Measurement of the lithium layer thickness using a proton beam

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In Budker Institute of Nuclear Physics an epithermal neutron source based on a tandem accelerator with vacuum insulation and a solid lithium target for $^{7}Li(p,n)^{7}Be$ reaction was developed. Lithium target is prepared by thermal vacuum evaporation of the thin (typically 60 μm) lithium layer on the water cooled substrate. Average thickness of the layer is calculated knowing the mass of evaporated lithium, but the distribution of the deposited lithium was still unknown. Due to fast oxidation of the lithium in air and its poor mechanical properties direct measurement of the lithium layer thickness is a challenging task. In this work we proposed and realized two different methods for measurement of the lithium distribution over the substrate surface. For this purpose we irradiated different spots of the target by collimated 2 mm proton beam along one axis. Scanning along x-axis is performed using flexible connection between accelerator and lithium target and actuator for target movement. For the first method we used 1.8 MeV protons and measured by a HPGe gamma-spectrometer the intensity of the emitted 478 keV photons in each spot. Lithium thickness distribution is calculated knowing the $^{7}Li(p,p'\gamma)^{7}Li$ reaction cross section and 478 keV photon yield from a thick lithium target that we have measured previously [1]. For the second method we used 2.05 MeV protons scanning over lithium target with average thickness of 7 μm and a neutron dosimeter for neutron yield measurement. In this case neutron yield is directly dependent on lithium thickness. The results of the measurements by two methods are compared and presented in this work. These two measurements are in good agreement with calculations and with each other.

Keywords:
lithium target, proton beam

References:

[1] T. Bykov, D. Kasatov, Ia. Kolesnikov et al. Measurement of the $^{7}Li(p,p'\gamma)^{7}Li$ reaction cross-section and 478 keV photon yield from a thick lithium target at proton energies from 0.7 to 1.85 MeV. These proceedings.