



Molecular Design and Atomic-Scale Control: New Directions in EUV Photoresist Materials and Pattern Enhancement

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Continued device scaling with the introduction of high numerical aperture (NA) extreme ultraviolet (EUV) lithography will require innovations in photoresist materials. This presentation will explore how molecular design and bottom-up synthesis approaches can address critical challenges in EUV photoresist materials. EUV lithography has achieved remarkable progress, but faces challenges including stochastic variations, pattern collapse, and material limitations. Bottom-up synthesis methods offer atomic-scale precision and new materials possibilities that can overcome some of these obstacles through multiple pathways.

This talk will present two strategies that highlight the power of bottom-up approaches. First, we introduce new classes of molecularly engineered photoresists based on molecular layer deposition (MLD). By rationally designing the organic linker chemistry, we create inorganic-organic hybrid resists with promising patterning properties. These MLD resists achieve down to 12 nm resolution with low line width roughness, while offering the atomic-precision control and chemical homogeneity characteristic of bottom-up synthesis [1]. Second, we will show how area-selective atomic layer deposition (AS-ALD) can enhance patterned photoresists through selective addition of hard mask layers. By systematic tuning of ALD precursors combined with vapor phase infiltration of polymers, we achieve selective deposition of metal oxides on resist patterns. This approach can bridge bottom-up deposition with top-down patterning, enabling improved pattern transfer for advanced device fabrication. Together, these strategies illustrate how molecular design combined with atomically precise synthesis methods can offer versatile solutions for lithography.

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References

- [1] L. Viet Than, G. D'Acunto, M. Harake, H. Im, O. Kostko, and S. F. Bent, ACS Appl. Mat. Interfaces, 17, 40, (2025) 56477–56490