Iodine Functionalized Metal-Organic Cluster EUV Resists for High- Resolution Patterning with Fab-Compatible Processing

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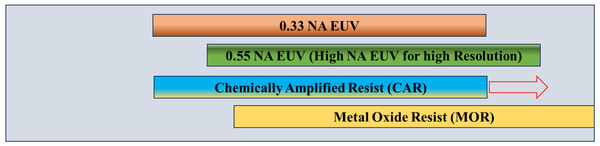
Background

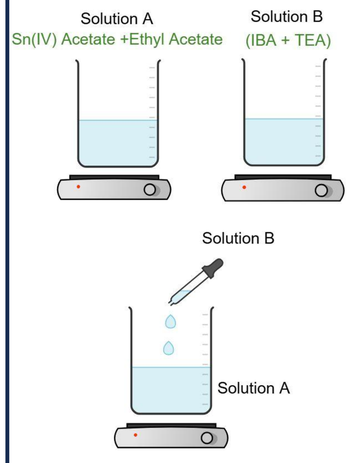
EUV lithography process roadmap

L/S pitch (nm)	34	32	30	28	26	24	22	20
L/S pitch (nm)	42	40	38	36	34	32	30	22



- Chemically amplified resist (CAR) extension Even with 0.33 NA platform, CAR could resolve up to pitch 24 nm L/S →The process integration gradually becomes difficult.
- Metal oxide resist (MOR) enablement Compared to the CAR,MOR is expected to give advantages at EUV stochastics.

Resist Formulation



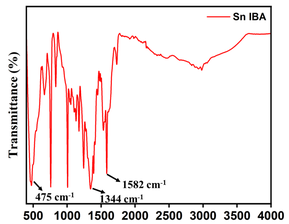
•Solution A: Tin(IV) acetate dissolved in ethyl acetate at 70–80 °C under N_2 for 1 h.

•Solution B: Iodobenzoic acid (IBA) dissolved and mixed with triethylamine at 5 °C.

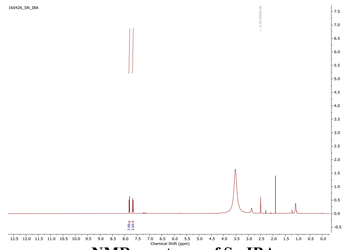
•Solution B added dropwise to Solution A at 70 °C with continuous stirring.

•Post-processing: Product dried and washed with hexane.

Chemical Characterization



FTIR spectrum of Sn IBA

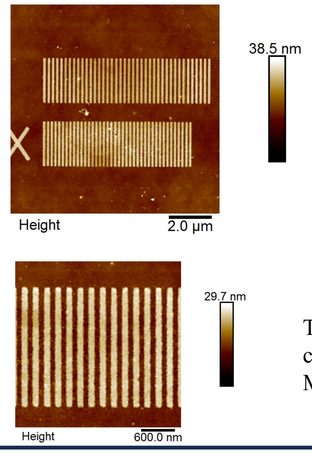


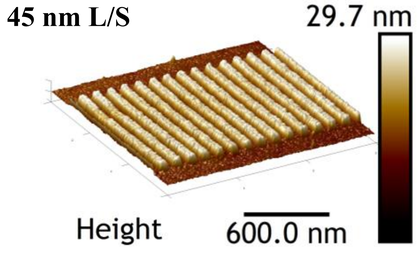
NMR spectrum of Sn IBA

•**1582 & 1344 cm⁻¹:** COO^- formation and coordination.
•**2500–3300 cm⁻¹:** Reduced –OH peak confirms deprotonation.
•**475 cm⁻¹:** Sn–O bond formation.

•**Aromatic proton shifts (7.6–7.8 ppm):** Confirm Sn–IBA coordination.
•**Absence of carboxylic acid proton (11–12 ppm):** Confirms deprotonation

AFM Analysis

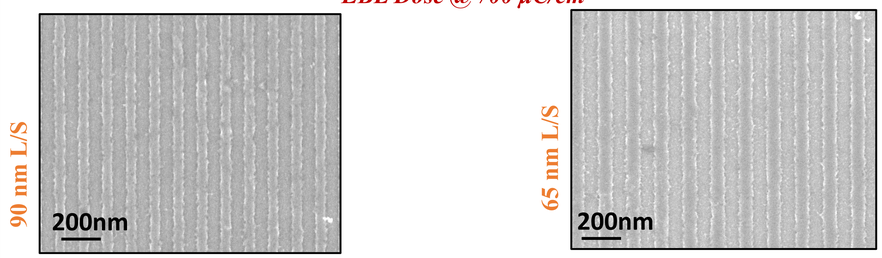




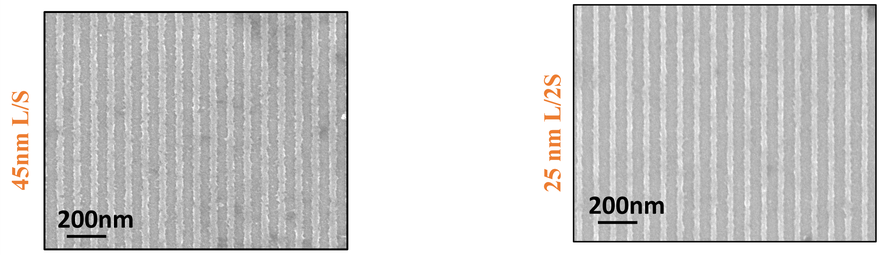
The AFM results of the resolved line patterns confirm the successful development of Sn–IBA MOC patterns down to 45 nm line/space (L/S).

EBL Patterning

EBL Dose @ 700 µC/cm²



Pre Bake = 95°C for 60 Sec
Post Bake = 95°C for 60 Sec



The Sn–IBA resist demonstrated an achievable resolution down to **25 nm L/2S** at a film thickness of **30 nm**, with patterns also resolved at **45 nm, 65 nm, and 90 nm L/S.**

Conclusion

- Sn–IBA MOC resist was successfully synthesized via a facile sol–gel route.
- The developed resist exhibited successful high-resolution patterning under electron-beam lithography (EBL).
- Incorporation of IBA enhanced resist sensitivity due to the presence of iodine in the MOC structure.
- Line patterns with ~25 nm resolution were achieved at an exposure dose of ~700 µC/cm², although further development optimization is required.

Acknowledgement

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Reference

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