Silicon-Based Low k Dielectric Materials with Remote Plasma ALD

Chanwon Jung[1], Suhyeon Park[2], Byunguk Kim[2], Jongwoo Kim[1], Seokhwi Song[1], Yurim Kwon[2] and Hyeongtag Jeon[1,2*]

[1] Division of Materials Science and Engineering, Hanyang University, Seoul 04763, Korea
[2] Department of Nano-scale Semiconductor Engineering, Hanyang University, Seoul 04763, Korea
Tel : +82-2-2220-0387, Fax : +82-2-2292-3523, E-mail : hjeon@hanyang.ac.kr

As the devices continue to shrink in size, resistive-capacitive (RC) time delay due to parasitic capacitance of devices is becoming a major problem. Low dielectric films with having high thermal stability and excellent step coverage is needed for applications such as barriers and gate sidewall spacers. Silicon oxycarbide (SiOC), silicon oxycarbonitride (SiOCN), silicon carbon nitride (SiCN) are possible candidates for these requirements because the carbon content and bonding state in the low dielectric materials can control the dielectric constant.

Atomic layer deposition (ALD) can be an ideal method for the high conformality with its self-limited reaction. The introduction of the plasma is necessary to decompose the ligands in the precursor for the ALD reaction by the plasma power. We used remote plasma ALD (RPALD) to prevent films from substrate damages caused ion bombardment.

In this work, we will discuss the trend of low k dielectric ALD studies and report the results of SiOC, SiOCN, and SiCN ALD. We used remote plasma ALD system. Octamethylcyclotetrasiloxane (OMCTS) and O_2, Ar, H_2, N_2 and CH_4+Ar plasmas were respectively used as a precursor and reactants for SiOC and SiOCN thin film deposition. Bis[(diethylaminohigh)dimethylsilyl](trimethylsilyl)-amine (DTDN-2) and N_2 plasma were used as a precursor and reactant for SiCN thin film deposition. X-ray photoelectron spectroscopy (XPS), Auger electron spectroscopy (AES), transmission electron microscopy (TEM), I-V measurement, C-V measurement, and wet etch rate (WER) test were performed for investigating the characteristics of low k dielectric films.