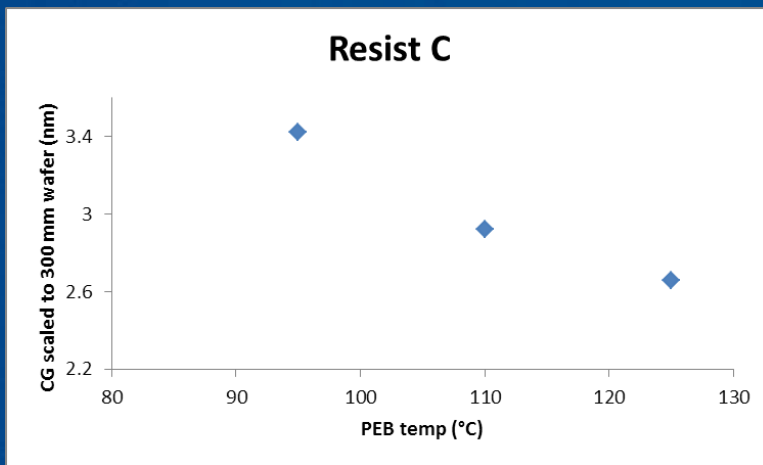
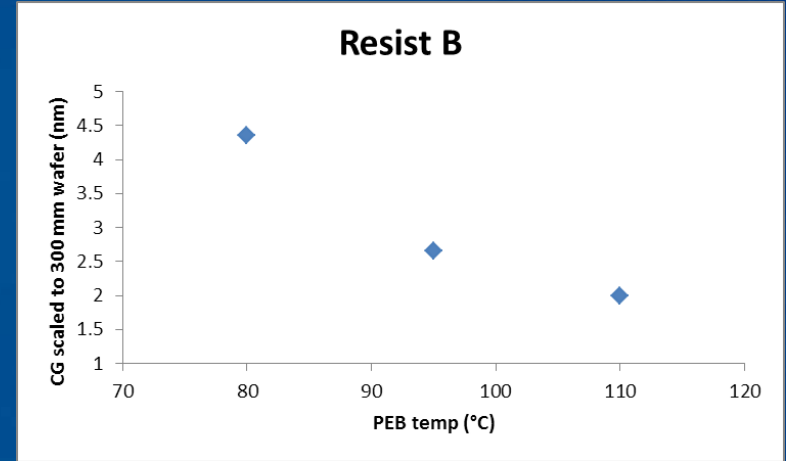
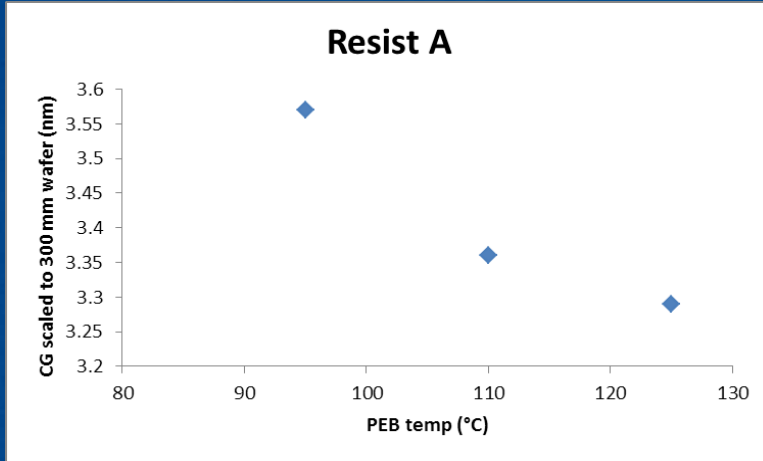
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Current status of family test

- The first resist family material has passed witness sample based outgas test and certified for NXE platform exposures (SEMATECH-JSR press release in Dec. 2014).
- Witness sample based outgas family test can be as low as **1** sample test per resist family.
- Resist family materials from multiple suppliers have demonstrated similar PAG correlation and passed the family outgas test

PEB conditions for outgas testing



- A similar “family-like” test for process conditions can be considered for further reduction in outgas testing
- Resists were selected from current calibration materials
- Higher PEB temperature results in lower contamination growth

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Facilitate novel resists outgas testing

- Multiple non-CA materials have been tested at SEMATECH
- They have passed both cleanable and non-cleanable specifications
- We don't have enough data to support whether outgas from non-CA materials can be cleaned

SEMATECH papers in resist materials

- **2/24 Tue 1:30 pm, Mark Neisser, oral talk**
Novel resist approaches to enable EUV lithography in high-volume manufacturing, 9422-20
- **2/25 Wed 11:00 am, Yu-Jen Fan, oral talk**
First results of outgas resist family test and correlation between outgas specifications and EUV resist development, 9422-36
- **2/24 Tue 6:00 pm, Cecilia Montgomery, poster**
Novel processing approaches to enable EUV lithography toward high-volume manufacturing 9425-28



Acknowledgement

- ❖ SEMATECH outgassing team
- ❖ CNSE SUNY PI - Gregory Denbeaux
- ❖ ASML - Noreen Harned, Gijsbert Rispens, So Van Pham
- ❖ JSR Micro - Ken Maruyama, Ramakrishnan Ayothi
- ❖ Shin-Etsu - Jun Hatakeyama, Rich Hershey

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