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Simulation of Double Peak Structure of Electric Field for Irradiated Si-Strip Sensors.

Silicon micro-strip sensors are the key device for the measurement of trajectories of charge particles in high energy physics experiments. In future they will be operated in harsh radiation environment which introduces defects, both in Si causing bulk damage and at Si-SiO2
interface causing surface damage that will affect the operating performance of sensors. Due to bulk damage type inversion occurs in n-type bulk resulting in the formation of double junction. As a result electric field profile shows two maxima both at the main junction and at the backside. In this work we have incorporated a simplified two-trap model in device simulation program to describe the double peak structure in the electric field after type inversion. The results for electric field, electron/hole concentration, and effective bulk doping concentration are compared against known model and a good agreement is observed.

Summary

In future Si strip sensor will face intense radiation environment which causes surface & bulk damage in Si-sensors. In order to explain the double peak feature of the electric field after type-inversion in n-type silicon sensors due to bulk damage, EVL model with two deep level traps is implemented in simulations which are being performed using TCAD simulation package ATLAS (Silvaco).
To compare the simulation results with modeled data for electric field profile, electron/hole concentration, effective bulk doping density, a systematic parametrization study is carried out by varying electron/hole capture cross sections and their ratio, carrier life time, trap introduction rate. Additional bulk current is generated by increasing cross-sections of the trap levels from 1x10-15cm2 to 4x10-14cm2 which results in good agreement between modeled data and simulations for effective substrate concentration, electric field and electron/hole concentration for different fluences. The simulated data also reproduces the double peak feature of electric field at higher values of fluence.

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