Metal Organic Cluster Photoresists: New Metal Oxide Systems for EUV Lithography

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Extreme ultraviolet (EUV) lithography, using 13.5 nm radiation, is a prominent candidate for next generation manufacturing. Over the past few years, our main effort has focused on metal organic cluster photoresists, including Zr and Hf metal oxides, both relatively low EUV absorbing metals. While effective, integration of high EUV absorption elements is now considered to be a promising route to further improve lithographic performance under EUV radiation. Here, we report our latest steps forward with zinc oxide-based metal organic cluster photoresists, possessing small nanoparticle size, good solubility in spin-coating solvents, good film-forming abilities and patterning enhanced by incorporating a photo-acid generator or photo-radical generator. Using the chemistry of metal-organic framework compounds, we have identified synthetic strategies that enable production of compositionally and size identical metal organic clusters. A main challenge for EUV resists is to simultaneously satisfy resolution, LWR (line-width roughness) and sensitivity requirements to meet the goals of the ITRS roadmap. We are approaching this by changing the metal oxide core, ligands, photoactive compounds and exposure process. These and other metal oxide cores offer enhanced performance opportunities. The lithographic performance of this and other metal oxides will be described and etch characteristics of these materials will be discussed.