

Mechanism-Based Design, Synthesis, and Characterization of a Small Molecule Inorganic Photoresist Candidate for EUV Lithography

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Further advances in extreme ultraviolet lithography (EUVL) require new photoresist materials that combine high EUV absorption and functional groups that promote electron-stimulated solubility switching. Here, we investigate bis(N-vinylimidazole)zinc diiodide, (**1**, Figure 1), as a single-component metal-containing resist designed to exploit the complementary functions of its constituent ligands. The ZnI₂ center provides enhanced EUV absorption, while the vinylimidazole ligands provide chemically active vinyl groups capable of electron-induced polymerization and subsequent crosslinking to produce negative-tone behavior. Single-crystal X-ray diffraction has confirmed the molecular structure and indicates a spatial proximity of the vinyl groups that may facilitate intermolecular crosslinking in the condensed phase. An EUV absorption coefficient was estimated from elemental absorption cross-sections and the crystallographic density of **1**, indicating greater EUV absorption than metal-oxo photoresists. The material formed uniform thin films from cyclohexanone and exhibited negative-tone behavior following 15 keV electron exposure (Figure 1). X-ray photoelectron spectroscopy was used to measure the impact of electron exposure on chemical composition while thermogravimetric analysis demonstrates that the resist exhibits thermal stability compatible with typical pre-bake requirements. These results establish (N-vinylimidazole)₂ZnI₂ as a promising molecular platform for further investigation as a high-absorption, negative-tone EUV resist.

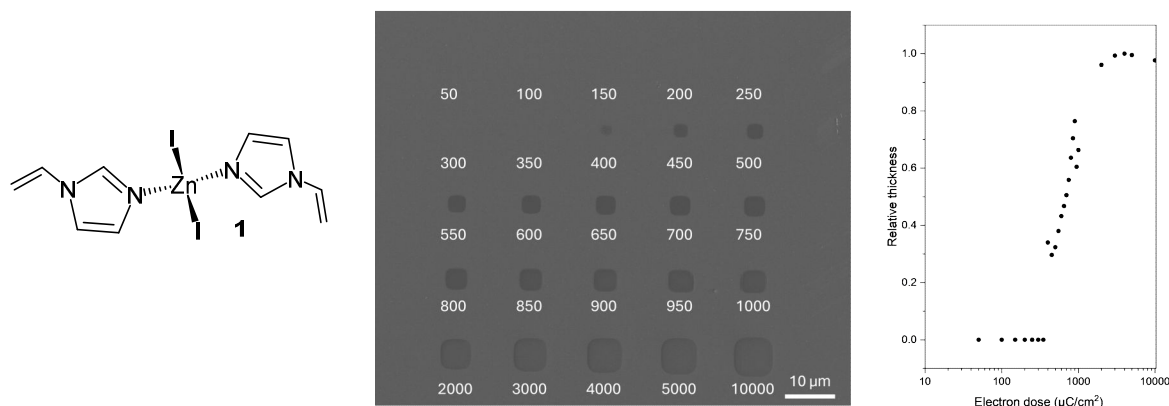


Figure 1. Left: Molecular structure of resist **1**. Center: SEM image of the 15 keV 5x5 dose array developed for 60 s in cyclohexanone and rinsed with isopropanol. Text labels in the image correspond to doses in μC/cm². Right: Normalized residual thickness for 15 keV EBL of the resist developed in cyclohexanone.

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