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Detection of fast neutrons using detectors based on semi-insulating GaAs

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Gallium arsenide (GaAs) is III-V semiconductor compound with promising physical properties (wide bang gap, fast reaction rate and good radiation hardness) for fabrication of detectors for various type of ionizing radiation. In this work we focused on detection of fast neutrons. As GaAs does not directly interacts with fast neutrons, the conversion layer has to be applied. Its task lies on the transformation of the energy of fast neutron to charged particle, which is simply detectable. In our experiments, we used HDPE (High Density PolyEthylene) conversion layer, which has relatively high elastic cross section for fast neutrons scattering. Output products of interaction between HDPE and fast neutrons are recoiled protons.
The 238-Pu-Be fast neutrons source was used in our experiment. The energy of generated neutrons varied between 0.5 and 12 MeV with maximum about 3 MeV. Fabricated detectors had Ti/Pt/Au square Schottky contact with the area of 2.5 × 2.5 mm2. On the back side, the whole area AuGeNi eutectic ohmic contact was evaporated. The thickness of the base material (semi-insulating GaAs) was 200 um. The connection of four detectors in parallel was tested to get the detection area of 25 mm2. We have investigated the optimal thickness of HDPE conversion layer for fast neutron source used. The spectra of neutrons were measured by detectors covered by HDPE converter of different thicknesses (150 −1500 um). The fast neutron detection efficiency proved experimentally was compared with results from simulations performed by MCNP and TRIM/SRIM code.

Primary author: Dr BOHUMÍR, Zaťko (Institute of Electrical Engineering, Slovak Academy of Sciences, Bratislava)

Co-authors: Dr PAVOL, Boháček (Institute of Electrical Engineering, Slovak Academy of Sciences, Bratislava); Dr FRANTIŠEK, Dubecký (Institute of Electrical Engineering, Slovak Academy of Sciences, Bratislava); Prof. VLADIMÍR, Nečas (Faculty of Electrical Engineering and Information Technology, Slovak Technical University, Bratislava); Dr KATARÍNA, Sedlačková (Faculty of Electrical Engineering and Information Technology, Slovak Technical University, Bratislava); Ms MÁRIA, Sekáčová (Institute of Electrical Engineering, Slovak Academy of Sciences, Bratislava)

Presenter: Dr BOHUMÍR, Zaťko (Institute of Electrical Engineering, Slovak Academy of Sciences, Bratislava)

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