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Real time fast neutron flux monitoring with diamond radiation detector

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Currently, devices that include electrophysical sources of neutron radiation, or, as they are also called, neutron generators, are widely used in applied research. Neutron radiation in these devices is obtained through the implementation of nuclear reactions such as d (d, 3He) n or d (t, 4He) n. Currently, generators based on sealed gas-filled neutron tubes (GFT) are becoming more and more widespread in the field of practical application.
In this work, an experimental study was carried out of the possibility of using diamond radiation detectors to control some characteristics of neutron generators operating on the basis of a nuclear reaction of the type (d, t). The possibility of using detectors of this type for real-time monitoring of the neutron flux density for generators based on GFT is shown. With the averaging time of readings from the detector on the order of 5 seconds, the value of the neutron flux leaving the generator target in the full solid angle can be determined with an accuracy of 4% at a flux value of the order of 1E + 8 neutrons per second. In the course of measurements, the impact of polarization on the stability of the detector was also assessed [1]
The use of a diamond radiation detector for generators neutron yield monitoring allows obtaining more accurate and timely information due to the low sensitivity of the detector to gamma radiation and the small size of the sensitive part. The signal from gamma quanta of any energy in energy equivalent from this detector does not exceed a level of the order of 400 keV. [2]. The small size of the sensitive part of the detector makes it possible to achieve the maximum ratio between the number of primary and scattered neutrons falling into it, when located as close to the source as possible.
Also, in the work, a model of the experiment was created using the Geant4 tool package. The value of flux attenuation coefficient of fast neutrons passing through the structural elements of the installation is obtained. The fraction of scattered neutrons falling into the sensitive volume of the detector is estimated.

1. O. Philip et al., 2016 IEEE Nuclear Science Symposium (2016)
2. Holmes, Jason & Dutta et al., Diamond and Related Materials (2019)

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