Advances on TCAD numerical modeling of radiation damage effects in silicon detectors for HL-LHC operations

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Introduction

- A Technology CAD (TCAD) combined surface and bulk radiation damage effects model is presented.
- The surface radiation damage effects model is based on amphoteric, uniform energy band distributed deep-level defects.
- The main parameters of the surface damage, e.g. the equivalent oxide charge and interface trap densities, have been extracted from experimental measurements carried out on different vendors (e.g. HPK, FBK and Infineon) irradiated test structures.
- The model has been coupled with a bulk damage model based on multiple level defects with variable capture-cross sections.

TCAD modeling of Radiation Damage Effects

- Modelling the effects of the radiation damage.
- Predictive insight of the behaviour of detectors, aiming at their performance optimization.

Simulations vs. Measurements

- Charge collection vs. hit position
- Charge collection vs. fluence

Conclusions

- A combined surface and bulk radiation damage effects model, suitable for commercial TCAD tools, has been further developed [1].
- The parameters of the surface damage model can be extracted from test structures fabricated by different vendors.
- Tools for to the optimization of active behaviour (i.e. charge collection) of pixel detectors (3D, 2D planar, ...) for HL-LHC operations.

References


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