RESIST OUTGASSING

GOALS of IEUVI industry efforts:

Help identify what levels of resist outgassing are of concern for:

- Near-term Alpha/Beta Scanners
- 2010-2013 production Scanners
- > 2014 EUV scanners

Identify relatively inexpensive, fast-turnaround testing required for any outgas limits

Two primary paths currently exist for testing resist outgassing:

- § Counting molecules outgassed
- § Determining reflectivity damage on 'witness' mirror samples

Today's agenda:

Counting molecules:

SEMATECH's outgas results and limits

University of Albany and NIST data on species severity

Witness mirror testing:

University of Albany and IBM projects to produce high-outgas resists for calibration of other witness plate test sites.

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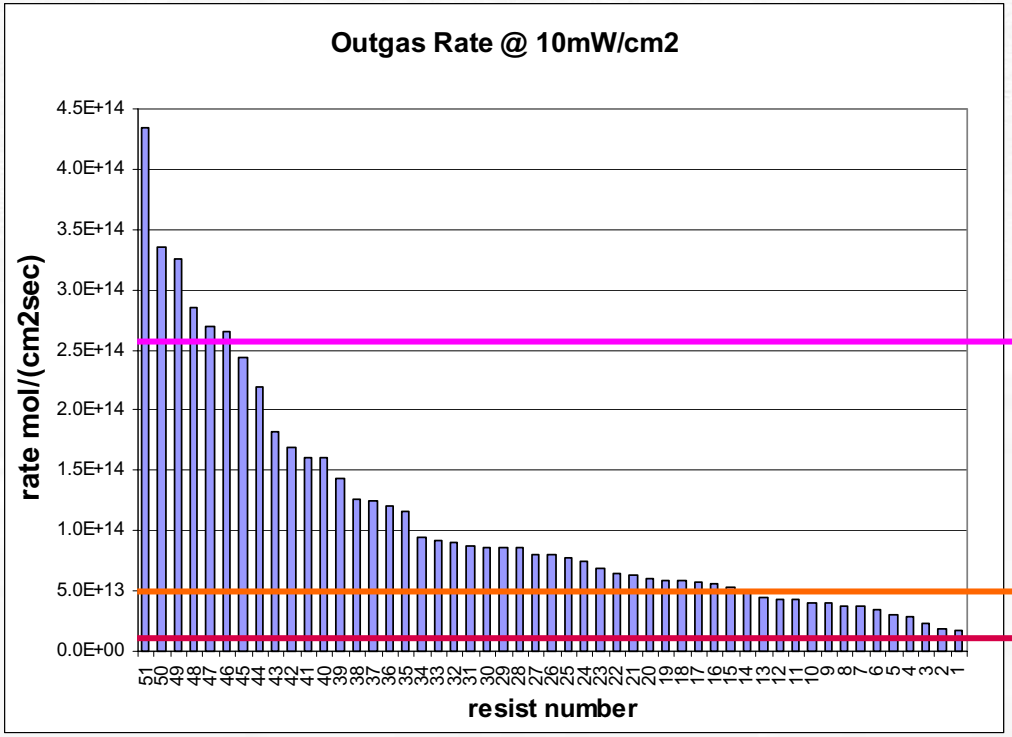
SEMATECH Resist Outgassing

SEMATECH tested outgassing for 119 resist samples in 2007 out of 224+ used on SEMATECH MET tools.

- **Roughly half of samples waived due to similar chemistries.**

Results for 51 samples from Commercial Resist Suppliers plotted below in order of decreasing outgassing.



SEMATECH spec MET tools
2.6E+14 molecules/(sec*cm²)
(roughly Scaled to 10mW/cm²)

ASML 'concern' ADT tools
5E+13 molecules/(sec*cm²)
Sapporo Optics Contamination TWG

Nikon spec EUV1 tools
7E+12 molecules/(sec*cm²)
Sapporo Optics Contamination TWG

It will be challenging to get resist outgassing down to levels of concern to scanner suppliers

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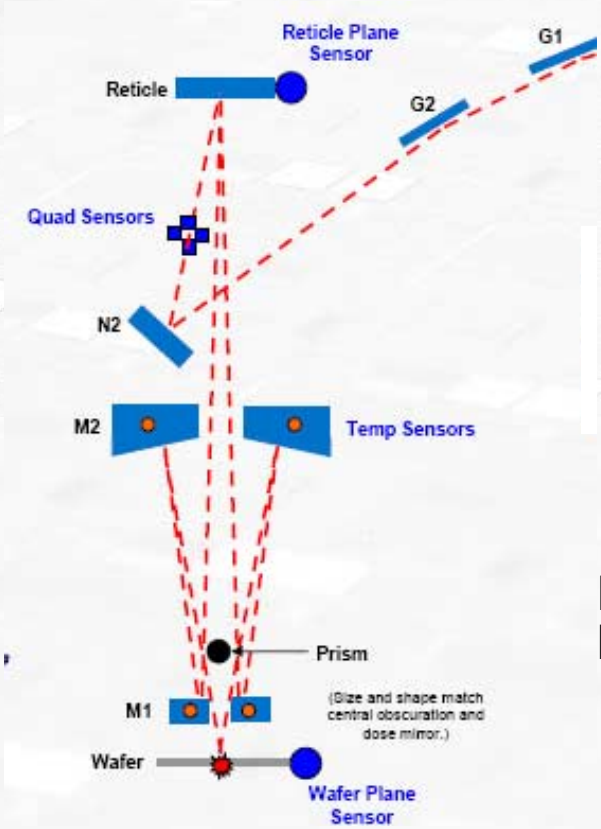
SEMATECH Resist Outgas Spec:

- Original Intel/SEMATECH spec [6.5E+13 molecules/cm^2] based on 2003 back-of-the-envelope calculations on risk to last mirror in optical lens.
- Spec relaxed over years to 6.5E+14 molecules/cm^2



Courtesy Matt Malloy

Current spec equivalent to (LBNL MET):
225 fields/wafer, 36 wafers/week, 40 weeks/year, 3 years
Surface area of M2 coated to one monolayer with C
20% of all outgas molecules hit M2
85% of all molecules that hit stick to M2
Each molecule that sticks generates 5 C atoms
At end of 3 years have ~1% reflectivity loss on M2

No sign of measurable reflectivity loss in optical lens of MET tools.

- **Damage seen in Illuminator optics**

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Witness Plate Testing

Goal of SEMATECH/Univ. Albany/IBM/AMD/Intel/IMEC effort:

Demonstrate high-outgas resist sample(s) that produce a high enough damage signal per wafer in TNO test to enable calibration of alternative witness plate test sites.

- **Recall ASML/TNO fail if 2% reflectivity loss per 300mm wafer.**
- **A sample that is near or above this level would validate ASML view on resist outgas test need for ADT tools.**
- **A sample that is near or above this level will permit calibration of alternative test sites.**
  - **This would be very useful in extending study to HVM tools.**

<u>Presentations</u>:

Albany high-outgas sample development – Greg Denbeaux for Robert Brainard.

IBM high-outgas sample development – Greg Wallraff

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