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MeV energy electron and proton irradiation effects in semiconductor materials for space applications

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Nowadays, space exploration is undergoing intensive investigation, and semiconductor electronic equipment in space operates in an environment irradiated by high-energy particles. MeV electrons and protons are present in the near-Earth space environment, where they are more intense, so the study was carried out in these simulated space conditions (energy, vacuum, temperature).
The effects of protons with an energy of 18 MeV and picosecond pulsed electrons with an energy of 3.5 MeV on the parameters (charge carriers'concentration and mobility, resistivity) of Si single crystals and n-GaP are investigated. On top of that, the introduction rate of radiation defects was studied depending on irradiation dose and it was demonstrated that the introduction rate of radiation defects at room temperatures could be expressed by the empiric exponential law of the form

$$\frac{\Delta N}{\Delta D}=\frac{n_{0}}{D_{0}}\text{exp}\left(- \frac{D}{D_{0}}\right),$$

which gives the best agreement with the experimental data, irrespective of the type of irradiation particle. Here N_{def} is the concentration of radiation defects and n_{0} is the initial concentration of charge carriers, D_{0} is the irradiation dose, at which the carrier concentration $n\left(D \right)$ at a temperature T=300K decreases by a factor of e.

Primary authors: Prof. HARUTYUNYAN, Vachagan; Dr SAHAKYAN, Aram (A. Alikhanyan National Laboratory (Yerevan Physics Institute)); ARZUMANYAN, Vika (A. Alikhanyan National Laboratory)

Co-authors: Dr GRIGORYAN, Norair (A. Alikhanyan National Laboratory (Yerevan Physics Institute)); Ms ARPHINE, Martirosyan (A. Alikhanyan National Laboratory (Yerevan Physics Institute))

Presenter: ARZUMANYAN, Vika (A. Alikhanyan National Laboratory)

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