



AZ EUV UL Overview

For SEMATECH TWG Presentation

AZ Electronic Materials US Corp.

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Talk Outline

- ▶ Introduction
- ▶ EUV underlayer requirements
- ▶ EUV underlayer benefits.
- ▶ Summary

Introduction

- ▶ EUV needed by industry

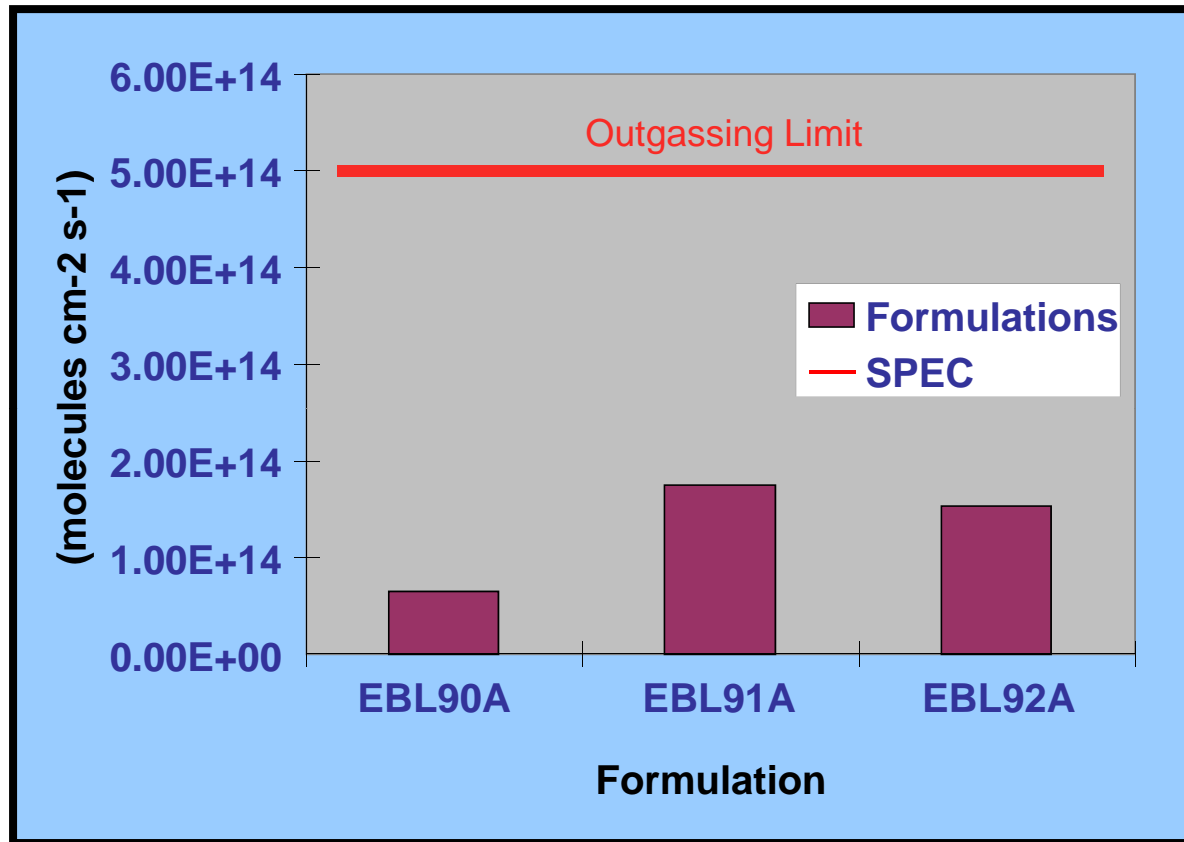
- ▶ Resist and tool development underway but challenges remain
 - Image collapse
 - LWR
 - Sensitivity
 - Resolution

- ▶ Ancillary materials can help with this
 - Under Layer (covered in this paper)
 - Rinse (see conference papers)

Fundamental Requirements for EBL Materials

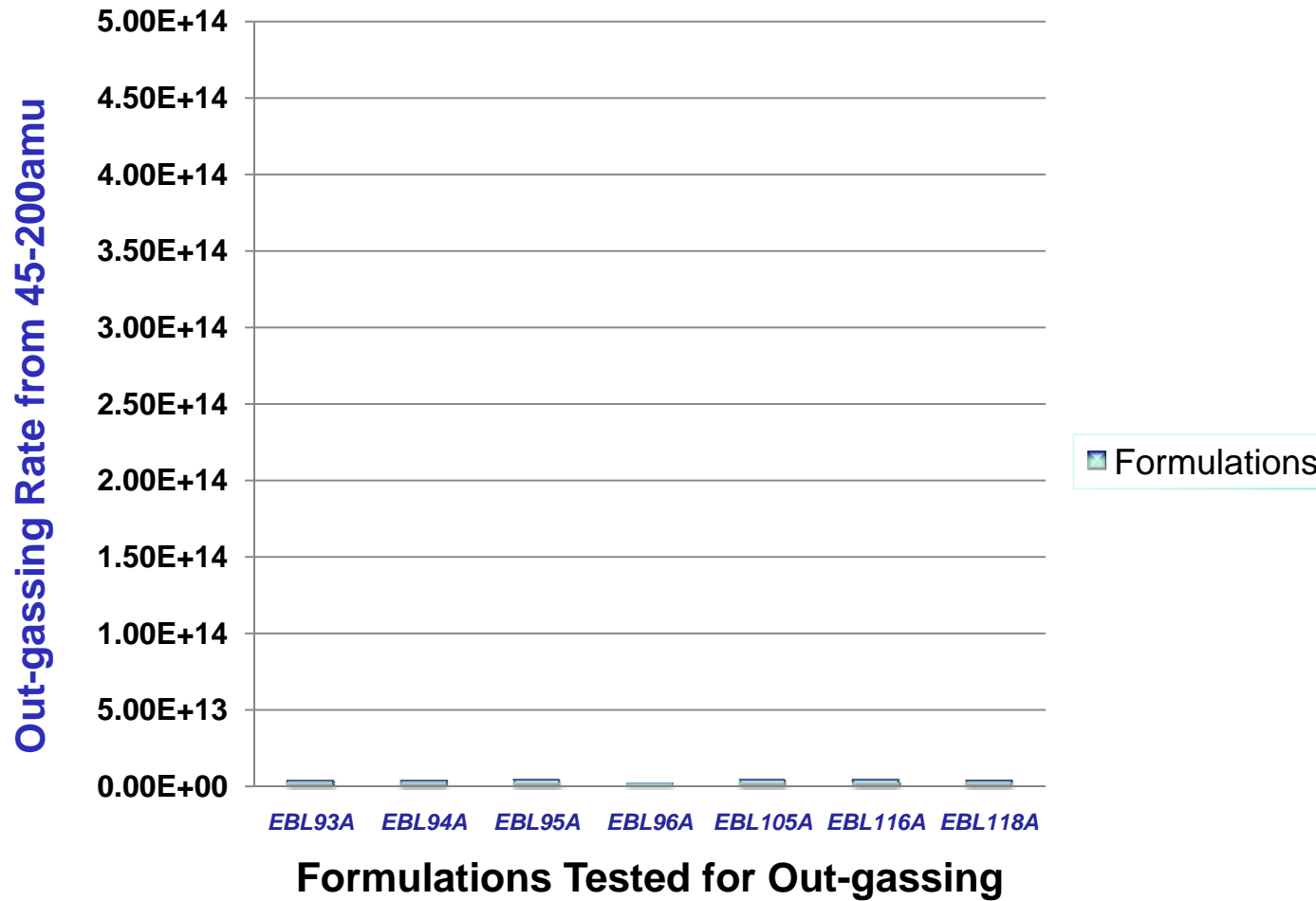
1. Good coatability for very thin film, \approx / $<$ 10nm (resist FT \approx / $<$ 60nm)
2. Low outgassing under vacuum during EUV exposure
3. Good resist compatibility, good profile and resistance to substrate variation.
4. High etch rate (AZ platform polymers have \sim 2 times faster etch rate than 193nm resist)

AZ EUV Underlayer Outgassing Summary

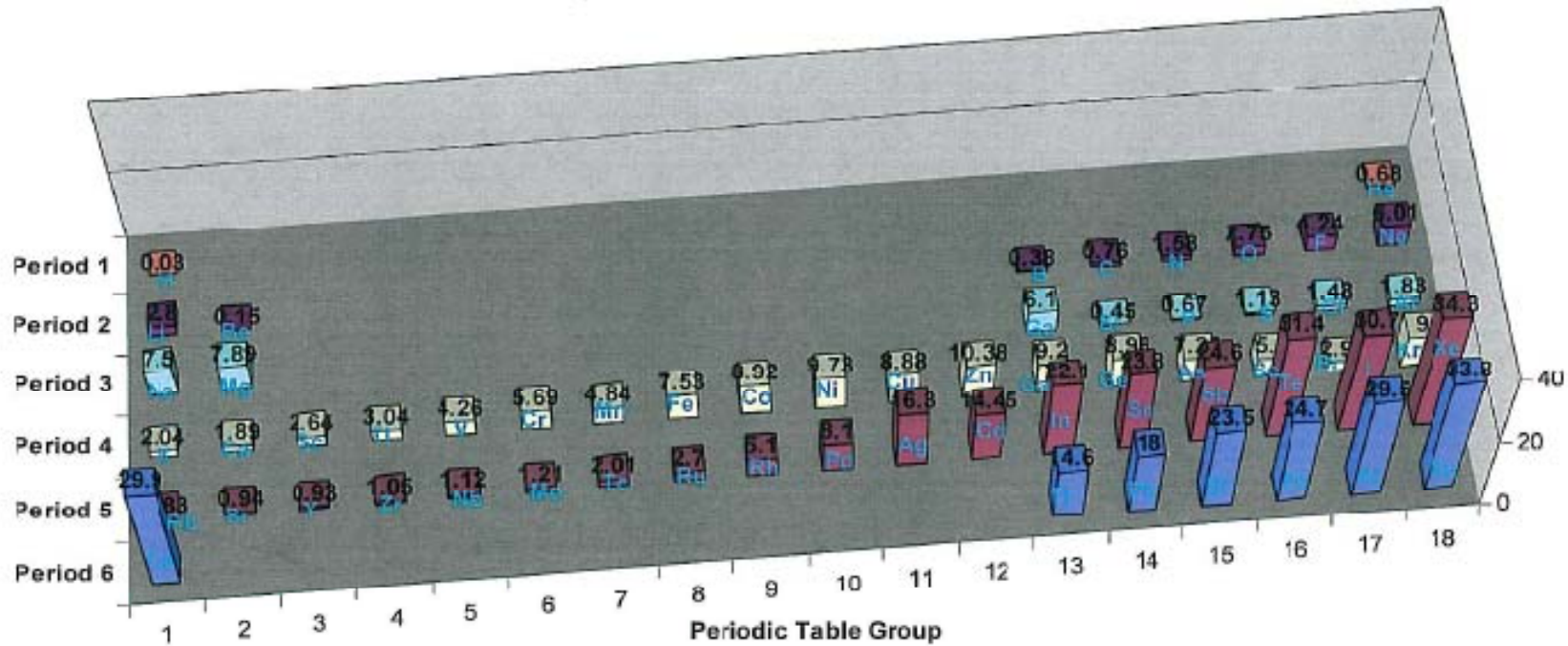


- Outgassing was done at IMEC facility using method suggested by ASML.
- All three materials meet the outgassing criteria for unlimited exposure on ASML EUV tools.

AZ EBL Out-gassing Report from IMEC

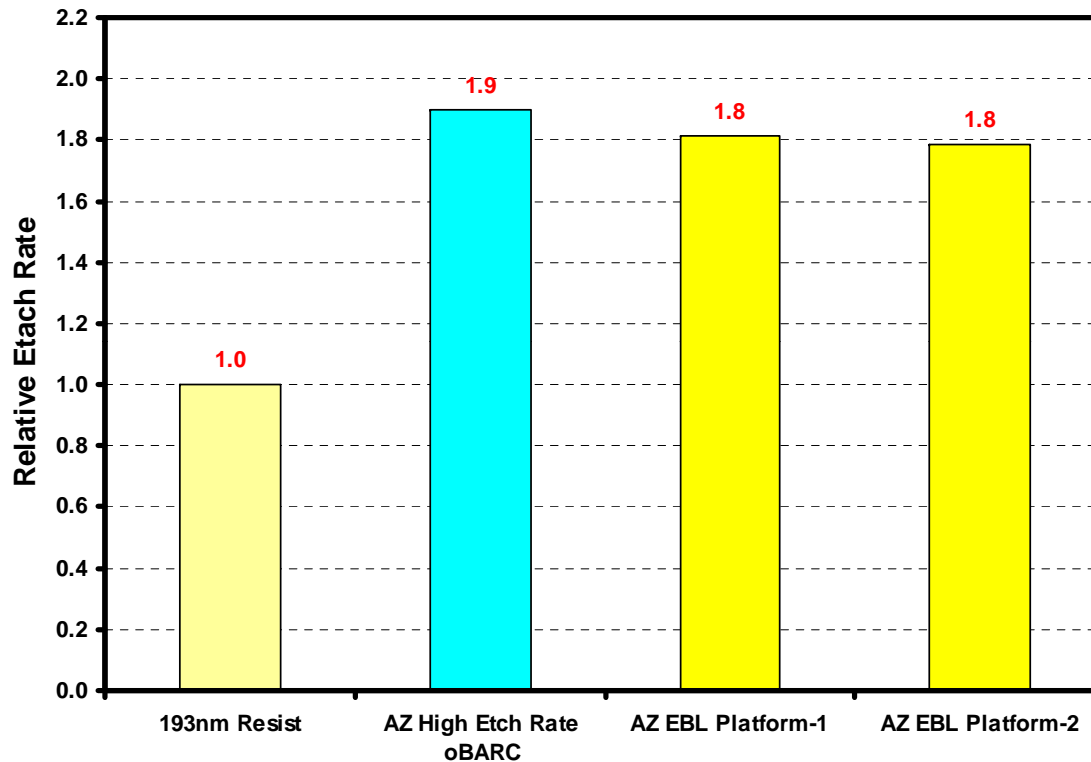


Atomic EUV Absorbance



- ▶ EUV absorbance may affect underlayer performance
- ▶ AZ is actively investigating this effect

Preliminary Etch Selectivity Test for AZ EBL Platform Polymer **vs.** 193nm Resist



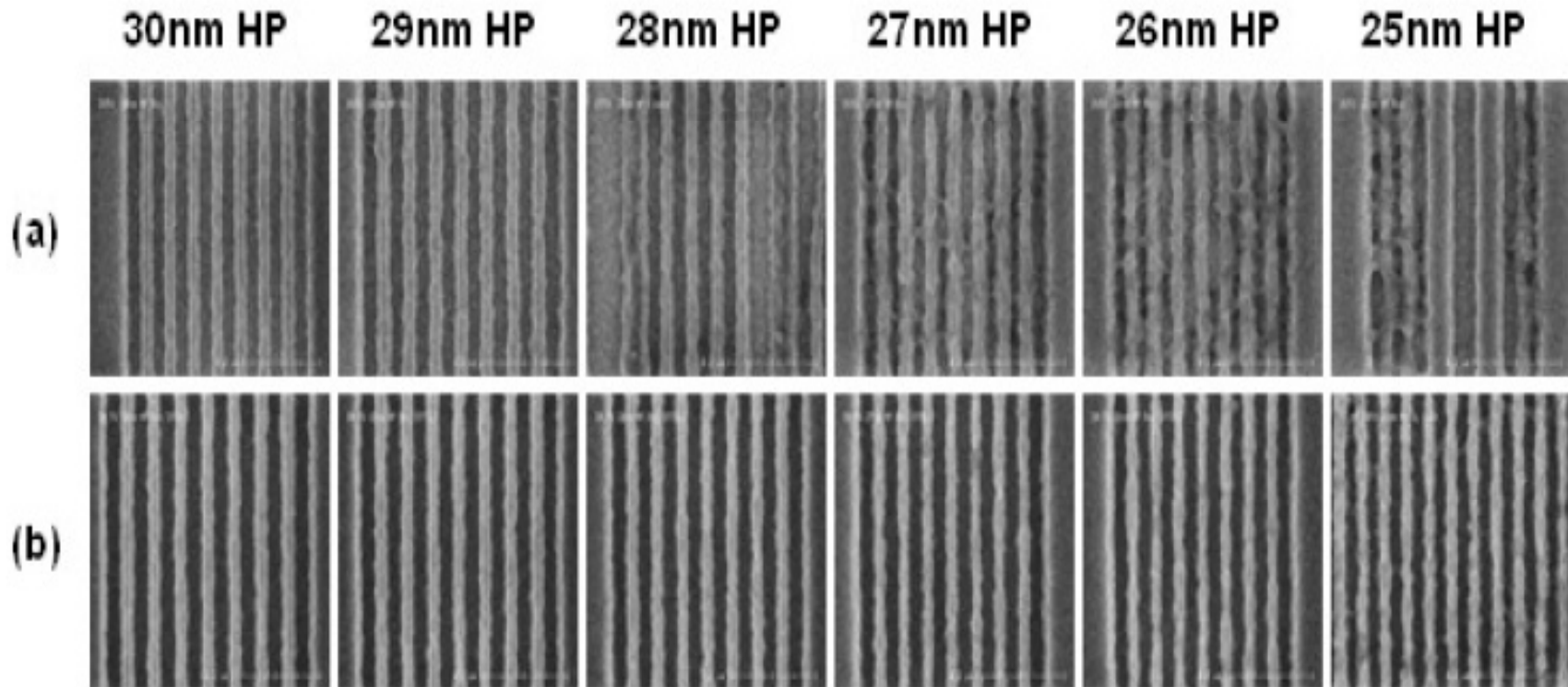
Ar	150(SCCM)
O2	20(SCCM)
CF4	50(SCCM)
H2 Pressure	266
Trigger Pressure	5.00Pa
Process time	10sec
Top Power	500W
Wafer Power	100W

Currently, AZ is focusing on development of high etch rate platforms for EBL applications. As shown in above graph, AZ EBL Platforms have as high as 1.8 etch selectivity compared to regular 193nm photoresist. Etch rate is tunable if necessary.

Benefits for EBL Materials

1. Better Z factor for resists
2. Improved resist profile
3. Wide substrate compatibility

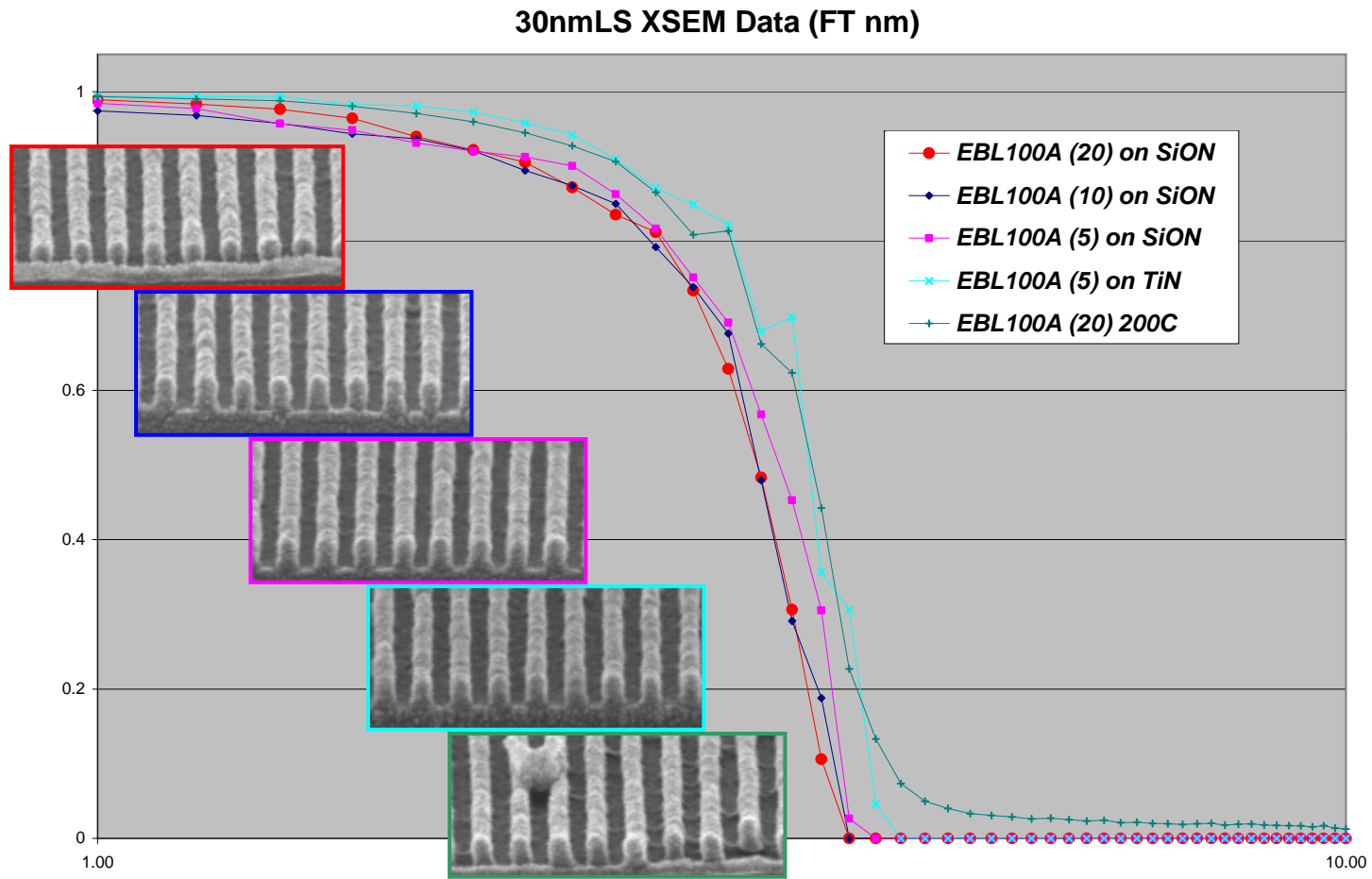
Introduction- EUV Underlayer Improves EUV Resist Z-factor



Results from SEMATECH/Intel; (a) w/o (b) w/ an underlayer demonstrating an improved resolution

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AZ EBL Substrate Compatibility



➤ No typical resist poisoning observed due to the use of those basic substrates (results need to be confirmed again).

AZ EBL95A and 96A Benchmark Data from IMEC

Dose-to-size for 30nm L/S ($\leq 15\text{mJ/cm}^2$)
 3 sigma LER on 30nm L/S ($\leq 4.0\text{nm}$)
 Max Exp latitude ($\geq 15\%$)
 Max DOF
 DOF at 10% EL ($\geq 120\text{nm}$)
 Exp latitude at 150nm DOF

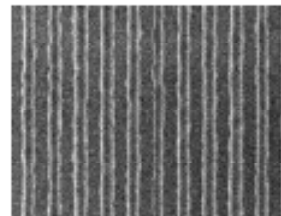
Top view © Best Energy & Focus

Dose-to-size for 30nm ISO.
 Max Exp latitude ($\geq 15\%$)
 Max DOF
 DOF at 10% EL ($\geq 100\text{nm}$)
 Exp latitude at 80nm DOF

Top view © Best Energy & Focus

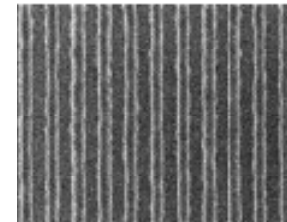
EBL 95A

11.1mJ/cm2
 4.7nm
 17.2%
 120nm
 120nm
 -



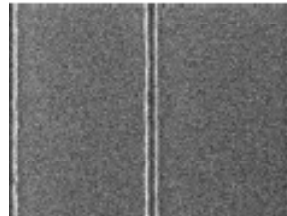
EBL 96A

11.1 mJ/cm2
 4.5nm
 14.1%
 160nm
 160nm
 13.1%



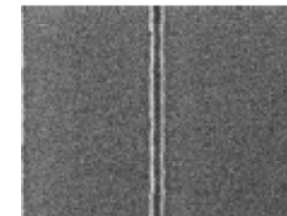
10.4 mJ/cm2

21.8%
 200nm
 200nm
 21.8%



10.3 mJ/cm2

21.8%
 220nm
 220nm
 21.7%



Conclusions

- Underlayers for EUV can be made that meet fundamental requirements
- EUV resist performance, substrate compatibility and resist profile can be improved