

# **Adhesion properties of silica-based low dielectric constant films by Modified edge lift-off test**

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As integrated circuit dimensions continue to decrease, RC delay, crosstalk noise, and power dissipation of the interconnect structure become limiting factors for ultra large scale integration. This requires the introduction of low dielectric constant materials as the interlayer dielectric materials. One critical factor for successful integration of these new materials is maintaining mechanical integrity through the multiplayer processes. Especially, adhesive fracture toughness is needed to sustain all layers and subsequent metal polish steps and also during wire bonding in packaging process. In this research, adhesion properties of silica-based low-k films to various underlayers were investigated with modified edge lift-off method by which quantitative evaluation is possible. We prepared the polymethylsilsesquioxane (PMSSQ)-based low-k materials having various material properties with changing chemical structure and synthesis conditions. Critical fracture energy ( $K_c$ ) was influenced by the material properties such as degree and kind of functionality of the precursor or mechanical strength of the low-k film. Effects of the introduction of coupling agent as adhesion

promoter, plasma process, and annealing on the adhesion onto various substrates, silicon, silicon nitride, silicon oxide and Cu were systematically studied. Factors contributing to adhesion issues of low-k materials for interconnect structure as well as general directions for enhancing adhesion strength were also discussed.