The 4H-SiC/Si02 Interface

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The interplay between interfacial chemistry and electronic defects is a classic semiconductor thin film problem, difficult to address experimentally because of the large differences in the sensitivity of electronic vs. physical interface probes. We have discovered a unique system, based in SiC, which clearly reveals this physical-electronic correlation. In particular, the relationship between nitrogen content and interface trap density (Dit) in SiO2/4H-SiC has been quantitatively determined. Nitridation reduces Dit near the conduction band, changing the defect energy distribution within the gap. The results are consistent with a quantitative model in which these traps are cluster defects[1] with a near-continuum of energy levels. Nitrogen passivation of these traps proceeds by the dissolution of these clusters, atom by atom, as revealed through the kinetic analysis. This N passivated interface has established new values for low interface state density and high interface mobility in the 4HSiC-SiO2 system.[2]

Investigations of oxide growth have also been performed on the carbon-terminated "c-face" (100% carbon) and the "a-face"(50%carbon, 50% silicon). We report remarkable differences in their rates of oxidation compared to the conventional Si terminated c-face (100%Si). These differences are attributed to variations in interface structure among the crystal faces . Since this interface is the controlling factor in the inversion layer mobility, the control and understanding of this boundary layer is of paramount performance in achieving the end goal of high quality SiC power MOSFET devices.

[1] R. Schorner, P. Friedrichs, D. Peters and D. Stephani, IEEE Elect. Dev. Lett. 20 241 (1999). V.V. Afanasev, M. Bassler, G. Pensl and M. Schulz, Phys. Stat. Sol. (A) 162 321 (1997).
[2] G.Y. Chung, et al. IEEE Elect. Dev. Lett. 22, 176 (2001).