Frank J. Grunthaner's abstract is presented here. His paper and visual material were not presented for publications.

CHEMICAL STRUCTURE OF INTERFACES

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The interfacial structure of silicon/dielectric and silicon/metal systems is particularly amenable to analysis using a combination of surface spectroscopies together with a variety of chemical structures of Si/SiO_2, Si/$SiO_2Si_3N_4$, Si/Si_2N_2O, Si/SiO_2/Al, and Si/Native Oxide interfaces using high resolution (0.350 eV FWHM) X-ray photoelectron spectroscopy. The general structure of these dielectric interfaces entails a monolayer chemical transition layer at the Si/dielectric boundary, which consists of specific distributions of the intermediate oxidation states of silicon (Si^{+1}, Si^{+2}, and Si^{+3}), which appear to be related to local morphology of the silicon substrate. Amorphous Si substrates show a wide variety of hydrogenated Si and $Si(OH)_x$ states that are not observed in thermal oxidation of single crystal material. Extended SiO_2 layers greater than 8 Å in thickness are shown to be stoichiometric SiO_2, but to exhibit a wide variety of local network structures. In the nitrogen-containing systems, we see an approach to stoichiometric oxynitride compounds with interesting impurity- and electron-trapping properties. In native oxides, we find substantial topographical non-uniformity in oxide thickness and composition (e.g., a nominal 25Å oxide can be shown to have 4 different areal distributions of SiO_2 ranging in thickness from 12 to 165 Å). Analysis of metal/oxide interfacial layers is accomplished by analytical removal of the Si substrate by UHV XeF_2 dry etching methods. The general question of the importance of the chemical state of the starting silicon surface to the final dielectric/silicon interface composition will be addressed in a series of experiments using covalent silicon surface substitution. Finally, the modification of silicon surface bonding and hybridization in the presence of sub-monolayer levels of transition metals will be examined from the perspective of a modification in interfacial reactivity.

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