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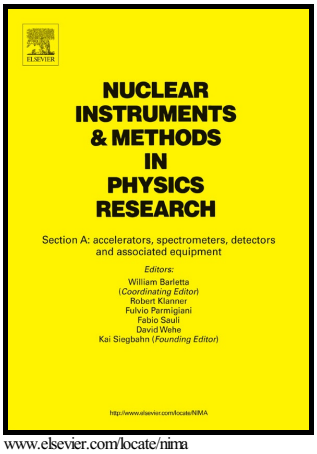

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Design and Spectrum Calculation of 4H-SiC Thermal Neutron Detectors using FLUKA and TCAD

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Abstract

SiC is a promising material for neutron detection in a harsh environment due to its wide band gap, high displacement threshold energy and high thermal conductivity. To increase the detection efficiency of SiC, a converter, such as ^{6}LiF or ^{10}B, is introduced. In this paper, pulse-height spectra of a PIN diode with a ^{6}LiF conversion layer exposed to thermal neutrons (0.026 eV) are calculated using TCAD and Monte Carlo simulations. First, the conversion efficiency of a thermal neutron with respect to the thickness of ^{6}LiF was calculated by using a FLUKA code, and a maximal efficiency of approximately 5% was achieved. Next, the energy distributions of both ^{3}H and α induced by the ^{6}LiF reaction according to different ranges of emission angle are analyzed. Subsequently, transient pulses generated by the bombardment of single ^{3}H or α-particles are calculated. Finally, pulse height spectra are obtained with a detector efficiency of 4.53%. Comparisons of the simulated result with the experimental data are also presented, and the calculated spectrum shows an acceptable similarity to the experimental data. This work would be useful for radiation-sensing applications, especially for SiC detector design.

Keywords: 4H-SiC, Thermal neutron detector, Simulation,
Pulse height spectra

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