Fundamental Behavior of Single Molecule Molecular Glass Resists Based on Onium Salt Cores

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Molecular glass (MG) photoresists are a promising alternative to polymeric photoresists for use as imaging materials with improved resolution and line edge roughness (LER) for next generation UV and EUV lithography. They offer advantages over polymers as resins for chemically amplified resists (CARs) because the copolymers used for resists have potential intrinsic problems including polydispersity of the resist polymer, difficulty in maintaining compositional uniformity of the copolymer, polymer aggregate formation, phase separation of polymers and additives, and heterogeneous deprotection not found in MG CARs.[1] The types of CARs based on MGs reported thus far have been blended materials in which a separate photoacid generator (PAG) has been formulated with an organic molecular glass compound to produce the CAR. Many of these blended glass systems resolve features smaller than 50 nm under EUV and e-beam exposure and have line-edge roughness (LER) of 6 nm or less, but still suffer from problems with inhomogeneous distribution of PAG.[2] A film composed of a single molecule which contains all of the different functionalities desired in a CAR should solve all these problems.

In this work, we report molecular glass CARs based on a single molecule, tris(4-hydroxy-3,5-dimethylphenyl)sulfonium. Various versions of this molecule are made with different protecting groups and acid counter-ions. These molecules have been imaged using both 248nm and e-beam. Their behavior is compared in terms of resolution, photoacid diffusion, quantum efficiency, LER, contrast, and sensitivity. The performance advantages and disadvantages of these single molecules as imaging systems are discussed and compared. New single molecule CAR designs based on lessons learned from these materials are discussed.

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[1] Cao, H.; Roberts J.; Dalin J.; Chandhok M.; Meagley R.; Panning E.; Shell M.; Rice B., *Proc. SPIE* 2003, **5039**, 484.
[2] Hirayama, T.; Shiono, D.; Matsumaru, S.; Ogata, T.; Hada, H.; Onodera, J.; Arai, T.; Sakamizu, T.; Yamaguchi, A.; Shiraishi, H.; Fukuda, H.; Ueda, M., *Proc. SPIE* **2005,** 5753, 738-745.

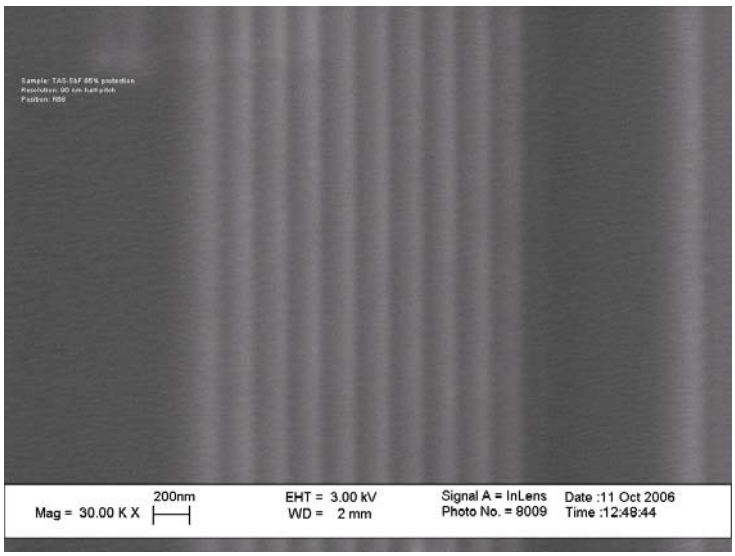

Figure 1. SEM image of 100nm line/space pattern for tris(4-(*tert*-butoxycarbonyloxy)-3,5-dimethylphenyl)sulfonium hexafluoroantimonate.

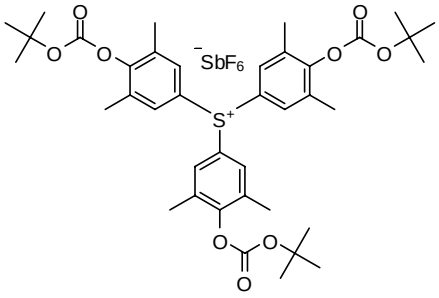

Figure 2. Molecular structure of tris(4-(*tert*-butoxycarbonyloxy)-3,5-dimethylphenyl)sulfonium hexafluoroantimonate, a single molecule molecular glass resist.