Contribution ID: **14**　　　　Type: **not specified**

Measurement of the charge collection for the irradiated n^+pp^+ pad diode in the region of the n^+p interface

Wednesday, 3 June 2020 14:40 (20 minutes)

The charge collection of two n^+pp^+ pad diodes for light with a wavelength of 660 nm from a sub-nanosecond laser and α-particles with energies, E_α, between 1.5 and 2.8 MeV injected from the n^+p side, has been measured. The diodes had an area of 25 mm^2, a thickness of 150 μm and a doping concentration of 4.5×10^{12}cm^{-3} in the bulk region. The measurements were performed at -20 °C for bias voltages up to $V_{bias} =$ 800 V. One diode had been irradiated by 23 MeV protons to a 1 MeV equivalent fluence of $\Phi_{eq} = 2 \times 10^{15}$ cm^{-2}, the other one had not been irradiated. As expected, above the depletion voltage the charge measured for the non-irradiated diode, Q_0, is independent of the bias voltage. The Charge Collection Efficiency (CCE) for the irradiated diode is obtained from $\mathrm{CCE}_\Phi(V_{bias}) = Q_\Phi(V_{bias})/Q_0$, where $Q_\Phi(V_{bias})$ is the charge measured for the irradiated diode. As expected, $\mathrm{CCE}_\Phi(V_{bias})$ increases with bias voltage because the higher electric field increases the drift velocity of the holes, which dominate the signal. In addition, it is observed that $\mathrm{CCE}_\Phi(V_{bias})$ for α-particles increases with increasing E_α, and at $E_\alpha \approx 1.5$ MeV the $\mathrm{CCE}_\Phi(V_{bias})$ for α-particles (with ≈ 5 μm range in silicon) is the same as for the laser light of 660 nm (with 4.5 μm attenuation length at -20 °C).

The data can be described assuming a V_{bias}-independent layer with zero charge collection of thickness d_0, followed by an active region with the V_{bias}-dependent mean charge collection $\mathrm{CCE}_\Phi(V_{bias})$ for the remaining range of the α-particles. It is found that $d_0 = 1.15 \pm 0.10$ μm and $\mathrm{CCE}_\Phi = 55 \pm 1$ % at $V_{bias} = 300$ V increasing to 78 ± 1 % at $V_{bias} = 800$ V. The presence of an inactive layer is relevant for the determination of charge-carrier lifetimes using light with a short attenuation length or low energy α-particles: Not taking into account d_0 underestimates the values for the lifetime.

Primary authors: HAJHEIDARI, Mohammadtaghi (Hamburg University (DE)); GARUTTI, Erika (Hamburg University (DE)); Dr SCHWANDT, Joern (Hamburg University (DE)); KLANNER, Robert (Hamburg University (DE))

Presenter: HAJHEIDARI, Mohammadtaghi (Hamburg University (DE))

Session Classification: Detector Characterization, NIEL and Irradiation Facilities