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Investigation of neutron-irradiated 4H-SiC p-in-n Diodes in forward and reverse Bias

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Due to its low leakage currents and high radiation displacement energy, silicon carbide (SiC) is an attractive candidate for future radiation hard detectors.

We present electrical characterization (I-V and C-V) and charge collection efficiency (CCE) measurements in forward and reverse bias for neutron-irradiated samples (CNM run 13575) between 5×10^{14} n_{eq}/cm^2 and 1×10^{16} n_{eq}/cm^2 1 MeV neutron equivalent fluence.

After irradiation, no diode-like current is present in forward direction, and charge is still collected for UV-TCT or impinging particles. The CCE measurements were carried out using alpha particles, UV-TCT, and proton beams, which allows for a comparison of different charge deposition profiles. For the alpha measurements, the CCE in forward and reverse bias are comparable. However, using UV-TCT and proton beams, a signal enhancement was observed for irradiated samples in forward bias, with CCEs surpassing 100%. These observations are in agreement with recent TPA-TCT results and correlate with the measured I-V characteristics.

Based on these results, possible mechanisms are discussed, and the required further investigations are highlighted.

Authors: GSPONER, Andreas (Austrian Academy of Sciences (AT)); MAIER, Jürgen (Austrian Academy of Sciences (AT)); KNOPF, Matthias (Austrian Academy of Sciences (AT)); GAGGL, Philipp (Austrian Academy of Sciences (AT)); THALMEIER, Richard (Austrian Academy of Sciences (AT)); WAID, Simon Emanuel (Austrian Academy of Sciences (AT)); BERGAUER, Thomas (Austrian Academy of Sciences (AT))

Presenter: GSPONER, Andreas (Austrian Academy of Sciences (AT))

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