Progress in Metal Organic Cluster EUV Photoresists

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Metal oxide photoresists have demonstrated that they are capable of high sensitivity and high resolution for EUV lithography. This paper reports on recent progress in an industry-university study of metal oxide nanocluster compounds, factors that control resist performance and recent progress in making working resists from these new materials [1].

Our recent work relies on metal organic framework (MOF)-inspired hybrid cluster compounds. In order to incorporate EUV absorbing metals into a structure that is straightforward to process in organic media, the MOFs offer many simple inorganic structures for cluster formation, made processable by the presence of organic ligands. By using monofunctional ligands, it is possible to directly convert the many known MOF apex sites into nm-scale species that are processable using conventional photoresist solvents and form vitreous films when coated on a substrate.

Initially investigating Zr and Hf as EUV absorbing metals, we have more recently focused on additional metals including Ti, Zn, In and Sn [2]. This talk will focus on Zr and Zn as examples of different MOF-inspired clusters and discuss the factors that control resist performance including cluster size and distribution, ligand selection and process conditions [3]. To date we have achieved L/S patterns with lines as small as 15 nm and expect that further performance improvement can be made using this family of materials.

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[2] Kazuki Kasahara, Hong Xu, Vasiliki Kosma, Jeremy Odent, Emmanuel P. Giannelis, Christopher K. Ober, “Recent progress in EUV Metal Oxide Photoresists”, Journal of Photopolymer Science and Technology, (2017) 30(1), 93-97, 201.

[3] Kazuki Kasahara; Hong Xu ; Vasiliki Kosma; Jeremy Odent; Emmanuel P. Giannelis; Christopher K. Ober, "Nanoparticle photoresist studies for EUV lithography", Proc. SPIE 10143, Extreme Ultraviolet (EUV) Lithography VIII, 1014308 (March 24, 2017); doi:10.1117/12.2258187