Interfacial Characterization of Post Etch Polymer Residues and Plasma Treated Cu Surfaces related to Advanced Cu Interconnects

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Abstract

In leading edge integrated circuit manufacture, reduction of RC time delay by incorporation of porous low-*k* interlayer dielectrics into Cu interconnect nanostructure continues to pose major integration challenges. The main challenge is that carbon-doped silicon oxide (CDO) becomes more organic-like and is susceptible to damage caused by common patterning process sequences such as fluorocarbon-based reactive ion etching. Characterization of the post-etch fluorocarbon polymer residues in the dielectric trench patterns is essential because incomplete removal can cause problems with subsequent layers such as poor adhesion and coverage, fluoride contamination and poor electrical contact. In addition, the Cu interconnect surface exposed to highly energetic plasma chemistry during trench etching could cause reliability issues that need to be carefully investigated as well. In this study, conformal etch residues of few nanometers coated on trench CDO patterns were characterized using scanning electron microscopy, infrared and x-ray photoelectron spectroscopy. Infrared spectroscopic characterization revealed a complex chemical bonding structure of fluorocarbon etch residue. New insights obtained on chemical, structural and bonding modification across fluorocarbon etch residues, low-*k* dielectric interface and Cu surface can facilitate development of plasma etching and post etch cleaning techniques that minimize dielectric damage**.**