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Comparison of Various Low Dielectric Constant Materials

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Abstract

To reduce the intrinsic resistance-capacitance delay of back-end-of-line (BEOL) interconnects in integrated circuits, low-dielectric-constant (low-*k*) materials with a dielectric constant (*k*) less than 4.0 have been introduced to be used as an interconnecting insulator from 130 nm technological node. In this paper, the physical and electrical characteristics, as well as the reliability, of various commercial low-*k* dielectric films with *k* values from 2.50 to 3.60, deposited by plasma-enhanced chemical vapor deposition were investigated. In addition to fluorinated silicate glass and dense organosilicate glass (OSG) low-*k* dielectric films, two porous OSG (P-OSG) films deposited using different sacrificial organic porogen precursors (alpha-terpinene (ATRP) and cyclooctane (C_8H_{16})) were compared. The P-OSG films provide a lower *k* value than other low-*k* dielectric films, however, their resistance to the integration process is relatively low, resulting in a large increase in the *k* value and degraded electrical performance and reliability. Accordingly, the pursuit of the highly porous low-*k* dielectric films with a further low *k* value for the advanced technology nodes remains arguable. If a highly porous low-*k* dielectric film must be adopted in BEOL interconnects, the use of a sacrificial porogen precursor must be carefully considered because it would affect the properties of the resulting P-OSG films. In this study, the P-OSG film for the ATRP precursor

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