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Comparative TCAD study of neutron irradiated p-stops for the CMS HGCAL

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The segmented n-on-p sensors require isolation implants to prevent the electrodes from electrically shorting and two isolation configurations are being considered for the high granularity endcap calorimeter (HGCAL) of CMS at the high luminosity LHC: common and individual (atoll) p-stops. Performance of the two p-stop options after irradiation is the focus of this study. We present a parametrization of Si/SiO_2 interface charge density with 1-MeV equivalent neutron fluence $N_f(\Phi_{eq},N_{f0})$, where N_{f0} is the initial N_f before irradiation, for silicon MOS-capacitors irradiated at reactors up to 1×10^{16} n_{eq}/cm^2, expected at the inner radius of HGCAL. $N_f(\Phi_{eq},N_{f0})$ is used to develop a preliminary non-uniform 3-level defect model (3L-model) for neutron bulk and surface damage at a fluence of 1×10^{15} n_{eq}/cm^2. Finally, $N_f(\Phi_{eq},N_{f0})$ and 3L-model are utilized for the first comparative simulation study of the surface properties of neutron irradiated common and atoll p-stops. Atoll p-stop was found to be more susceptible to the degradation of surface properties and increased electric fields with increasing N_f due to electron trapping between p-stops.

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