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Simulation of a silicon neutron detector coated with TiB2 converter

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Neutron radiation cannot be directly detected in semiconductor detectors and therefore need converter layers. Standard clean-room processes can be used in the manufacturing process of semiconductor detectors with metal layers to produce a cost-effective device. We used the Geant4 Monte-Carlo toolkit to simulate the performance of a semiconductor neutron detector. A silicon photo-diode was coated with vapour deposited titanium, aluminium thin films and a titaniumdiboride (TiB2) neutron converter layer. The neutron capture reaction 10B(n, alpha)7Li is taken advantage of to create charged particles that can be counted. Boron-10 has a natural abundance of about 19.9%. The emitted alpha particles are absorbed in the underlying silicon detector. We varied the thickness of the converter layer and run the simulation with a thermal neutron source in order to find the best efficiency of the TiB2 converter layer and optimize the clean room process.

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