TF-P16

Structural and electronic properties of low dielectric constant SiOC(-H) films deposited by using PECVD from DMDMS/O_2 precursors

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Materials with a low dielectric constant are required as interlayer dielectrics for the on-chip interconnection of ultra scale integration devices to provide high speed, low power consumption and low cross-talk noise. We report of the structural and electric properties of low dielectric constant SiOC(-H) thin films prepared by using plasma enhanced chemical vapor deposition from dimethyldimethoxy silane (DMDMS) and oxygen as precursors. Bonding characteristics and chemical structure of the SiOC(-H) films were investigated by Fourier transform infrared (FTIR) spectroscopy in the absorbance more and X-ray photoelectron spectroscopy (XPS), respectively. Detailed I-V and C-V characteristics of the SiOC(-H) films were carried out for the metal-insulator-semiconductor structure, Al/SiOC(-H)/*p*-Si(100) in order to study the interface behavior. The presence of the Si-O and the Si-CH_3 bonding in the SiOC(-H) film attributes the electrical property of the SiOC(-H) film at the Al/SiOC(-H)/*p*-Si(100) interface. The ratio of Si-O-Si and Si-O-C can be suitably modified by choosing proper flow rate ratio of the precursors during the preparation of the SiOC(-H) thin film. The experimental parameters have been optimized in order to obtain the SiOC(-H) film with low dielectric constant as well as good quality. The detailed electrical properties such as leakage current density, fixed charge, surface state density and dielectric constant of the SiOC(-H) films are presented.