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Optical properties and metrology of the high-k/Si interface STEFAN ZOLLNER, YONG LIANG, DAVID THEODORE, Z. YU, DINA TRIYOSO, JAY CURLESS, CLARENCE TRACY, Freescale Semiconductor, Inc. — Since future CMOS devices require equivalent gate oxide thicknesses on the order of 10-15 Å, control and measurements of the interfacial layer at the Si/metal oxide interface are important. We deposited typical 35 to 150 Å thick HfO_2 layers on Si for gate stack applications and measured these layers using variable-angle vacuum-UV spectroscopic ellipsometry (0.74 to 9.5 eV, rotating analyzer instrument with Berek waveplate compensator) and x-ray reflectivity (XRR: ω <20000", $\Delta\omega$=20", dynamic range: 7 orders of magnitude) on commercial instruments. All our spectra (even for annealed films) can be fitted using a single layer (HfO_2 on Si), apparently containing no information about the amorphous interfacial layer, which is expected to be 5-10 Å thick. We conclude that ellipsometry and XRR measurements on tool sets similar to ours cannot determine the thickness of the SiO_2 interfacial layer at the Si/high-k metal oxide interface. We also show that significant variations of the optical constants of high-k materials are possible, depending on growth conditions.

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