



EUV Stimulated Resist Outgassing BOC Edwards Activities

Anthony Keen

IEUVI Resist TWG

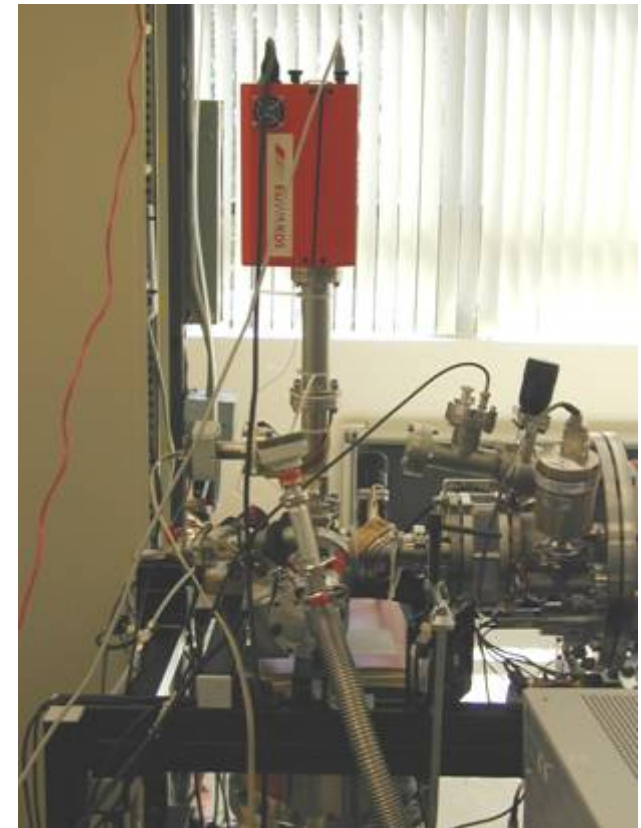
San Jose, 3rd March 2005

Why Do Outgas Measurements?

- Motivation for outgassing measurements is to qualify all the materials for use in the EUVL tool against requirements for optics lifetime.
 - Vacuum outgassing budget specified for all material and components in the litho tool.
 - Partial pressure requirement for the PO Box $\sim 10^{-9}$ torr.
- BOC Edwards has outgas qualified 200+ materials and components for various EUVL suppliers using throughput method.
 - Measurements performed with a known pumping speed .
 - Total and partial pressure recorded using Residual Gas Analyser RGA (or QMS) as $f(t)$.
 - Outgassing rates quoted in torr.l/s or mbar.l/s or Pa.m³/s.
- The resist coated wafer should be treated like any other component in terms of vacuum outgassing qualification for acceptance in the EUVL tool.
 - Except that it represents a fresh (continuous) outgassing source with each new wafer introduced (every 30 seconds?) while the rest of the tool is continuously pumped.
- Stimulated resist outgassing vs. short term solvent outgassing?
 - Important to quantify level of outgassing from both the stimulated resist and the solvent.

Experimental Setup

- Outgassing measurements were performed using 200amu residual gas analyser.
- The pumping speed at the chamber was approximately 70 l/s.
- Chamber base pressure better than 5×10^{-7} torr, rising to 1×10^{-6} torr during exposure. Sensitivity limit of the RGA was 1×10^{-12} torr.
- Wafer samples positioned 90cm from plasma, 45° to both EUV beam and RGA.
- EUV light filtered by a 200nm thick zirconium foil, size 1cm^2
- Exposure area 1.4cm^2 , exposure time 300 seconds.



Source Conditions

> Measurements were performed using EUV from a z-pinch gas discharge source.

> Exposure conditions **Power 1**

- 1.4kW input power 14W EUV in band into 4π sr
 - =0.5% CE into 2π sr
 - power density achieved 200 mW/cm²



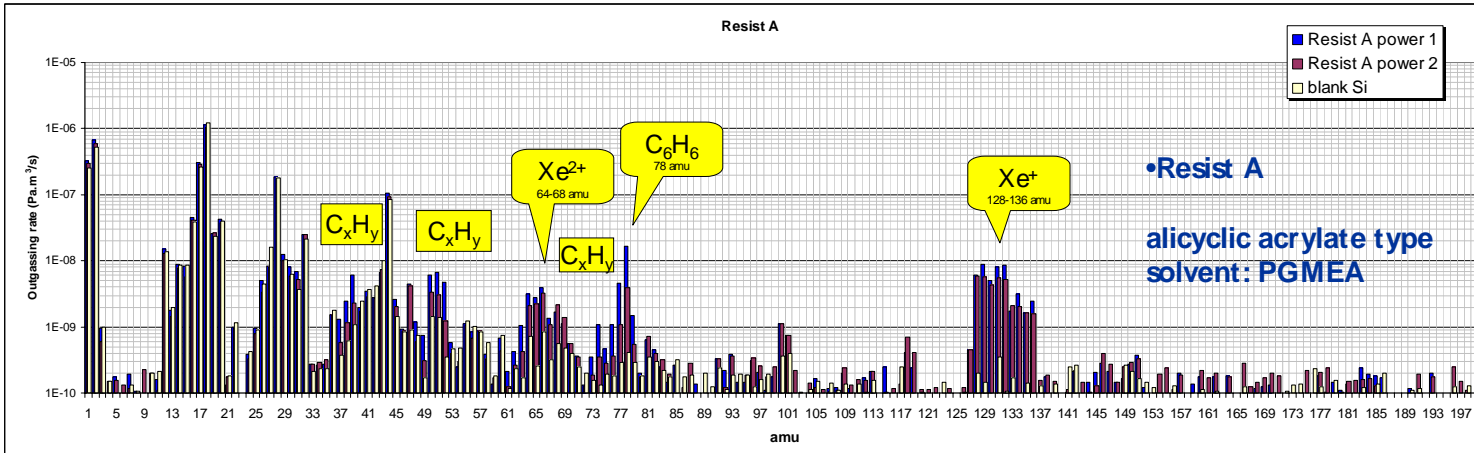
> Exposure conditions **Power 2**

- 1kW input power 9W EUV in band into 4π sr
 - =0.5% CE into 2π sr
 - power density achieved 135 mW/cm²

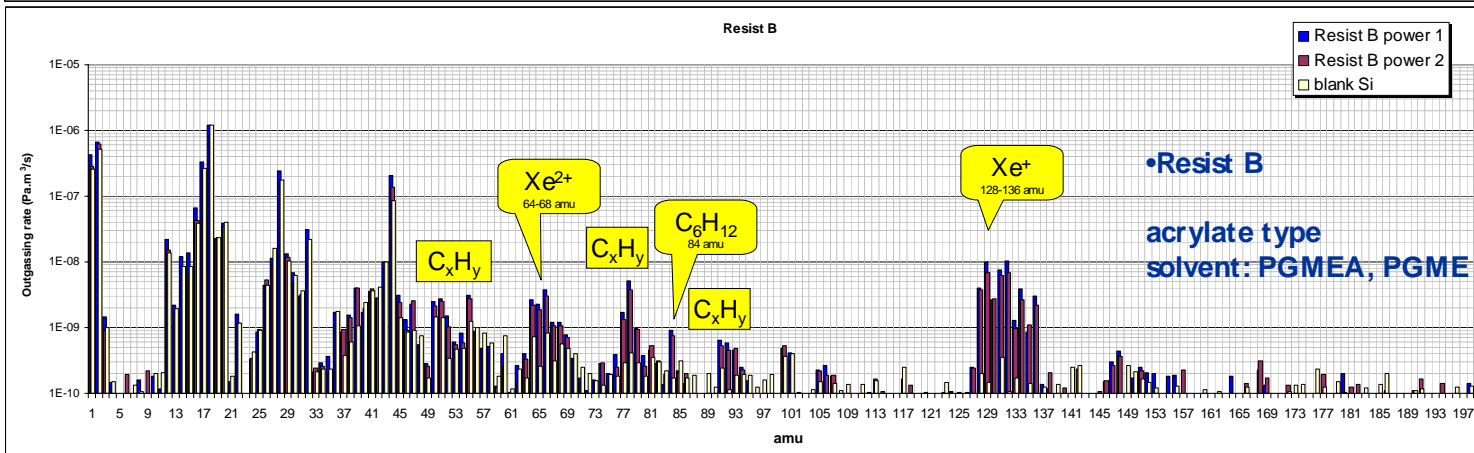


Typical sample exposure

EUV Stimulated Resist Outgassing



Resist A:
78amu due to C₆H₆ identified from cracking pattern as Benzene outgassing from resist PAG.



Resist B:
84amu due to C₆H₁₂ Identified from cracking pattern as Cyclohexane.

- > Estimate of total hydrocarbon outgassing rate for a 300mm wafer 5×10^{-5} torr.l/s
- > Compare with typical clean stainless steel outgassing rate of 5×10^{-10} torr.l/s.cm²
- 5 • equivalent outgassing rate of ~1000m² stainless steel.

Summary

- BOC Edwards is planning to continue measurements of EUV stimulated photoresist outgassing.
- In absence of another contamination detector RGA likely to be employed as monitor of vacuum environment so it's essential to understand outgassing of components (resist included) in a method which is traceable to the tool as a whole.
- We believe it is important to adopt a standard method to qualify resists in terms of outgassing rates against tool requirements and would like to canvas interest for such an idea.
- Allied with conventional photoresist outgassing BOCE also believes that outgassing of solvents over short timescales will be a significant contribution to the outgassing load contributed by the wafer. It is therefore important to quantify this effect.