BIAS POWER EFFECT ON PROPERTY OF
PE-CVD LOW-K SiOCH FILM

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Low-k SiOCH film is indispensable for RC delay time reduction in high speed and high density logic devices. We have developed SiOCH film with k=2.66 by dual frequency plasma enhanced chemical vapor deposition (PE-CVD) using hexamethyldisiloxane (HMDSO), nitrous oxide (N2O) and helium (He) gases (1).

The low frequency bias power effects on the deposition rate, k value, leakage current and pore diameter were investigated. The deposition rate shows an interesting behavior as shown in Fig. 1. It initially decreases and then increases with increasing bias power. The k value increases from 2.66 to the order of 4.0 with increasing bias power as shown in Fig. 2. The leakage current also increases. The composition as a function bias power was investigated The hydrogen content decreases, but the oxygen and silicon contents increase with increasing bias power. The carbon content remains almost constant. The reason of hydrogen reduction is that the hydrogen is removed from HMDSO gas with ion bombardment caused by high plasma potential at the film deposition. The density, stress, dynamic hardness and Young's modulus are increases with increasing bias power. The pore diameter decreases and the distribution changes from separate to continuos type with increasing bias power (2). The pore density and pore volume ratio were calculated as shown in Fig. 3 (3). It is found that the pore density increases but the pore volume ratio decreases with increasing bias power. The values are on the order of 10^{21} pores/cm^3 and 30 to 20 % in the bias power range, respectively.

The property of SiOCH film deposited with the combination of high frequency (13.56 MHz) and low frequency (380 KHz) bias powers can be easily controlled and the film is useful candidate for high-end device process.

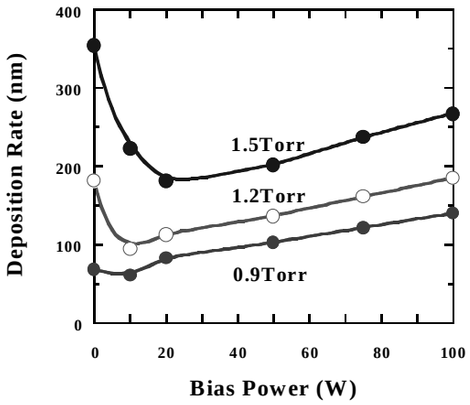


Fig. 1 Deposition rate of SiOCH film as a function of bias power.

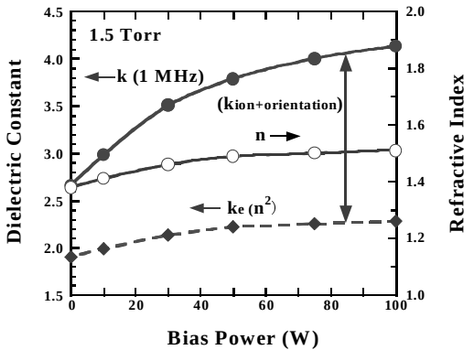
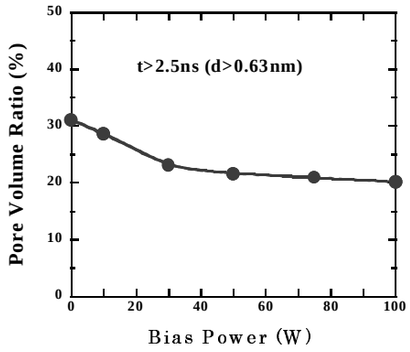


Fig. 2 K values as a function of bias power.

Fig. 3 Pore volume ratio as a function of bias power



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