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Atomic-layer-deposited HfO_2 on $In_{0.53}Ga_{0.47}As$ – passivation and energy-band parameters Y.C. CHANG, K.Y. LEE, M.L. HUANG, Y.J. LEE, T.D. LIN, M. HONG, Dept. of Materials Science and Engineering, Natl Tsing Hua Univ., Taiwan, J. KWO, Dept. of Physics, Natl Tsing Hua Univ., Taiwan — High κ dielectric HfO_2 films were deposited by atomic layer deposition on air-exposed $In_{0.53}Ga_{0.47}As$/InP (100), and found to exhibit an atomically sharp interface free of arsenic oxides, an important aspect for Fermi level un-pinning. Angular-resolved x-ray photoelectron spectroscopy (XPS) using synchrotron radiation, however, observed the existence of Ga_2O_3, In_2O_3, and $In(OH)_3$ at the interface. The I-V of the MOS diode for an HfO_2 7.8 nm thick follows the Fowler-Nordheim tunneling mechanism with a low leakage $\sim 10^{-8}$A/cm^2 at V_{FB}+1V, and an interfacial density of states D_{it} of 2x10^{12}cm^{-2}eV^{-1}. A conduction-band offset of $\sim$ 1.8 eV, and a valence-band offset of $\sim$ 2.9 eV were derived from the transport, and XPS data, respectively. For another HfO_2film 4.5nm thick we achieved a CET value as small as 1.0nm, and a leakage of 3.8x10^{-4}A/cm^2 at V_{FB}+1V. The good scalability of ALD grown HfO_2 film with low leakage makes it very promising for III-V MOSFET applications.

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