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Mechanical properties of highly porous low-k dielectric nanofilms: A Brillouin light scattering study J. ZIZKA, S. BAILEY, Department of Physics, The Ohio State University, E. MAYS, D.J. MICHALAK, R. CHEBIAM, S. KING, Intel Corporation, Logic Technology Department, R. SOORYAKUMAR, Department of Physics, The Ohio State University, DEPARTMENT OF PHYSICS, THE OHIO STATE UNIVERSITY COLLABORATION, INTEL CORPORATION, LOGIC TECHNOLOGY DEPARTMENT COLLABORATION — To reduce RC time delays in micro-electronic devices, the semiconductor industry has pursued low dielectric constant (k) hybrid organic-inorganic interconnect layers with controlled levels of porosity. However, increased porosity as well as reduced film thicknesses ($<$ 100nm) could reduce mechanical and thermal stability thereby degrading device functionality. Such structural characteristics present limitations with traditional measurement techniques as nanoindentation to characterize the mechanical properties of these highly compact and porous structures. We report on Brillouin light scattering measurements to determine the independent elastic constants, and thus the mechanical properties, of dielectric films with thicknesses as low as 25 nm and porosity levels up to 45%, the highest in the industry. The frequency dispersion and associated light scattering intensities of longitudinal and transverse acoustic standing mode type excitations were utilized to determine Poisson's Ratio (ν) and Young's Modulus (E). Significant modifications were found in ν and E of these highly porous carbon-doped SiO_2(Si-O-C-H) and amorphous carbon(a-C:H) materials compared to traditional SiO_2 and non-porous low-k materials.

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