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Inductively coupled plasma etching of SnO2 as a new absorber material for EUVL binary mask

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Currently, extreme ultraviolet lithography (EUVL) is being investigated for next generation lithography. EUVL is one of competitive lithographic technologies for sub-22nm fabrication of nano-scale Si devices that can possibly replace the conventional photolithography used to make today's microcircuits. Among the core EUVL technologies, mask fabrication is of considerable importance due to the use of new reflective optics having a completely different configuration compared to those of conventional photolithography. Therefore, new materials and new mask fabrication process are required for high performance EUVL mask fabrication. This study investigated the etching properties of SnO2 (Tin Oxide) as a new absorber material for EUVL binary mask. The EUVL mask structure used for etching is SnO2 (absorber layer) / Ru (capping / etch stop layer) / Mo-Si multilayer (reflective layer) / Si (substrate). Since the Ru etch stop layer should not be etched, infinitely high selectivity of SnO2 layer to Ru ESL is required. To obtain infinitely high etch selectivity and very low LER (line edge roughness) values, etch parameters of gas flow ratio, top electrode power, dc self - bias voltage (Vdc), and etch time were varied in inductively coupled Cl2/Ar plasmas. For certain process window, infinitely high etch selectivity of SnO2 to Ru ESL could be obtained by optimizing the process parameters. Etch characteristics were measured by on scanning electron microscopy (SEM) and X-ray photoelectron spectroscopy (XPS) analyses. Detailed mechanisms for ultra-high etch selectivity will be discussed.