HfO2/β-Ga2O3(−201) interface electrical properties after thermal treatment

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β-Ga2O3 is a material that has attracted particular attention recently [1]. It has an ultra wide bandgap (4.8 eV), a high critical field and high electron mobility values where the electron concentration can be tuned over a wide range. This combination of electronic and wafer scale properties opens new possibilities in power electronics and applications in harsh environments.

The interface between β-Ga2O3 and the dielectric is critical for MOSFET devices since the electrically active defects (interface states or border traps) can degrade the device electrical properties and generate instabilities by trapping/emitting carriers from/to the device channel. There has been a lot of interest in the HfO2/β-Ga2O3 MOS system[2,3].

In this study we have explored the electrical properties of the HfO2/β-Ga2O3 interface post thermal treatment. Impedance measurements were performed to investigate the properties of MOS devices annealed at 450oC for 5 min in different ambient atmospheres. Physics based simulation of the MOS electrical parameters as well as photo-depopulation experiments were employed to extract the distribution in energy and space of electrically active defects.

The 450oC annealing treatment degrades the HfO2/β-Ga2O3 interface regardless of the ambient (N2, N2+H2 or O2). The charge trapping in the HfO2 increases as compared to the control sample. The photo-depopulation results show the presence of defects likely located in the HfO2 layer at an energy band centred ~3eV below the conduction band. A similar defect band was detected in the HfO2/Si system using a comparable technique [4].