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Abstract Booklet

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80 MeV Nitrogen Ion Irradiation Studies on N-channel MOSFETs at Low Temperature

Arshiya Anjum[1], M. Darshan[1], N. Pushpa[2], R. C. Meena[3], Ambuj Tripathi[3], A. P. Gnana Prakash[1,*]

[1] *Department of Studies in Physics, University of Mysore, Manasagangotri, Mysore-570006, India.*
[2] *Department of PG Studies in Physics, JSS College, Ooty Road, Mysore-570025, India.*
[3] *Inter-University Accelerator Centre (IUAC), Aruna Asaf Ali Marg, New Delhi-110067, India.*
**Email:gnanaprakash@physics.uni-mysore.ac.in*

The electronic systems which operate under adverse ambient conditions that lie outside the domain of commercial or even military specifications are called as extreme environment electronics (EEE). The N - channel MOSFETs are the fundamental components for many EEE applications which require the devices to operate reliably for a long time at extreme temperatures and radiation harsh environments. The incident ionizing radiation can cause an accumulation of charges to build up at the sensitive interface i.e., at Si/SiO_2 and thereby degrade the performance of the devices. Thus, it is very important to study the radiation response of MOSFETs at different temperatures.

The MOSFETs were exposed to 80 MeV Nitrogen ions (N^{6+}) at room temperature (300 K) as well as low temperature (100 K) with all the terminals are grounded at Inter University Accelerator Centre (IUAC), New Delhi in the fluence range of 2.4 x 10^9 to 7.14 x 10^{11} N^{6+} ions/cm^2. The corresponding gamma equivalent total dose is 100 krad to 30 Mrad. The electrical characterizations were studied before and after irradiation at 300 K using Keithley dual source meter 2636A. The electrical characteristics of MOSFET such as threshold voltage (V_{th}), density of oxide trapped charges (ΔN_{ot}), density of interface trapped charges (ΔN_{it}), transconductance (g_m), mobility (μ) and leakage current (I_L) were studied as a function of total dose. The low temperature irradiation results were compared with the room temperature irradiation results. Fig. 1 and Fig. 2 respectively depict the variation in V_{th} and μ of MOSFETs irradiated with 80 MeV N^{6+} ions at 300 K and 100 K. A significant decrease in V_{th} and μ was observed after irradiation due to the creation of interface and oxide trapped charges at the Si/SiO_2 interface of the device. From the results, it is observed that the MOSFETs irradiated at 300 K show more degradation than devices irradiated at 100 K. The MOSFETs show significant radiation hardness at low temperatures. The results will be discussed in detail at the conference.

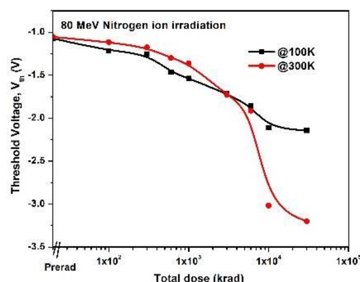

Fig. 1: Variation in V_{th} with total dose at 300K and 100K

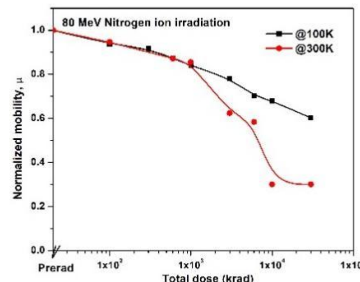

Fig. 2: Variation in μ with total dose at 300K and 100K