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#4-236 Single crystal diamond detector of fast neutrons generated by D-T nuclear reaction

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Detectors based on wide bandgap semiconductors and high radiation hardness are very promising for detection of fast neutrons. Single crystal diamond is a very attractive semiconductor material. It has a bandgap energy of 5.48 eV at room temperature, which gives it an extremely high resistivity. The electron and hole mobilities are 2200 cm2/Vs and 1800 cm2/Vs, respectively. Diamond detector is able to operate at increased temperature up to several hundred degrees Celsius and is suitable for operation in harsh environments. In our work we used 500 μm thick electronic grade single crystal diamond substrate for fabrication of detector. On top side we prepared a square contact of 3.5×3.5 mm2 using Ti/Pt metallization. On the opposite site a full area Ti/Au back contact was deposited. The diamond detector structures were characterized by current-voltage measurements up to 1000 V. Detector demonstrated a flowing current below picoamperes in whole range of measurement. Following, the detector was connected to the spectrometric chain and used for alpha particle spectrometry. As a source of α-particle the 238Pu239Pu244Cm triple radioisotope was used. Diamond detector shows the energy resolution in full width at half maximum of about 23 keV for 5.5 MeV α-particles. Subsequently, detector was used for the detection of monoenergetic fast neutrons from the deuterium-tritium nuclear reaction where deuterons were targeted to the tritium. The energy of deuterons varied from 60 keV up 90 keV. Detection of fast neutrons in diamond detector is realized through elastic and inelastic scattering on carbon nuclei. The detected energy of fast neutrons was about 14.5 MeV. In measured spectra we observed the peaks corresponding to the nuclear reactions between fast neutrons and carbon nuclei of diamond material. The observed relative energy resolution of the peak resulting from the 12C(n,α)9Be reaction between fast neutrons and 12-C nuclei was about 4.0%. In detected spectra we noticed a bifurcation of the main detected peak which indicated that neutrons were generated not only by accelerated monoatomic deuterons but also accelerated molecular deuterons were impinging the tritium target.

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