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Electrical characterization of deep level defects created by bombarding the n-type 4H-SiC with 1.8 MeV proton irradiations

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We have characterized the deep level defects present before and after proton irradiation and annealing of n-type, N-doped, 4H-SiC using deep level transient spectroscopy (DLTS). The bombardment of the sample was carried out at fluence of 1.0 × 1012 cm−2. The suitability of Schottky barrier diodes (SBDs) was tested before and after proton irradiation and annealing by current−voltage (I-V) and capacitance−voltage (C-V) carried out at room temperature. I-V and C-V results revealed a degradation of the (SBDs) properties after proton irradiation. Rectification properties of the SBDs were restored gradually after annealing in flowing argon at temperatures varies from 125 to 625 ℃. Presence of four electron traps (Ec – 0.10, Ec – 0.13, Ec – 0.18 and Ec – 0.69 eV) were observed in as-grown diodes. Deep level defects, Ec – 0.42 and Ec – 0.76 eV, were revealed after annealing the proton-irradiated SBDs up to 225 ℃, while Ec – 0.42 eV later annealed out at 425 ℃ which led to changes in the spectrum shown in Fig. 1. The disappearance of Ec – 0.42 eV also probably led to the appearance of two electron traps (Ec – 0.31 and Ec – 0.62 eV) at annealing temperature of 425 ℃. We speculate that the defect Ec – 0.42 eV has a link or relationship with defects Ec – 0.31 and Ec – 0.62 eV, respectively. The defects, Ec – 0.31 eV, remained up to high temperature annealing, has a similar energy with defect Ec – 0.32 obtained after electron irradiation, though unstable, which has been attributed to a carbon interstitial.

Summary

Proton irradiation with 1.8 MeV introduced deep level defects into thermally fabricated Ni/4H-SiC. These defects emanated were characterized by deep level transient spectroscopy. Annealing the irradiated devices revealed the presence of two new defects.

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Primary author: Dr OMOTOSO, Ezekiel (University of Pretoria, Pretoria, South Africa)

Co-authors: Mr PARADZAH, Alexander (MSc Student); Prof. AURET, Danie (University of Pretoria); Mr JANSE VAN RENSBURG, Johan (University of Pretoria); Dr MEYER, Walter (University of Pretoria)

Presenter: Dr OMOTOSO, Ezekiel (University of Pretoria, Pretoria, South Africa)

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