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Frequency effect of TEOS oxide layer in dual-frequency capacitively coupled CH2F2/C4F8/O2/Ar plasma

J. H. Lee[1], B. S. Kwon[2] and N.-E. Lee*

School of Advanced Materials Science & Engineering and Center for Advanced Plasma Surface Technology, Sungkyunkwan University

Recently, the increasing degree of device integration in the fabrication of Si semiconductor devices, etching processes of nano-scale materials and high aspect-ratio (HAR) structures become more important. Due to this reason, etch selectivity control during etching of HAR contact holes and trenches is very important. In this study, The etch selectivity and etch rate of TEOS oxide layer using ACL (amorphous carbon layer) mask are investigated various process parameters in CH2F2/C4F8/O2/Ar plasma during etching TEOS oxide layer using ArF/BARC/SiOx/ACL multilevel resist (MLR) structures. The deformation and etch characteristics of TEOS oxide layer using ACL hard mask was investigated in a dual-frequency superimposed capacitively coupled plasma (DFS-CCP) etcher by different fHF/ fLF combinations by varying the CH2F2/ C4F8 gas flow ratio plasmas. The etch characteristics were measured by on scanning electron microscopy (SEM) And X-ray photoelectron spectroscopy (XPS) analyses and Fourier transform infrared spectroscopy (FT-IR). A process window for very high selective etching of TEOS oxide using ACL mask could be determined by controlling the process parameters and in turn degree of polymerization. Mechanisms for high etch selectivity will discussed in detail.

Keywords: ACL (amorphous carbon layer), multilevel resist (MLR), high etch selectivity