



boron imaging

Prompt gamma spectrometry method for measuring therapeutic dose during boron neutron capture therapy

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For the implementation of boron neutron capture therapy (BNCT) in clinical practice, the issue of therapy planning and control of doses received by the patient during injection is still very important and unresolved. In cancer treatment with BNCT, it is necessary to control the dose to both tumor-affected tissues and healthy tissues. The dose received by tissues during BNCT is multicomponent, however, in case of effective accumulation of boron-10 in the tumor, the main contribution to the total dose is the dose from the interaction of boron with epithermal neutrons. The contribution of this dose is the only one among others has a selective character. Thus, it is of priority to control the boron dose during therapy.

The method of prompt gamma spectrometry could be an excellent solution to the issue of boron dose measurement, it would allow real-time monitoring of the dose received by patients during therapy. The method is based on the registration of the instant gamma quanta with the energy of 478 keV, born as a result of the reaction $^{10}\text{B}(n,\alpha)^7\text{Li}$.

As a result of this study, an implementation plan of the prompt gamma spectrometry method at the accelerator based neutron source VITA was proposed. The possibility of using a semiconductor detector made of high-purity germanium to measure boron dose in BNCT was demonstrated. A comprehensive calibration of the detector is carried out, the signals obtained from boron-containing samples are investigated, and the attenuation of the 478 keV line during passage through water is studied. The obtained spectra with a clearly distinguishable 478 keV line with predicted Doppler broadening are discussed. The first results on the application of the prompt gamma spectrometry method during the treatment of pets with spontaneous tumors by BNCT are demonstrated. The dynamics of boron removal from the animal organism as well as the spatial distribution of boron in the tumor area of the animal is presented.

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