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TCAD simulations of breakdown voltage and isolation properties of 3D sensors

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We report on the initial results from a TCAD simulation study aimed at investigating the breakdown voltage and read-out electrode isolation properties of 3D sensors. Both these features can vary significantly with sensor geometry and process details; moreover, after irradiation, they strongly depend on both bulk damage and surface damage, making any prediction based on analytical models unreliable. TCAD simulations can effectively address all the involved aspects and their mutual interplay in a quantitative way, so they can aid in the interpretation of experimental results from existing samples and in the design and optimization of new sensors oriented to the HL LHC upgrades. However, in order to yield accurate results, comprehensive radiation damage models, incorporating both bulk damage and surface damage (in particular for the interface state parameters), must be adopted, that are currently being developed by several groups.
In this study, we have used the new combined bulk/surface model from the University of Perugia. As a first step, simulations have been performed with reference to the double-sided 3D sensors from FBK used in the ATLAS IBL, for which a wide set of experimental results are available for validation purpose. In particular, the sensitivity of the breakdown voltage to several parameters of the radiation damage model has been analysed, also studying the corresponding impact on the surface isolation properties. We will report on selected results from simulations, in comparison to experimental measurements.

TRACK

Simulations

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