Novel Crosslinked Molecular Resists Based on Acid-Catalyzed Depolymerization

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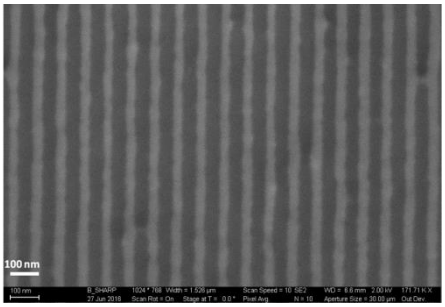
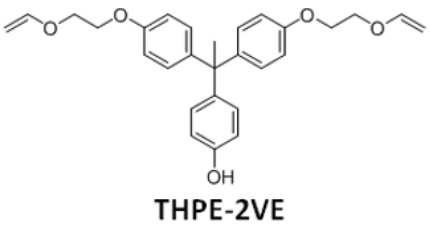
THPE-2VE, a molecular glass resist based on acid catalyzed depolymerization, has been evaluated for 248-nm DUV lithography and previously reported by our group. This paper will show that THPE-2VE is capable of resolving sub-40 nm features (Figure 1) using 100 kV e-beam lithography. It will also be shown that the material can be developed in both standard 0.26N TMAH and organic solvent developers (e.g.MIBK) and shows no signs of pattern collapse at the feature sizes probed. In addition to THPE-2VE, several new resists have been synthesized that are based on the TPOE core, which has an even number of phenols. This number of phenols has allowed the number of vinyl ethers on the core molecule to be varied to produce the resists shown in Figure 2. As a whole, this family of resists has been shown to be quite sensitive to 248-nm DUV lithography, with currently-evaluated molecules exhibiting DUV sensitivities well below 20 mJ/cm^2 at 5 mol% PAG loadings. The materials reported here first crosslink through thermally-driven phenol-alkene reactions to form an insoluble network during the PAB. By simply adjusting the PAB temperature, the sensitivity can be tuned without varying the amount of added PAG. The effect of varying the number of phenols on the TPOE core will be examined and reported. E-beam patterning of these materials will also be presented.





THPE-2VE

Figure 1: E-Beam patterning showing dense arrays of the sub-40 nm capabilities of THPE-2VE in MIBK development when formulated with 5 mol% TPS-SbF_6 as PAG on bare silicon substrate.

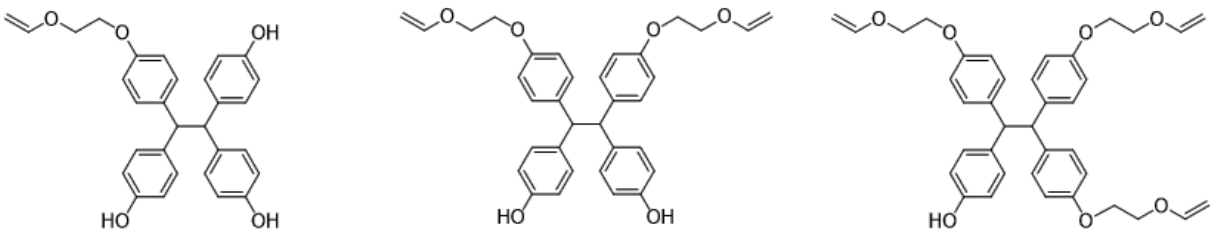


Figure 2: TPOE-based molecules that have been synthesized and evaluated for their patterning performance.