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Process window for infinitely high etch selectivity of TEOS oxide to PVD *a*-C in dual-frequency capacitively coupled $C_4F_8/CH_2F_2/O_2/Ar$ plasmas

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For the purpose of obtaining highly selective etching process of silicon oxide layer using a very thin amorphous carbon (*a*-C) layer, the highly selective etching of the TEOS oxide layer using physical-vapor-deposited (PVD) *a*-C mask (≅50nm) was investigated in a dual-frequency superimposed capacitively coupled plasma etcher by varying the process parameters in $C_4F_8/CH_2F_2/O_2/Ar$ plasmas: $CH_2F_2/(CH_2F_2+O_2)$ flow ratio,high-frequency power (P_{HF}) and low-frequency power (P_{LF}). It was found that a wide process window for infinitely high etch selectivities of the TEOS oxide layers to the PVD *a*-C on both the blanket and patterned wafers could be obtained for certain process conditions. And the etch gas flow ratio was found to play a critical role in determining the process window for infinite TEOS oxide/PVD *a*-C etch selectivity, due to the disproportionate change in the degree of polymerization. Etching of ArF PR/BARC (bottom anti-reflective coating)/SiO_x/PVD *a*-C/TEOS oxide MLR structure supported the possibility of using a very thin PVD *a*-C layer as an etch-mask layer for etching of the high-aspect ratio TEOS oxide line or contact.