Contribution ID: **69** Type: **Contributed Poster**

Germanium MOS Technology for Infra-Red Detectors

Thursday, September 15, 2005 10:30 AM (30 minutes)

There are a number of position sensitive detector applications where there is a requirement for an imaging device which has enhanced response in the near infra-red spectrum (0.77μm to 1.5μm). Although infra-red detectors are fabricated using III-V and HgCdTe materials, integration with silicon readout circuitry is not easily achievable, often relying on bump-bonding technology. Germanium (Ge) is compatible with silicon device technology, and is once again becoming a mainstream semiconductor material. A Ge detector will exhibit a high quantum efficiency at all wavelengths from ultra-violet up to near infra-red, and is thus highly desirable for multi-spectral imaging and image fusion applications.

Fabrication of an electrically stable dielectric is a key enabling technology in the production of a Ge detector. This work investigates the use of atmospheric pressure CVD (APCVD) silicon dioxide (SiO2) deposited on Ge at 400oC using SiH4, O2 and N2 source gases. After deposition the SiO2 layers were densified at 800oC for 10 minutes in N2. To study the electrical properties of the Ge-SiO2 interface MOS capacitors have been fabricated on p-type 2Ω-cm Ge substrates, using a dielectric thickness of 170nm. Analysis of these characteristics reveals a satisfactory oxide surface-state charge (Qss) of 1.7x1011cm-2, a flat-band voltage (Vfb) of -1.77V, and a threshold voltage (Vth) of -0.60V. The DC leakage current density through the Ge MOS capacitors is less than 2x10-11Acm-2 for applied voltages between −5V and +5V, thus verifying the insulating properties of the dielectric.

At a frequency of 10kHz the capacitance measured in strong inversion approaches that of the dielectric alone. This ‘low frequency’ mode of operation occurs at a frequency approximately three orders of magnitude higher than would be observed for a Si MOS capacitor, and is due to the increased charge generation rate in the narrower bandgap Ge substrate. SIMS analysis of the APCVD SiO2 after densification at 800oC shows that significant Ge outdiffusion from the substrate into the dielectric layer has occurred. For comparison, results from Ge MOS capacitors incorporating APCVD SiO2 layers densified at 600oC, and dielectrics deposited using plasma enhanced CVD (PECVD) will be presented. The effect of 450oC forming gas (H2/N2) post-metal anneals on the capacitor characteristics will also be discussed.

Primary author: Dr RUDDELL, Fred (Northern Ireland Semiconductor Research Centre)

Presenter: Dr RUDDELL, Fred (Northern Ireland Semiconductor Research Centre)

Session Classification: P : Coffee and Poster Session

Track Classification: New Solid-State Detector Technology