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Abstract Booklet

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100 MeV Sulfur Ion Irradiation Studies on 2N 3866 NPN Transistor at Low Temperature

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NPN transistor are widely employed in several extreme environmental applications such as at cryogenic temperature, high temperature (300 ^{o}C) and in radiation rich environments. The exposure of transistors to ionizing radiation can induce significant degradation in the electrical characteristics and affect the performance of the electronic circuits. Thus, it's vital to study the radiation response of NPN transistor at different temperatures.

The NPN transistor were exposed to 100 MeV Sulfur ions (S^{8+}) at room temperature (300 K) and low temperature (100 K) at Inter University Accelerator Centre (IUAC), New Delhi in the fluence range of 1.34 x 10^{9} to 2.685 x 10^{11} S^{8+} ions/cm^2. The corresponding equivalent dose is 300 krad to 60 Mrad and all the terminals of the devices were grounded during irradiation. The electrical characterizations were performed both before and after irradiation at 300 K using Keithley dual channel source meter 2636A. The key electrical parameters of NPN transistor such as Gummel characteristics, excess base current (ΔI_B), dc current gain (h_{FE}) and output characteristics were studied as a function of total dose. The low temperature irradiation results were compared with the room temperature results in the same dose range. Fig. 1 and Fig. 2 respectively represent the variation in I_B vs V_{BE} and h_{FE} of NPN transistors with total dose irradiated with S^{8+} ions at 300 K and 100 K. The observed degradation in the key electrical characteristics of the transistor is mainly due to the generation-recombination (G-R) centers created in emitter-base (E-B) spacer oxide (SiO_2) and displacement damage in the bulk of the transistor structure. It can be observed that the degradation is more for the transistor irradiated at 300 K when compared to the irradiation at 100 K. The devices show significant radiation hardness at low temperatures and the detailed results will be presented at the conference.

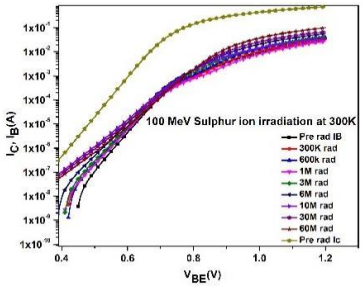

Fig. 1: Variation of IB vs VBE at room temperature

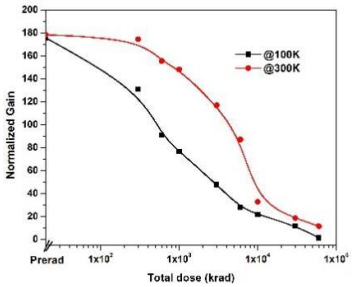

Fig. 2: Variation in h_{FE} with total dose at 300K and 100 K