

MODELLING A PROTOTYPE OF THERMAL NEUTRON DETECTOR USING A THIN BORON FILM AND A PHOTODIODE

Priscila Costa, Marcus P. Raelle, Hélio Yoriyaz,
*Guilherme S. Zahn and Frederico A. Genezini

*Instituto de Pesquisas Energéticas e Nucleares (IPEN-CNEN/SP),
Av. Professor Lineu Prestes, 2242, São Paulo, Brasil*

Neutron detection is an important task especially for worker protection in nuclear installations. For that purpose, it is desired to have portable and compact detectors, an aim which can be achieved using semiconductor detectors. In this work the Monte Carlo modelling of a neutron detector based on a thin boron film and photodiode is presented. The simulation was carried out using the MCNP6 code, in order to evaluate the detection efficiency for the alpha particles emitted in the boron neutron capture reaction. Two different setup subsets were modelled, taking into account the fact that the film could be deposited either in direct contact to the photodiode surface, or in indirect contact, where the film was deposited in a substrate (glass). In direct contact the thin film thickness ranged from 0 to 5 μm . For the indirect contact the thicknesses of the substrate and air region were varied. For both cases, the model was also prepared to consider the situation in which the film was sandwiched between two photodiodes in order to increase alpha particle detection efficiency. The results show that the thickness of the substrate, of 150 μm or 1000 μm , has a small influence on the alpha particle flux on the photodiode surface. The increase of the air region causes a decrease of 57 % in the flux of alpha particles in the photodiode. These different setups allowed determining the thickness values of thin boron film that delivers a higher alpha particle flux, which will lead to an optimum detection efficiency.