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Preliminary Experimental Comparison of Fast Neutron Measurement by Np237 Fission to Capture Ratio and Reverse Dark Current of Planar Silicon Detector Methods

Abstract:

It is a subsequent step of feasibility study of fast neutron fluency measurement using two different complementary methods.

The idea of the first method is to search the neutron energy for the ratio of fission cross section to capture cross section of the selected actinide isotope from the nuclear data base that is equal to the measured ratio of fissioned and captured actinide isotope Np-237.

The idea of the second method is measurement of fast neutron irradiation induced reverse dark current increase of planar silicon detectors which is linearly proportional to neutron fluence.

We have focused on the efficiency dependence of incineration the minor actinides on the distance of their samples from the neutron spallation source. So far, we have not been able to place actinide samples in any place other than the lead specimen window.

We have processed the experimental data of irradiated Np- 237 actinide samples and silicon detectors directly placed on sections 2 and 4 of the QUINTA setup without lead shield-reflector. These samples were 12 cm from the source of the neutron spallation source, what is about 8 cm closer than before when we placed the actinides samples in the window of the lead shield-reflector.

Applying the try and error method we find the neutron energy for which the ratio of fission cross section to capture cross section of the actinide Np-237 from the nuclear data base is equal to the measured ratio of fissioned and captured actinide isotopes. It means that the retrieved distinct fission and capture cross sections for the distinct neutron energy from the nuclear data base describe the average values because the measured ratio (spectral index) is defined as the ratio of average fission and capture cross sections. The obtained values for average fission and capture cross sections let us to evaluate the neutron fluencies.

Given the considered above experimental data and the earlier obtained data we have found that the higher is the average neutron energy the smaller is the difference of neutron

fluency measurement between the two methods. This effect was expected since the silicon detector method effectively measure the fast neutrons of energy higher than 170 keV.

Serdecznie zapraszamy
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