Electrical Properties of Proton-Irradiated on Silicon PIN power diode

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The silicon power devices can undergo many problems such as a switching delay and a power loss during switching when it operates at a higher frequency of a long minority carrier lifetime. It is therefore needed to reduce the MCLT in order to increase the switching speed of the power device. The MCLT can be reduce by introducing the recombination centers either by the diffusion of metallic impurities or by the irradiation of high energy particles. However, it is not easy to control impurity concentration by diffusion method, which increase the leakage current and resistance.

Recently, the defect creation methods by irradiating the high energy particle beams such as proton, neutron, electron, etc. have been studied because the defects can be controlled and another process without effecting to the defects were carried on.

In this present study, the proton irradiations with several energies as 5.26, 6.2, 7.2 and 8.67 MeV were adopted to improve the switching characteristics of a semiconductor device. With these select energies, the projectile range of irradiation proton would be at the P+ region, P+-P- junction and neutral region, and P--N+ junction region of PN diode, respectively. Characterizations of the device were investigated by I-V(current-voltage), C-V(capacitance-voltage), IL(leakage current) measurements. The measured results of the irradiated devices were compared with the non-irradiated devices values.

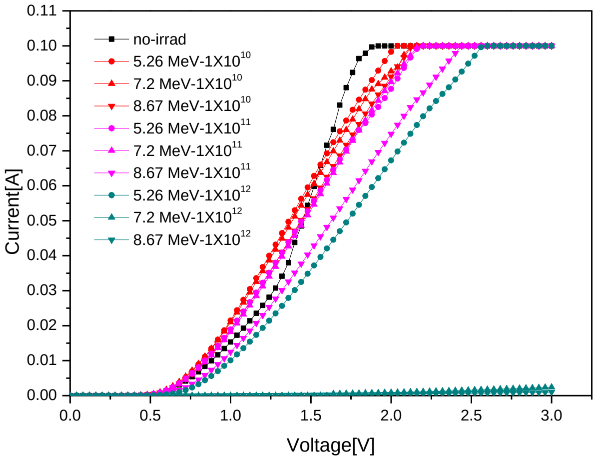

Fig. 1. Gate-emitter voltage and collector-emitter current curves for each irradiation dose

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