

New structure of ultra low-k materials using SiCOH/mesoporous SiO₂ composite films with robust mechanical properties

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Here, we used allyltrimethylsilane (ATMS) consisting in an allyl group along with three methyl groups attached to silicon for SiCOH matrix, in order to prepare the low dielectric constant (low-k) and high modulus films by plasma-enhanced chemical vapor deposition (PECVD). We found that the dielectric constant and mechanical properties of the low-k material are strongly affected by the selection of precursor, the processing conditions such as a deposition temperature and post-treatment, and the introduction of a second labile phase, its chemical structure and composition. After thermal treatment with mesoporous SiO₂, the resulting material exhibits low dielectric constant with excellent mechanical and thermal properties, having $k \sim 2.0$ and 4.3 GPa of Young's modulus. FT-IR and XPS results show that this is attributed to the desorption of labile phase (C_xH_y), formation of cage-like structure and change of chemical composition in the films after thermal treatment.