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Prospects for Silicon, Diamond and Silicon Carbide detectors as fast neutron spectrometers

The range of application of high band-gap solid state detectors is expanding in those environments where the high neutron flux is an issue, such as the high-flux spallation neutron sources and the thermonuclear fusion experiments. In particular, Diamond and Silicon Carbide are considered an interesting alternative to Silicon thanks to their high resistance to neutron damage. In this work we present measurements, performed at the neutron Time-Of-Flight facility at CERN (n_TOF), of the response function to neutron of three different detectors, namely a Single-crystal Diamond, a pure Silicon and a Silicon Carbide. At n_TOF neutrons are generated via spallation process in a lead target, making use of the pulsed proton beam delivered by CERN PS accelerator (E=20 GeV, pulse width 6 ns r.m.s, max frequency 0.8 Hz). Neutrons from the target are collimated and travel in vacuum along a beam pipe towards the n_TOF experimental area where they are detected. Neutron detection is based on the collection of the electron-hole (e-h) pairs produced by neutron interaction with Carbon and Silicon atoms. By storing, for each neutron event, both the Time of Flight (univocally related to the neutron kinetic energy) and the deposited energy, the response to quasi-monoenergetic neutrons was measured for each detector in the energy range from 1 to 50 MeV. The results found for the three detectors are compared and discussed in view of their use at spallation neutron sources and at fusion experiments.

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