02

Atomic Structure and Optical Properties of Plasma Enhanced Chemical Vapor Deposited SiCOH Low-*k* Dielectric Film*

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The SiCOH low-*k* dielectric film was grown on Si substrate using plasma-enhanced chemical vapor deposition method. Atomic structure and optical properties of the film were studied with the use of X-ray photoelectron spectroscopy (XPS), Fourier transform infrared (FTIR) absorption spectroscopy, Raman spectroscopy, and ellipsometry. Analysis of XPS data showed that the low-*k* dielectric film consists of $Si-O_4$ bonds (83%) and $Si-SiO_3$ bonds (17%). In FTIR spectra some red-shift of Si−O−Si valence (stretching) vibration mode frequency was observed in the low-*k* dielectric film compared with the frequency of this mode in thermally grown SiO_2 film. The peaks related to absorbance by C−H bonds were observed in FTIR spectrum. According to Raman spectroscopy data, the film contained local Si−Si bonds and also C−C bonds in the $s-p^3$ and $s-p^2$ hybridized forms. Scanning laser ellipsometry data show that the film is quite homogeneous, homogeneity of thickness is $\sim 2.5\%$, and homogeneity of refractive index is $\sim 2\%$. According to the analysis of spectral ellipsometry data, the film is porous (porosity is about 24%) and contains clusters of amorphous carbon ($\sim 7\%$).

Keywords: low-*k* dielectrics, PECVD, optical properties, atomic structure.

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