Myo-Inositol as a Fully Dry-Processed Positive Electron Beam Resist

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The widespread application of electron beam lithography in integrated circuit manufacturing requires positive resists that can be fully processed within vacuum cluster tools. To enable high throughput volume manufacturing, substrate transfers into and out of vacuum environments should be minimized, driving the need for vacuum-compatible lithographic processes. While negative resists based on sublimation and conversion of organometallic compounds have been explored, a fully vacuum compatible positive resist remains elusive.[1]

Here, we introduce myo-inositol as a promising positive-tone resist. This cyclic sugar alcohol can be thermally evaporated at ~215 °C without degradation, forming hard, adherent films. Upon electron beam exposure, volatile species appear to form, and subsequent heating to 150 °C leads to clearing in exposed regions. While the exact mechanisms are still under investigation, we demonstrate that thermally developed myo-inositol films enable sub-100 nm patterning in thin metal layers via 500 V Ar ion milling, with the residual resist removable by oxygen plasma.

Lines have been transferred into a 25 nm gold layer using a 200 nm myo-inositol resist exposed with 10 nC/cm at 30 kV, yielding 100 nm features in 400 nm grating patterns before careful process optimization. With a molecular size of ~1 nm, myo-inositol resists may enable feature sizes below those of conventional organic positive resists. However, further optimization is needed to further improve both resolution and sensitivity. For example, variations in dose may impact product volatility, requiring careful balancing among feature size, development completion, and film stability. Additionally, sugar alcohols can crystallize, and water is known to lower the glass and recrystallization temperatures. However, this can be avoided by maintaining the entire process in dry or vacuum environment, complimenting the application to vacuum cluster tools.

[1] S. M. Lewis et al., J. Micro/Nanopatterning, Materials and Metrology, Vol. 21, 041404, (2022)