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Properties of Ultrathin Al_2O_3-TiO_2 Nanolaminate Films for Gate Dielectric Applications Deposited by Plasma-Assisted Atomic Layer Deposition NELSON GARCES, DAVID MEYER, NEERAJ NEPAL, VIRGINIA WHEELER, CHARLES EDDY, U.S. Naval Research Laboratory — High permittivity dielectrics such as Al_2O_3, HfO_2, Ta_2O_5, TiO_2, etc., are an essential component of aggressively-scaled III-V and graphene field effect transistors (FETs) where insulators are necessary to reduce gate leakage current while maintaining high gate capacitance and charge control of the channel. Atomic layer deposition (ALD) has the capability to deposit hybrid films, or nanolaminates, of two or more dielectrics that have unique properties. Thin [Al_2O_3+TiO_2] nanolaminates with varying TiO_2 and Al_2O_3 content were deposited on *n*-Si substrates at ~225-300 ° C using ALD. A nanolaminate is composed of bilayers, defined as the sum of (x)Al_2O_3 and (y)TiO_2, where x, and y indicate the number of times a component monolayer is repeated. While the overall thickness of the dielectric was held at ~ 17-20 nm, the relative ratio of Al_2O_3 to TiO_2 in the bilayer stack was varied to evaluate changes in the material properties and electrical performance of the oxides. C-V and I-V measurements on various [(x)TiO_2+(y)Al_2O_3] MOS capacitors were taken. The high-TiO_2-content films show limited evidence of oxide charge trapping and relatively large dielectric constants (κ ~15), whereas the high-Al_2O_3-content films offer a larger optical bandgap and improved suppression of leakage current. We will discuss the properties of very thin nanolaminates and their possible use as gate oxides. Morphological, electrical, and XPS composition assessments will be presented.

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