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Advanced Low-k Materials for Cu/Low-k Chips

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As the critical dimensions of integrated circuits are scaled down, the line width and spacing between the metal interconnects are made smaller. The dielectric film used as insulation between the metal lines contributes to the resistance-capacitance (RC) time constant that governs the device speed. If the RC time delay, cross talk and lowering the power dissipation are to be reduced, the intermetal dielectric (IMD) films should have a low dielectric constant. The introduction of Cu and low-k dielectrics has incrementally improved the situation as compared to the conventional Al/SiO_2 technology by reducing both the resistivity and the capacitance between interconnects. Some of the potential candidate materials to be used as an ILD are organic and inorganic precursors such as hydrogensilsequioxane (HSQ), silsesquioxane (SSQ), methylsilsisequioxane (MSQ) and carbon doped silicon oxide (SiOCH), It has been shown that organic functional groups can dramatically decrease dielectric constant by increasing the free volume of films. Recently, various inorganic precursors have been used to prepare the SiOCH films. The *k* value of the material depends on the number of CH_3 groups built into the structure since they lower both polarity and density of the material by steric hindrance, which the replacement of Si-O bonds with Si-CH_3 (methyl group) bonds causes bulk porosity due to the formation of nano-sized voids within the silicon oxide matrix. In this talk, we will be introduce some properties of SiOC(-H) thin films deposited with the dimethyldimethoxysilane (DMDMS: $C_4H_{12}O_2Si$) and oxygen as precursors by using plasma-enhanced chemical vapor deposition with and without ultraviolet (UV) irradiation.