Brookhaven National Laboratory
Center for Functional Nanomaterials

U.S. DEPARTMENT OF ENERGY

High-sensitivity hybrid EUV resist synthesis via vapor-phase infiltration

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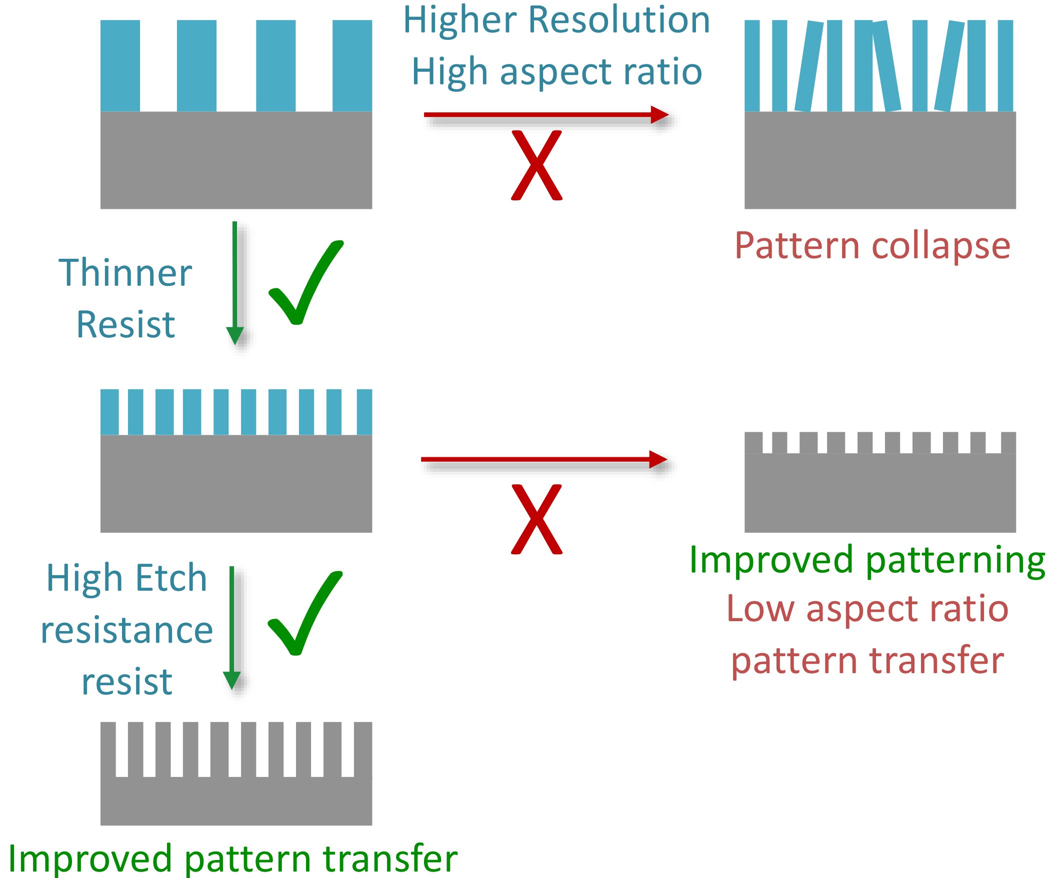
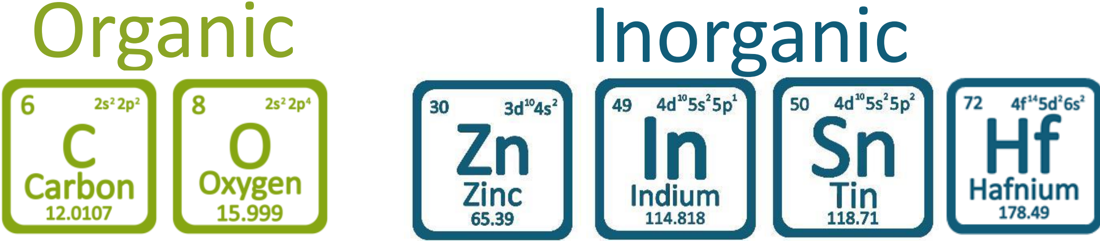
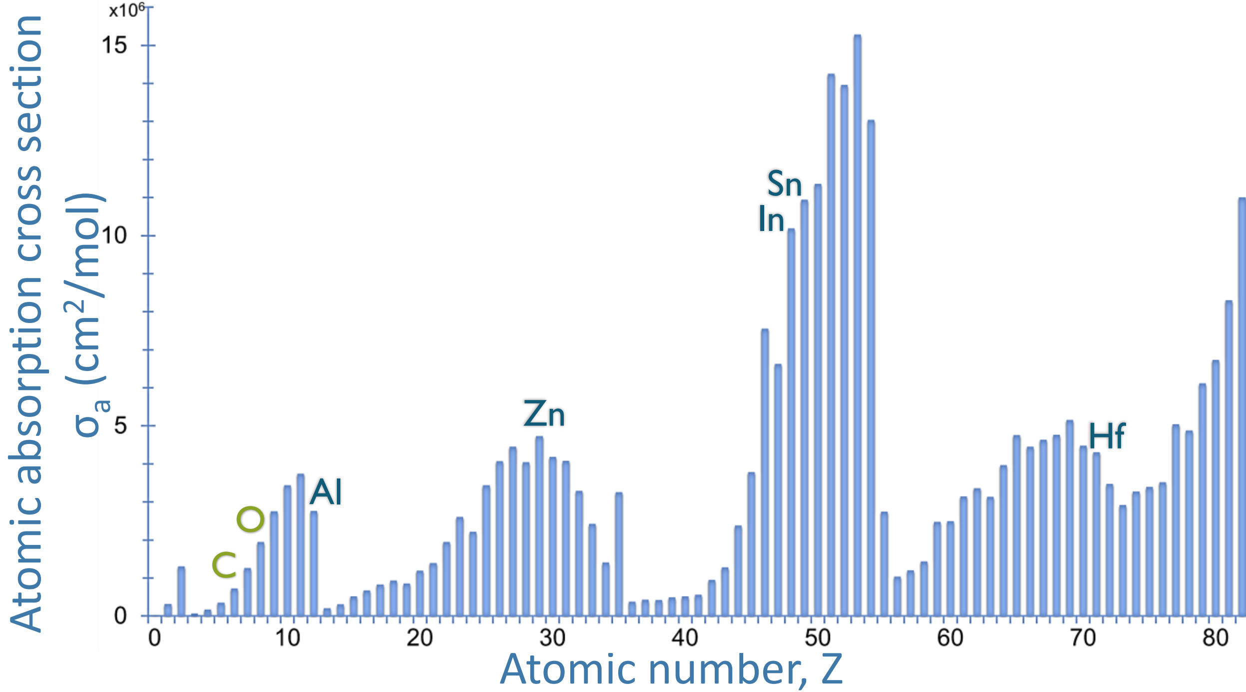
Extreme ultraviolet (EUV) nanolithography resist challenges



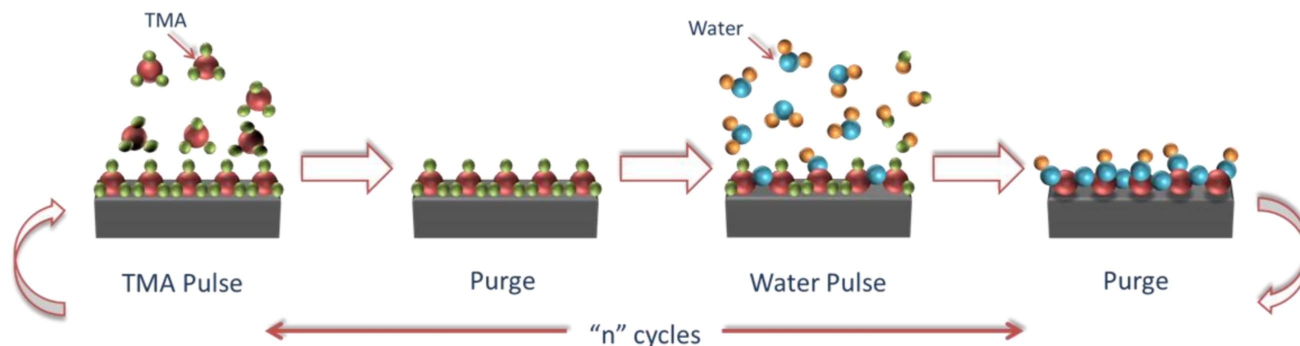




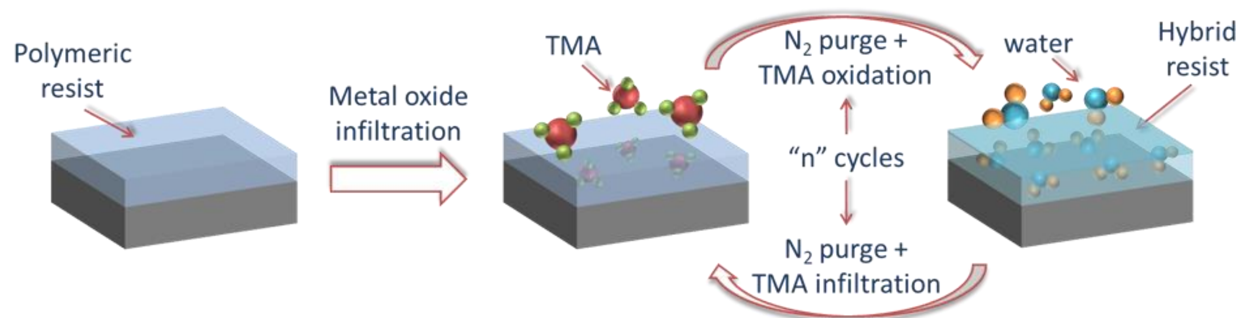
Li et al. (2017), Fallica, et al. JM3 (2016), Tiwale et al. *Proc. SPIE 11326* (2020)

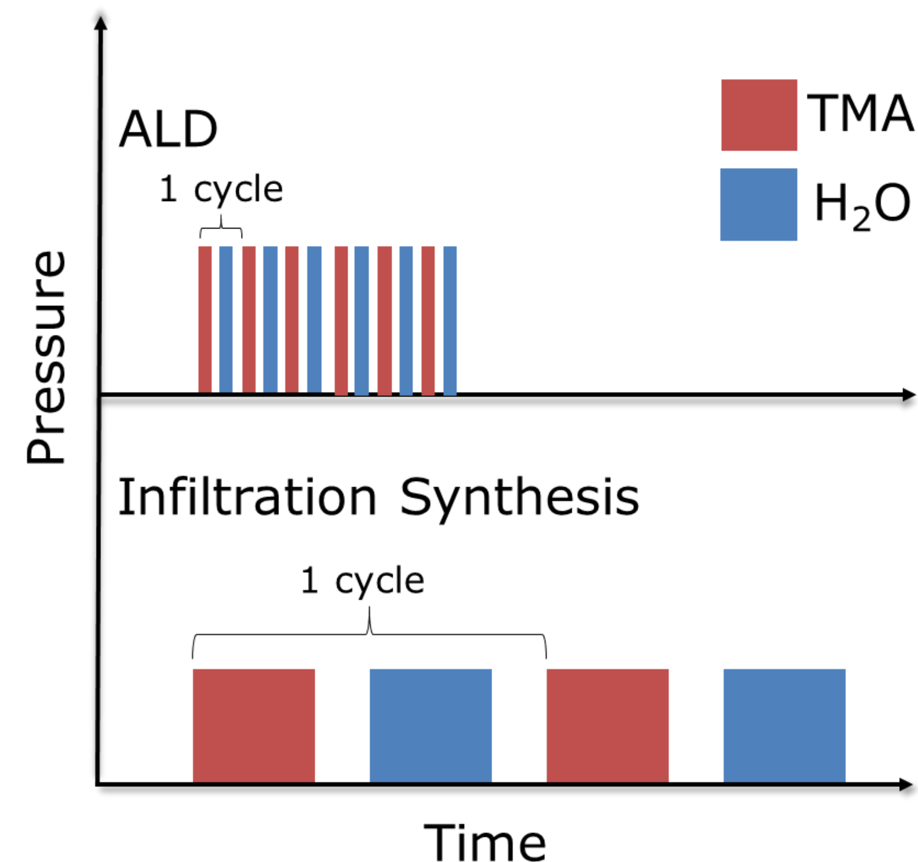
Infiltration synthesis using ALD system

ALD - Surface-limited reaction & thin film deposition



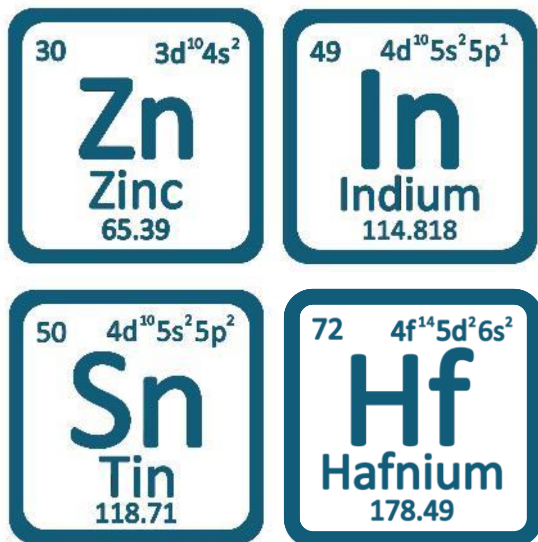
Infiltration synthesis: Precursor diffusion & binding



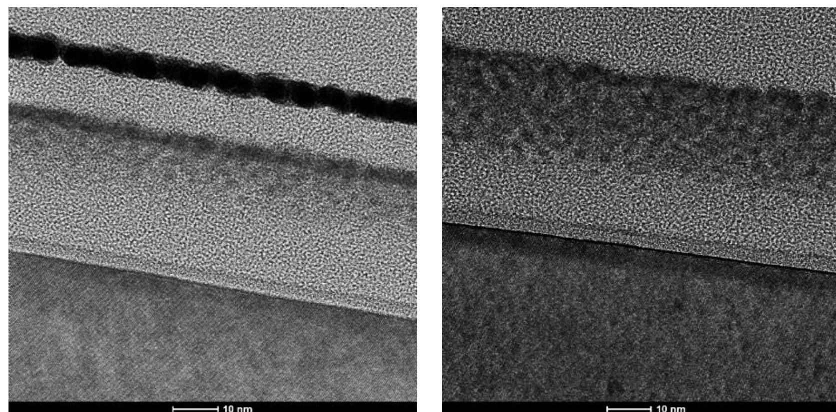


Infiltration synthesis of hybrid resists

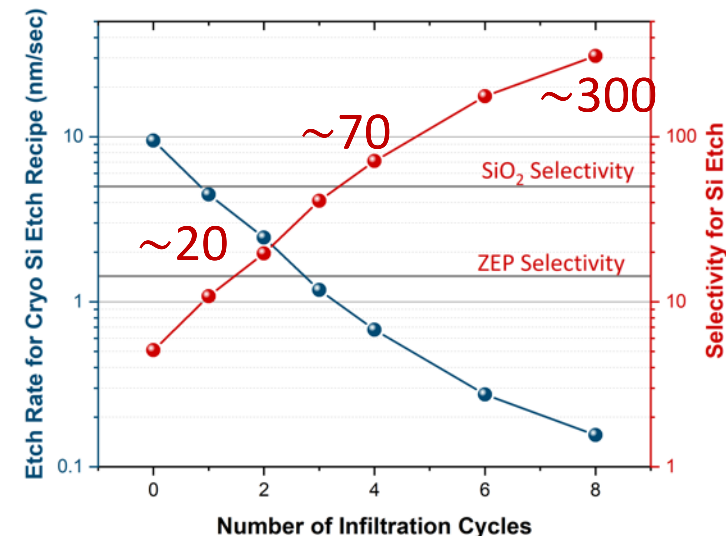
Enhanced EUV Sensitivity (Improved Productivity)

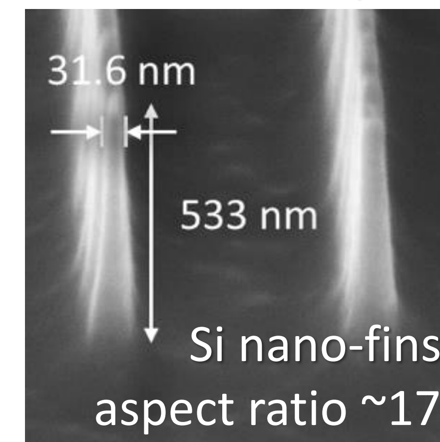


Tunability of compositional distribution



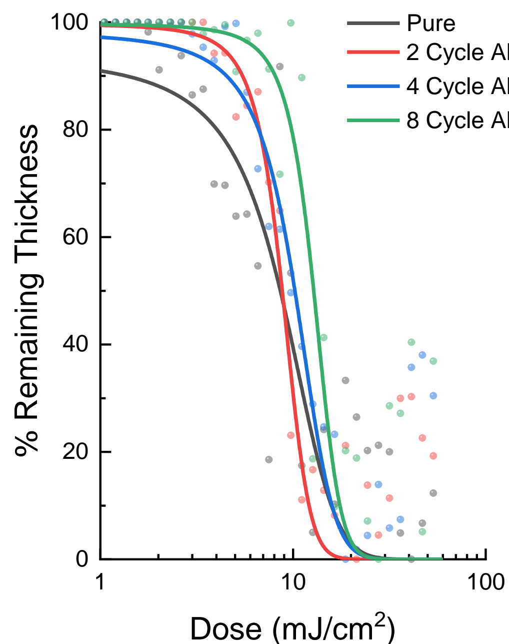
Enhanced Etch Resistance

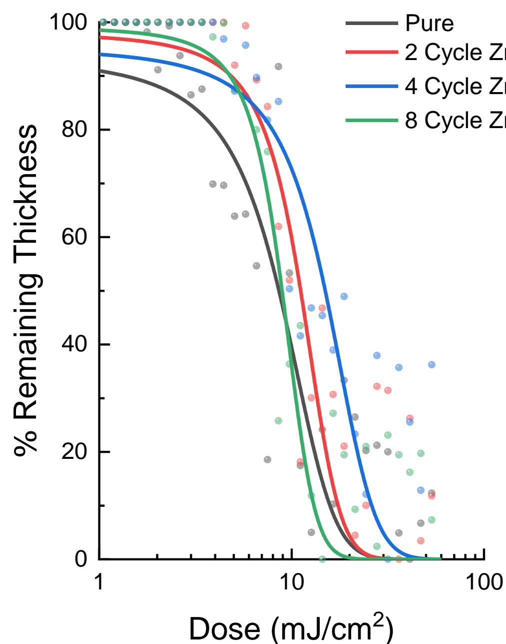


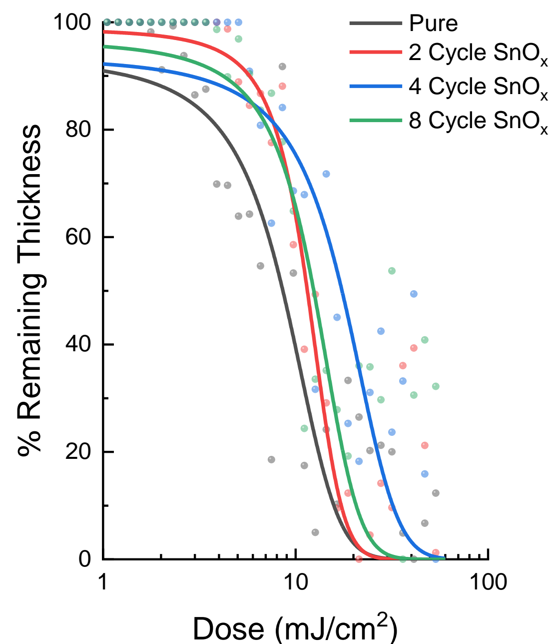


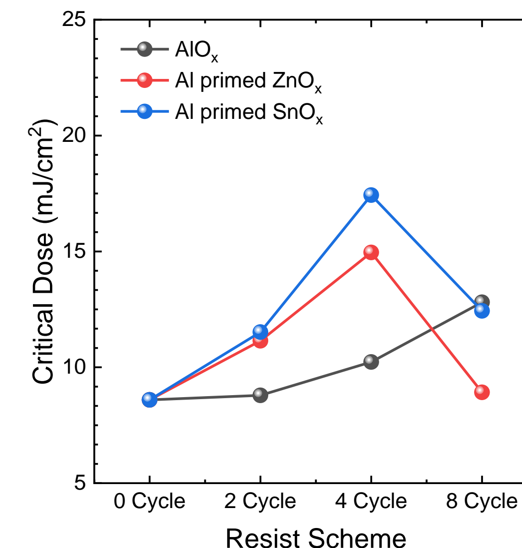
Tiwale et al. J. Mater. Chem. C (2019), Tiwale et al. Proc. SPIE 11326 (2020), Tiwale et al. Proc. SPIE 11612 (2021), U.S. Patent Application 16/808,661(2020)

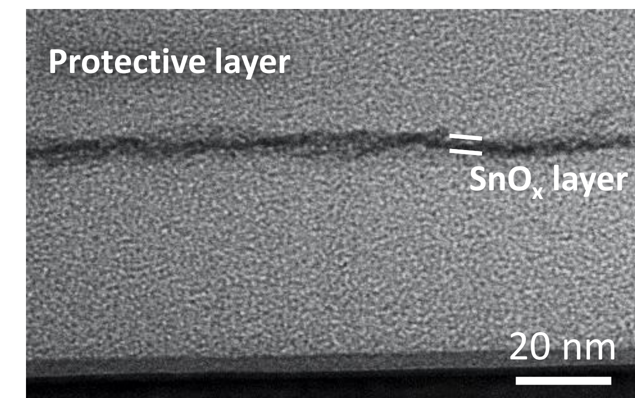
High sensitivity resist (HSR)-MO_x EUV resists









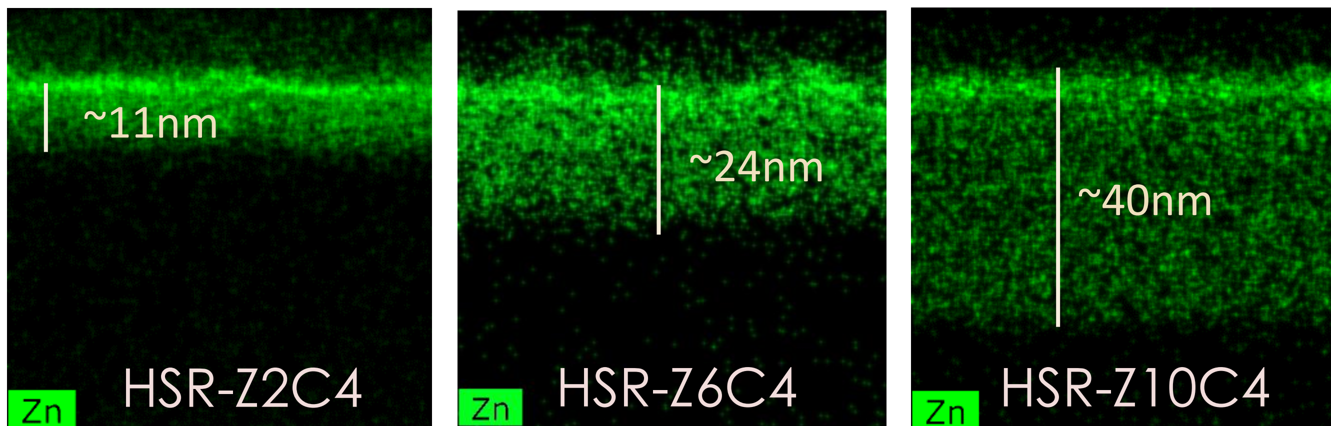


AlO_x primed SnO_x

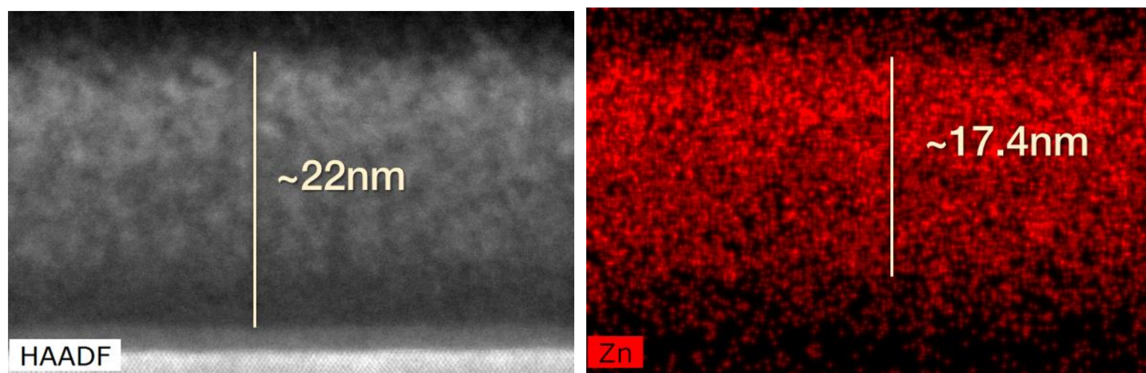
- ❑Monotonic increase for AlO_x infiltration-internal crosslinking
- ❑Al primed ZnO_x & Al primed-SnO_x, drop in critical dose with sufficiently high infiltration
- ❑Increased EUV absorption due to Zn or Sn maybe compensating increased dose requirement due to inter-crosslinking

Controllable ZnO_x infiltration into HSR & preliminary EUVL results

Controllable infiltration depths



Cross section of HSR-Z2C4 after post-infil bake



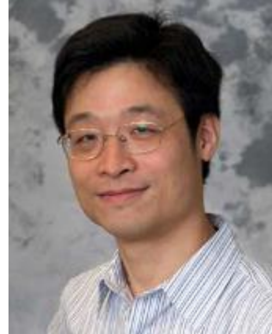
Acknowledgement

Nam

Kim

Subramanian

Stein


Lu

Sadowski

Kisslinger

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