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Photoemission Studies of Nitrided Hafnium Silicates for High-κ Dielectrics ANOOP MATHEW, KORHAN DEMIRKAN, University of Delaware, CHANG-GONG WANG, GLEN WILK, ASM America Inc., ROBERT OPILA, University of Delaware — Nitrided hafnium silicates are strong candidate materials for replacing the SiO_2 gate dielectric in transistors for low standby power applications. Integrating these materials with the silicon substrate of the channel or metal gates open up a variety of interfacial issues. Photoelectron spectroscopy with its sensitivity to local chemical bonding is an invaluable tool for investigating these interfaces. Hafnium silicates were deposited using Atomic Layer Chemical Vapor Deposition and subsequently nitrided. A maximum entropy based algorithm was used to non-destructively reconstruct concentration profiles as a function of depth from angle resolved photoemission data and a good correlation was obtained from depth profile data obtained using Medium Energy Ion Scattering. Nitrogen is seen to diffuse towards the gate stack/silicon interface at higher temperatures. Trends in the nitrogen and oxygen profiles suggest replacement of the oxygen with the nitrogen during nitridation. These films were rapid thermally annealed to study their phase stability, and shifts in the photoelectron spectra reveal behavior that is not entirely consistent with what would be expected with previously reported phase segregation of these films into pure HfO_2 and SiO_2. Interfacial charge associated with these systems is reflected in the photoemission spectra, and this complements observations from other techniques.

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