

In-film investigation of photoacid generator for semiconductor applications

Emmanuelle Despagnet-Ayoub¹, Wesley W. Kramer¹, Wesley Sattler², Thomas Cardolaccia², Jay R. Winkler¹, Harry B. Gray¹

¹California Institute of Technology, Pasadena, California 91125, USA.

²The Dow Chemical Company, Dow Electronic Materials, Marlborough, Massachusetts 01752, USA.

E-mail: despagne@caltech.edu

Photolithography is a key element in large scale manufacturing of integrated circuits.^[1] This process takes advantage of photoacid generators (PAGs) embedded in functional polymers leading to formation of high-resolution nanoscale features. Widely used classes of PAGs, salts of triphenylsulfonium (TPS) cation, have been studied in solution,^[2] however, to the best of our knowledge there are only a few reports relating the photochemistry of TPS in polymer matrices.^[3] Thus, in order to mimic industrial ArF lithography, we investigated the 193-nm photochemistry of TPS embedded in polymethylmethacrylate. To our surprise new photoproducts were detected (Fig.1). Mechanistic investigations will be presented showing that these products are obtained by in-cage secondary photoprocesses. Our findings will have an impact in the semiconductor manufacture as only primary photochemistry was believed to occur.

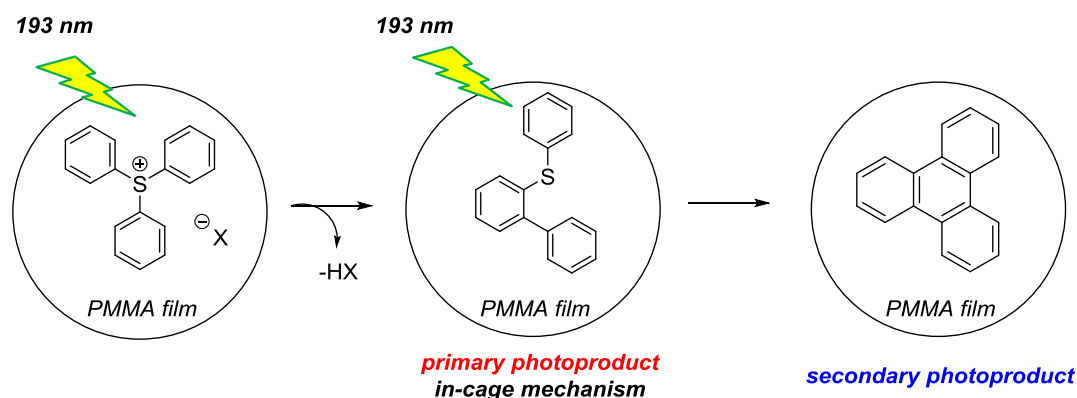


Figure 1. Photochemistry of triphenylsulfonium in PMMA film at 193-nm irradiation.

Funding: National Science Foundation Center for Chemical Innovation in Solar Fuels (CHE-1305124) and The Dow Chemical Company through a university partnership program (Agreement # 227027AK).

References:

- [1] a) C. A. Mack, *Fundamental Principles of Optical Lithography: The Science of Microfabrication*; Wiley: London, 2007.

- [2] a) J. L. Dektar, N. P. Hacker, *J. Am. Chem. Soc.* **1990**, *112*, 6004, b) S. Tagawa, S. Nagahara, T. Iwamoto, M. Wakita, T. Kozawa, Y. Yamamoto, D. Werst, A. D. Trifunac, *Proc. SPIE: Advances in Resist Technology and Processing XVII* **2000**, 3999, 204.
- [3] a) N. P. Hacker, K. M. Welsh, *Advances in Chemistry Series*, **1993**, *236*, 557, b) N. P. Hacker, K. M. Welsh, *Macromolecules*, **1991**, *24*, 2137, c) S. Tsuji, S. Seki, T. Kozawa, S. Tagawa, *J. Photopolym. Sci. Technol.* **2000**, *13*, 729.