EUVL R&D in Korea

Jinho Ahn
Hanyang University, Seoul, Korea
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Who is interested in EUVL ?

Device manufacturer and material supplier

- Samsung : NAND Flash, DRAM, High-end Foundry
- Hynix: DRAM
- Dongjin Semichem: Photoresist

Academia and Research Institute

- Hanyang Univ.: strongest activity, owns EUVL beamline
- Seoul National University, SKKU, Inha Univ., POSTECH…..
- Pohang Accelerator Laboratory (PAL)

Tool maker

- Some small/med. size companies are developing EUV-related tools in collaboration with customers

NXE 3100 delivered …

Samsung (2010) and Hynix (2011) got their PPT from ASML with Cymer source

Mask-related activities

EBL

Blank

Etch

Repair

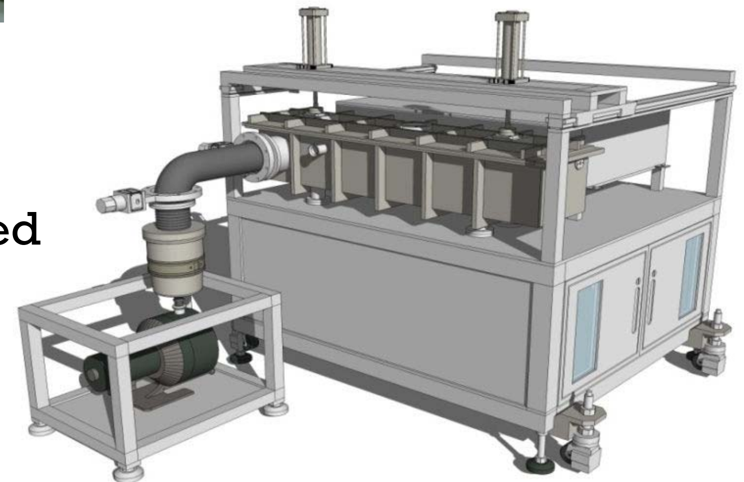
Cleaning

Inspection

Actinic Mask Inspection

Coherent Scattering Microscope at Pohang Synchrotron Facility,

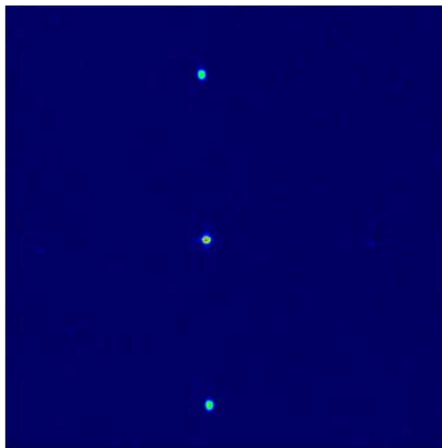
Recently moved to Hanyang Univ. and installed with stand-alone coherent source



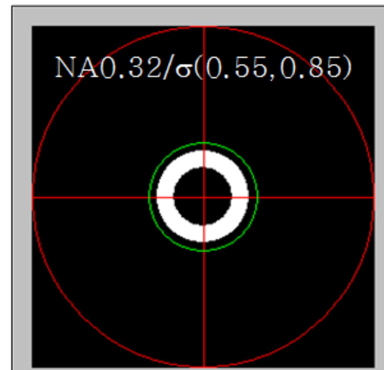
Actinic CD measurement by CSM

Field Spectrum

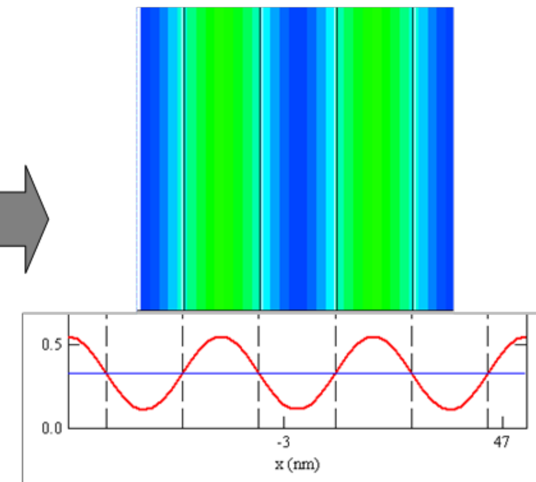
17.5 nm L/S (4x)



Illumination condition



Aerial Image



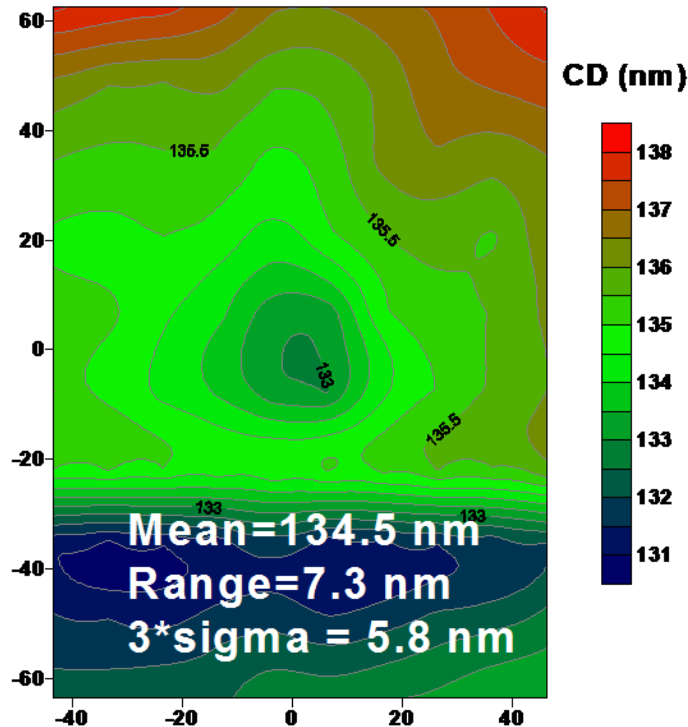
Now, field spectrum measurable down to 13 nm node

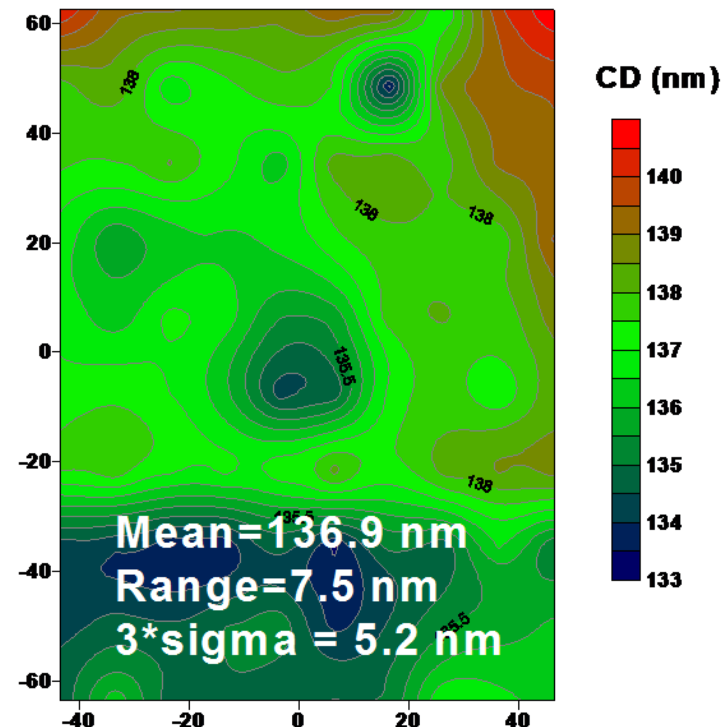
From the aerial image, CD, contrast…… can be extracted

Reflectivity measurement error (3s) is 0.76(%)

And the resulting CD error is ~ 0.38%

CD Uniformity
– Actinic vs. Non-actinic



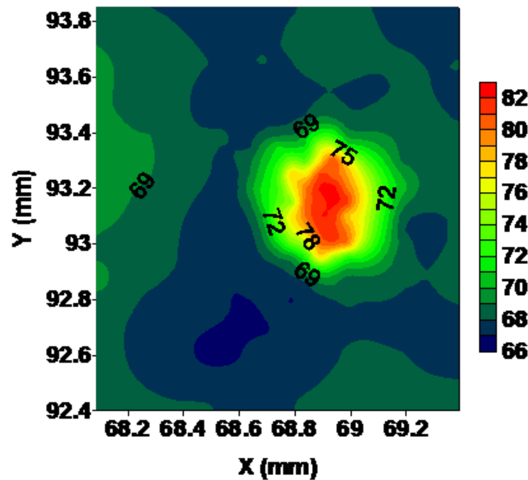


Similar results between CSM and Mask SEM

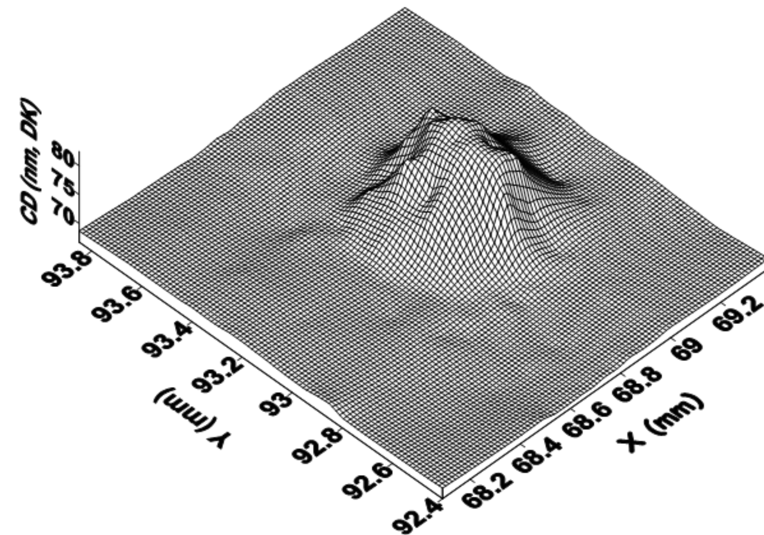
Reproducibility is superior for CSM (ΔCD: CSM < 0.2 nm, SEM < 1 nm)

CD measurement after Contamination

Mask CD Uniformity after Exposure

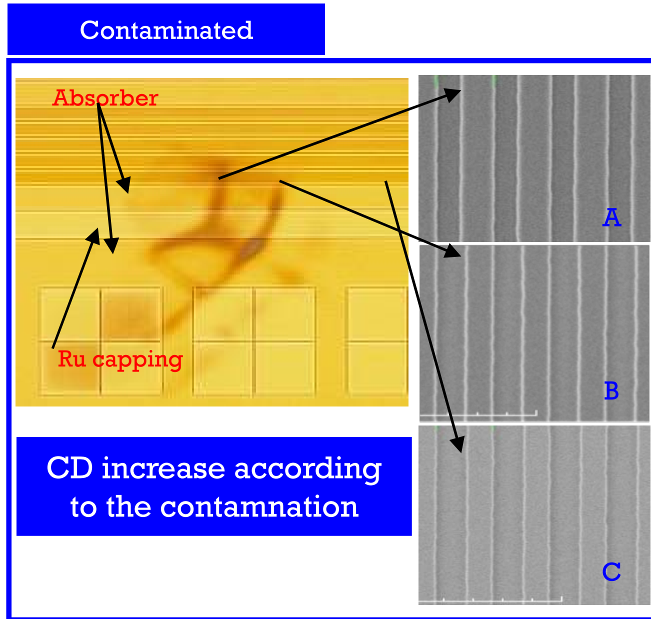


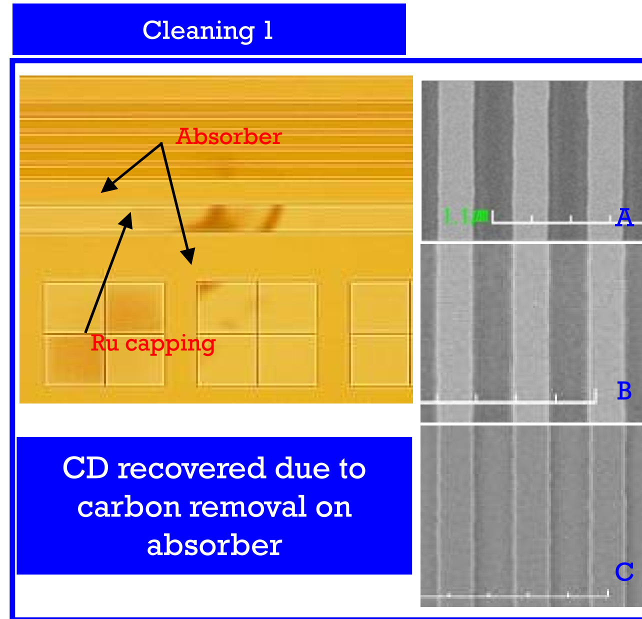
CD Uniformity 3D Plot

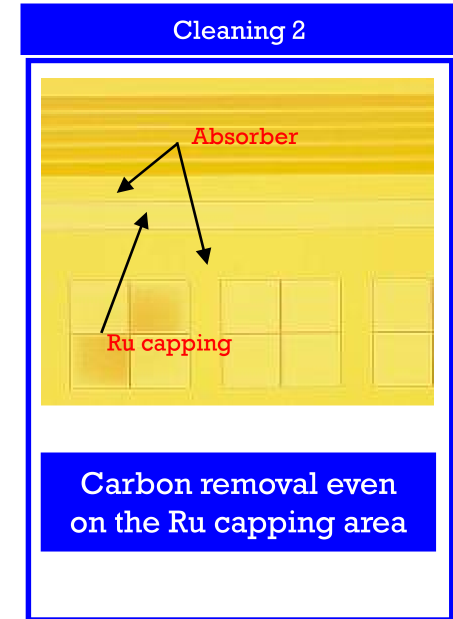


HP88 nm mask pattern after 3 hr exposure with synchrotron
- Max. 15nm CD increase due to contamination

Mask Contamination Removal





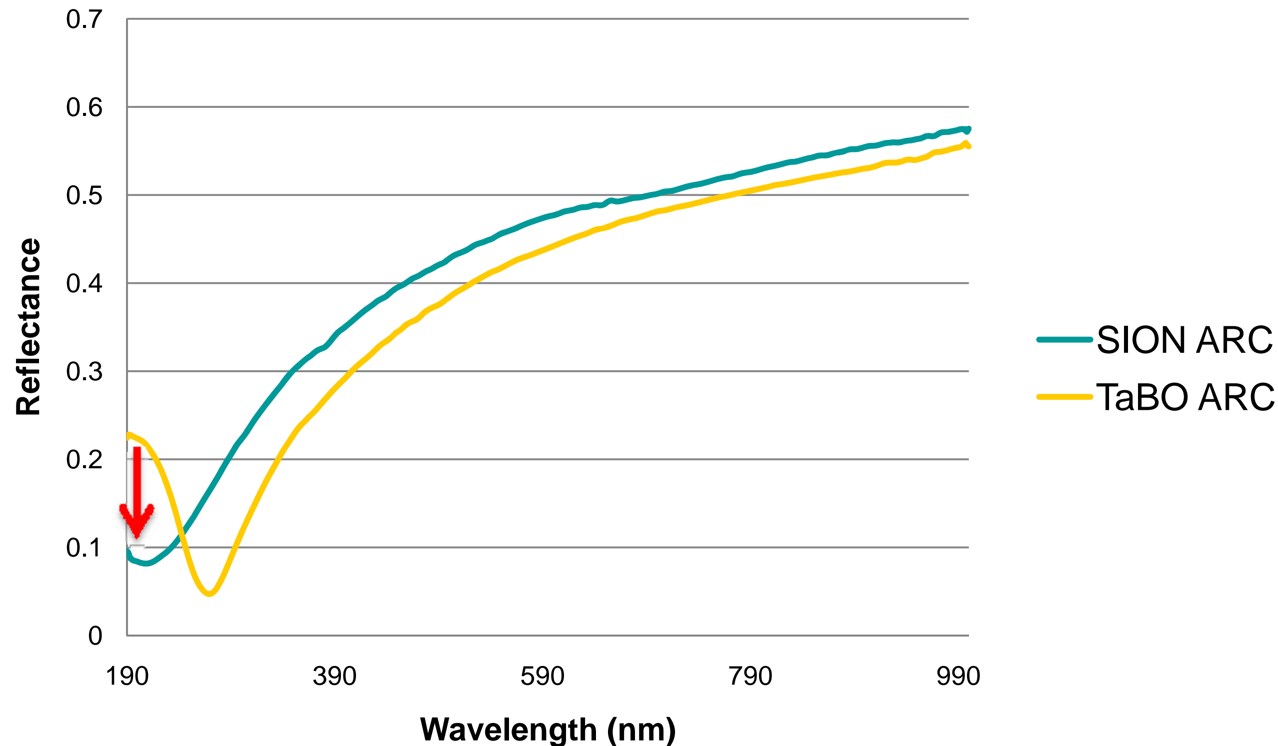


Carbon contamination removal recipe developed.

Cleaning_1 condition removes carbon on absorber but not on Ru capping

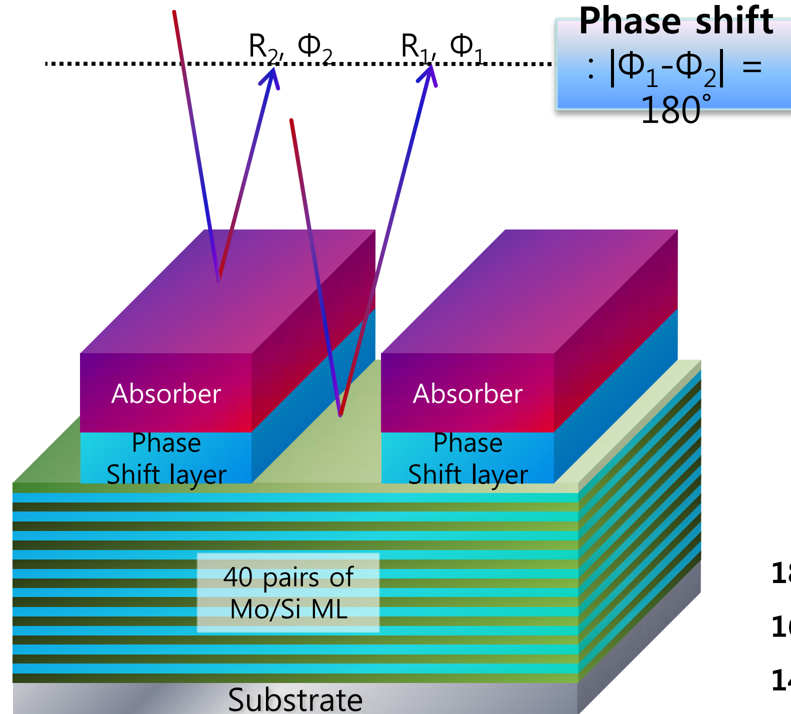
Cleaning_2 condition removes carbon on Ru as well as absorber.

New ARC for 193nm inspection

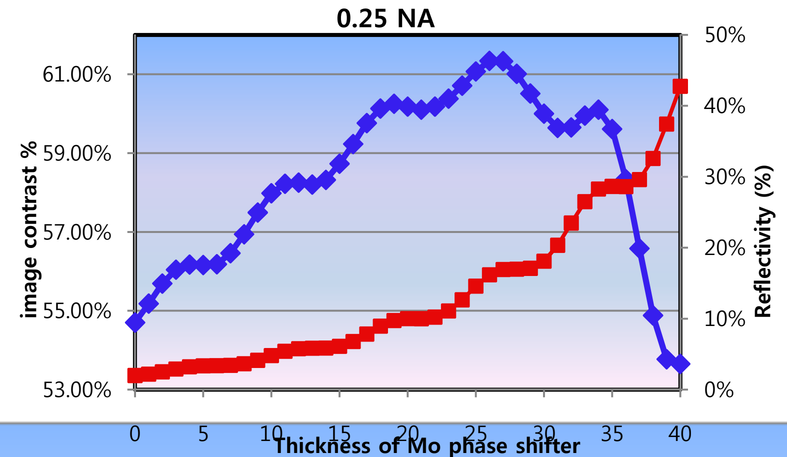


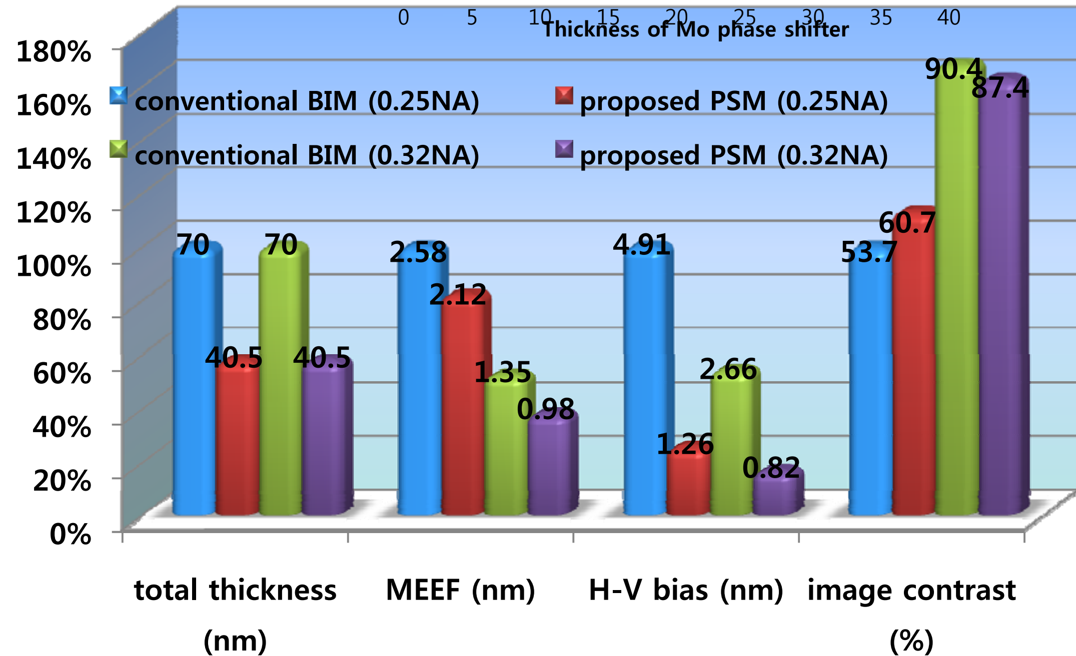
Compared to TaBO, SiON exhibits improved performance
(Reflectivity at193 nm: 22.3% → 8.8%)

Attenuated PSM



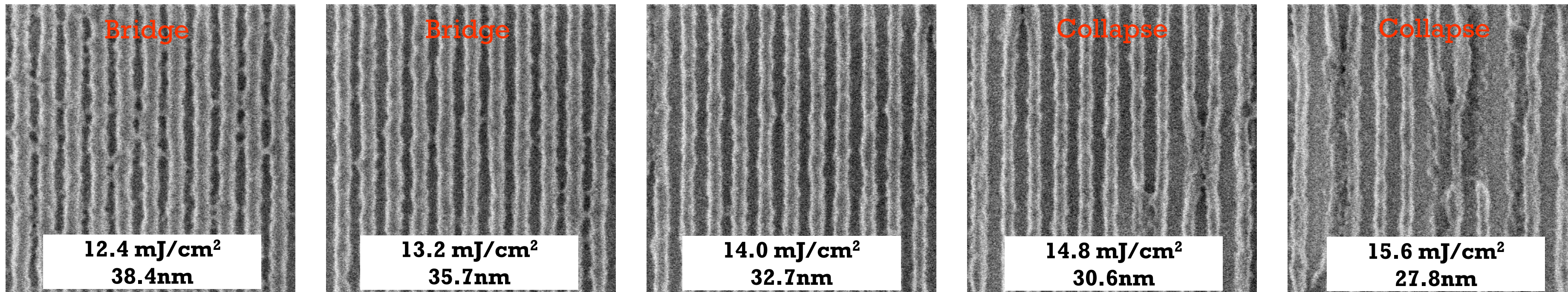
Phase shift
: $|\Phi_1-\Phi_2|$ = 180˚





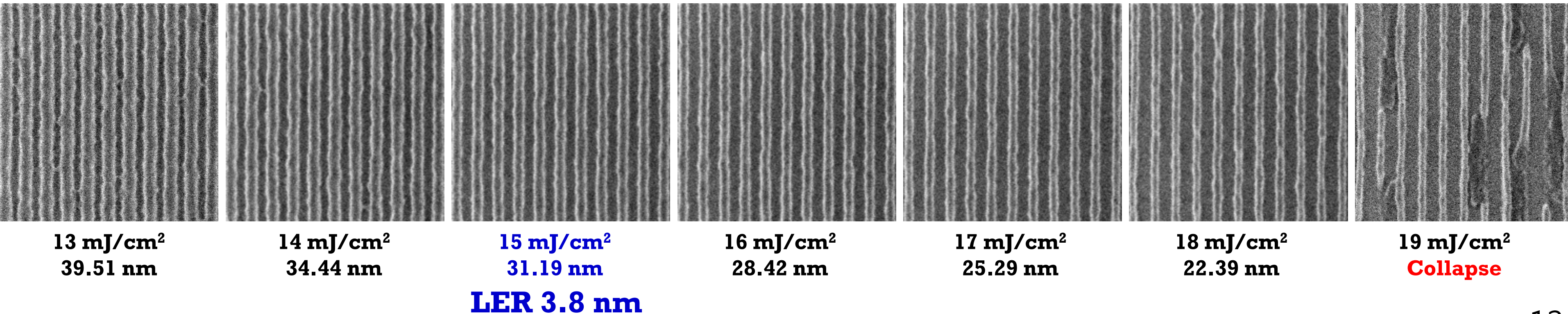
Resist exposure test with ADT

DHE-1212 on UL, resin(P,F)=(3.2, 5.2), Quencher(P)=(-1.2)



Improved collapse & LER

DHE-1302 on UL, resin(P,F)=(2.8, 6.5), Quencher(P)=(4.1)

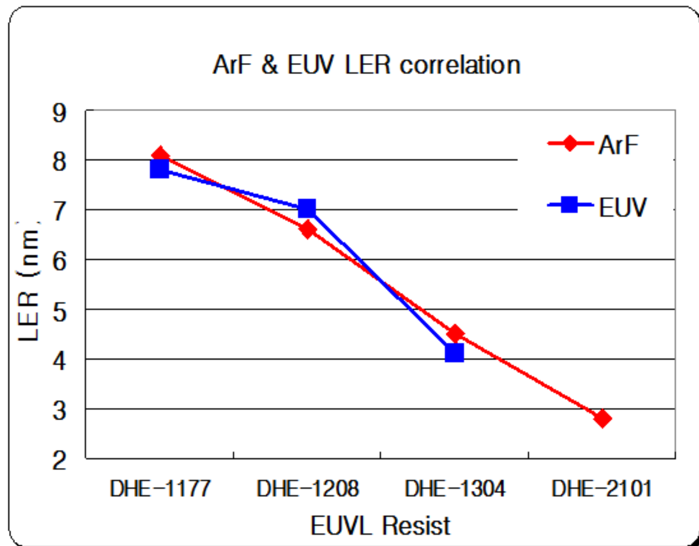


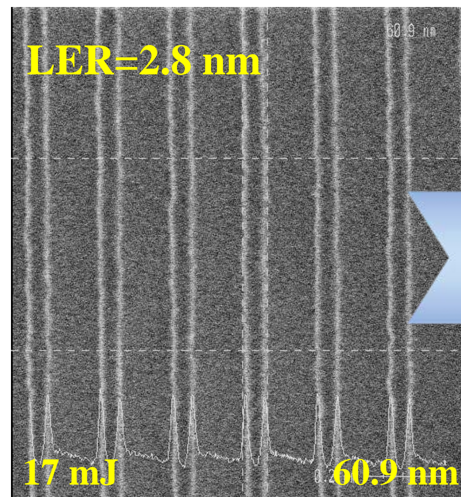
13 mJ/cm²	14 mJ/cm²	15 mJ/cm²	16 mJ/cm²	17 mJ/cm²	18 mJ/cm²	19 mJ/cm²
39.51 nm	34.44 nm	31.19 nm	28.42 nm	25.29 nm	22.39 nm	Collapse

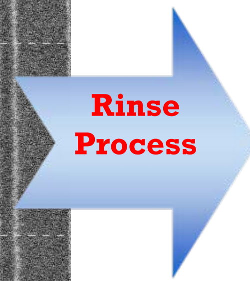
LER 3.8 nm

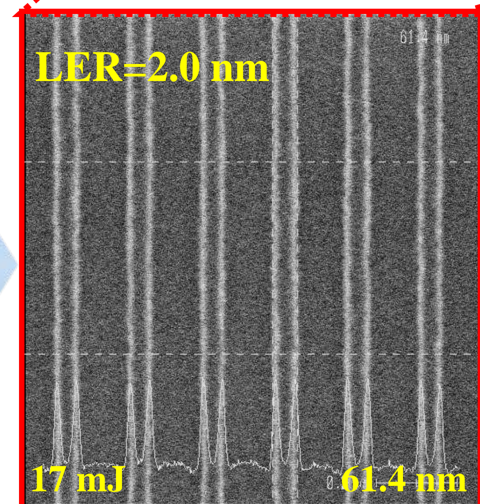
PAG-bound polymer (ArF Test)

11mJ 111.9
12mJ 98.1
13mJ 90.1
14mJ 79.0
15mJ 69.1
16mJ 65.3
17mJ 61.4
18mJ 53.0
19mJ 49.6
20mJ 47.0
21mJ 40.4
22mJ 39.4
23mJ 34.4
24mJ x









Greetings from Korea EUVL R&D Consortium
(EUVL Workshop on June 3-4, 2011 @ Jeju Island)