T-14

An investigation of ultra low dielectric constant SiOC(-H) thin films for interconnect technology: Understanding the requirements

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In recent years, the continuous progression of ultra-large scale integration has driven the emergence of technological solutions. In particular, major challenges have been faced for the fabrication of interconnect structuresin which the critical problem arises due to continuous miniaturization of interconnects in the form of parasitic capacitance and crosstalk. To mitigate this problem, the interconnect industry urgently demands new materials that have a lower dielectric constant for use in interlayer and intermetal insulation layers. In this paper, we review work that we have performed in our laboratory to understand and characterize these low dielectric constant materials. Various precursors have been used to prepare low dielectric constant SiOC(-H) thin films on p-type Si(100) substrates by using plasma enhanced chemical vapor deposition (PECVD). The characterizations, such as chemical structure, thermal stability, refractive index, mechanicaland dielectric constant of the SiOC(-H) films are evaluated. A possible mechanism responsible for the reduction in the dielectric constant of the SiOC(-H) is described. The dielectric constant of the SiOC(-H) film is evaluated by C-V measurements using metal-insulator-semiconductor (MIS), Al/SiOC(-H)/p-Si(100) structure. We also discuss recent process-related advances of low-k inter layer dielectrics in interconnect technology.