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Probing the mechanical properties of high-k dielectric nano-films by Brillouin light scattering study JONATHAN ZIZKA, The Ohio State Physics Department, JEFFREY BIELEFELD, SEAN KING, INTEL Corporation, R. SOORYAKUMAR, The Ohio State Physics Department — As microelectronic transistors scale to smaller dimensions, device functionality suffers from current leakage. This problem can be overcome by using thicker gate materials with a high dielectric constant. SiO_2 has been the material of choice, but becomes unsuitable due to its relatively low dielectric constant (k = 3.9). Alternate materials, such as BN:H (k = 5.7) and HfO_2 (k = 25) are promising choices to replace SiO_2 to achieve the desired performance while preserving ultra-thin thickness (<10 nm). Despite these promising features, one concern of including these materials, are their mechanical and thermal properties that could degrade device functionality. There is thus a growing need for non-destructive techniques to evaluate the mechanical properties of such laminar structures since traditional methods like nano-indentation are not effective at these dimensions. We report on Brillioun light scattering studies to determine the individual elastic constants and, thus the mechanical properties of BN:H and HfO_2 high-k films with thicknesses as low as 24 nm. Young's modulus (E) and Poisson's ratio (ν) were determined by measuring the frequency dispersion of confined and traveling transverse and longitudinal acoustic waves as well as their associated light scattering intensities.

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