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# Combining COMSOL and Monte Carlo Methods to Simulate SiC Sensors using the Allpix2 Framework

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Accurate simulation of nuclear-voltaic battery performance can provide valuable insight into optimal power generation through novel nuclear-voltaic designs. Rigorous models require the use of Monte Carlo methods along with electrostatic field simulations, detailed charge generation, and correct treatment of the charge propagation. This paper presents simulations for a silicon carbide (SiC) planar Schottky detector that was configured as an alpha-voltaic power cell using 241Am electrodeposited on its Schottky metal contact. The model integrates a detailed electric field model from finite element software COMSOL Multiphysics into a Monte Carlo based simulation using the Allpix2 framework. The approach is applicable to the study of complex semiconductor devices when exposed to various radioactive sources or environments.

The use of Monte Carlo based software such as Geant4 and Allpix2 in combination with COMSOL or TCAD is a relatively recent development, but not entirely new. However, this paper details an approach that accurately models the charge propagation in SiC using a SiC specific mobility model in a relatively novel detector configuration. The results can be used as a baseline validation of the approach, lending credibility to the simulation approach when applied to more complex device geometries of more intricate electric field distributions

In this study, the alpha spectrum are simulated from a custom SiC detector having 241Am electrodeposited onto its surface, as well as simulations of other SiC detectors where the 241Am source is located some distance from the SiC detector. The simulated alpha spectra are compared to experimental data recorded from the custom SiC detectors. The charge propagation details such as charge collection time and propagation paths of the SiC detectors are quantified and illustrated. The comparisons show good agreement between the modeled and experimental data.

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