Electrically optimized high-κ/metal gate MOSFET by specific modification of the band alignment

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The electrical optimization of metal/oxide/semiconductor gate stacks by specific modification of the band alignment for advanced MOS technology incorporating high dielectric constant (κ) materials is explored. Because of requirements concerning continued scaling of MOSFET transistors, gate oxides and metal electrode have been grown in situ successively on Si substrate respectively by means of atomic layer deposition (ALD) and evaporation. The thicknesses of high-κ films were around 1-2 nm. We applied synchrotron radiation based x-ray photoelectron spectroscopy (SR XPS) to characterize our samples, which allows step by step in situ investigations. In this way, by controlling sample preparation process we are able to improve functional properties of our thin films. Si 2p, O 1s, Zr 3d, Al 2p core levels and valence band (VB) spectra were measured and analyzed. As a result we determined chemical composition, growth rate and electronic band structure.

Keywords: high-k MOSFET, atomic layer deposition, band alignment, photoelectron spectroscopy

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