

Trainee's Project Report

Job Code	PH106
Department	PH
Discipline	Experimental Applied Physics
Supervisor	MOLL Michael

Description

===== Background: Research on radiation hard silicon detectors
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Silicon detectors are the key devices for the reconstruction of charged particle tracks in the experiments at the CERN Large Hadron Collider. In order to distinguish between primary and secondary vertices and in order to achieve a good track resolution these devices have to be placed very close to the interaction points. There they have to operate in extremely intense radiation fields causing appreciable deterioration of the detector performance. In fact the radiation induced change of the detector depletion voltage - which is closely linked to the charge collection efficiency - is the limiting factor for the detector lifetime in the experiments. Therefore the radiation tolerance is of prime interest and had led to a broad line of investigations worldwide. The CERN-RD50 collaboration ζ Radiation hard semiconductor devices for very high luminosity colliders ζ (<http://cern.ch/RD50>) has been formed to develop radiation harder detectors. One approach is the use of so-called defect engineered silicon containing deliberately introduced impurities such as e.g. oxygen. One type of oxygen enriched silicon is Czochralski silicon. Another approach is to use p-type silicon or produce special sensors with intrinsic charge multiplication after high levels of irradiation. These and other types of silicon materials and silicon sensor types are presently under investigation by RD50 and this Student project would be part of these investigations.

===== Project: =====

Detectors with intrinsic charge multiplication have been produced by the RD50 collaboration and are now under study. They are investigated before and after exposing them to proton and neutron irradiation. Capacitance-Voltage and Current-Voltage characteristics as well as laser and beta particle induced current pulses will be measured in order to determine the depletion voltage, the leakage current and the charge collection efficiency of the irradiated devices. These parameters will be monitored during an isothermal annealing experiment at temperatures of 60C, 80C, 100C and 120C. The analysis of the extracted device parameters will be compared to previous studies on standard silicon sensors in order to quantify the radiation tolerance of the new detectors and test them for their feasibility as detector for the LHC upgrade program.

===== About the supervisor: =====

Michael Moll (michael.moll@cern.ch) - Leader of the Detector Development Section PH-DT-DD - Deputy Spokesperson of the CERN-RD50 collaboration.



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Special Requirements

Hardware oriented. Interest in radiation detectors and solid state physics. Basic knowledge of Labview software would be helpful.

Training Value

All aspects of Radiation hardness of silicon detectors will be studied ranging from the operation principle of solid state detectors (Detector Physics) to the microscopic defects created in the semiconductor crystal during and after exposure to irradiation (Solid State Physics).