

# Study on characteristics of organic-inorganic hybrid plasma-polymer thin films for low- $\kappa$ ILD material

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This study investigated the interaction of varied plasma power with ultralow- $\kappa$  Toluene-TEOS hybrid plasma-polymer thin films, as well as changing electrical and mechanical properties with varied with various mixture ratio between toluene and TEOS. Organic-Inorganic hybrid polymer thin films were deposited on silicon(100) substrates under the several condition such as RF (radio frequency using 13.56 MHz) power and the mixture ratio of TEOS (tetraethoxysilane) against toluene by PECVD (plasma enhanced chemical vapor deposition) method. Toluene and TEOS were mixed and prepared as a single precursor, and hydrogen and argon gas were used as a bubbler and carrier gases, respectively. In order to compare the difference of the electrical and the mechanical properties of the plasma polymerized thin films, the hybrid polymer thin films were grown under the conditions of various RF power. The as-grown polymerized thin films were in first analyzed by FT-IR, SEM, and AFM. The result of FT-IR showed that the hybrid polymer thin films were totally fragmented and polymerized with increasing RF power. AFM and SEM also showed that the polymer films with smooth surface and sharp interface could be grown under various deposition conditions. An impedance analyzer was utilized for the measurements of  $I$ - $V$  curves (for leakage current density;  $1 \times 10^{-9}$  A/cm<sup>2</sup> at 1 MV/cm) and capacitance (for dielectric constant; 1.69). Also, MTS nano-indenter was used to measure the hardness and Young's modulus and showed that these values increased as deposition RF power increased in this experiment. The each highest value is 2.69 and 27.6 GPa at 50 W of deposition RF power.

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