2 - 31 Study of Spallation Yield of Neutrons Produced in Thick Lead Target*

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The neutron yield from thick target of Pb irradiated with 250 MeV protons has been studied experimentally. The Pb target was surrounded by a water bath, where this size effectively contained most of the neutrons emitted from the target. The moderated neutrons were measured by the activity induced in an array of Au activation foils (with or without Cd cover). The axial coordinates of the foils without Cd cover were Z = -15, -10, -5, 0, 5, 10, 15, 20 cm along the target axial, and the radial coordinates of the foils were R = 7.5, 12.5, 17.5, 22.5 and 27.5 cm above the target axial. The Au-foil activities were determined by measuring the peak intensities of the 412 keV line from ^{198}Au[1], and the results are shown in Fig. 1.

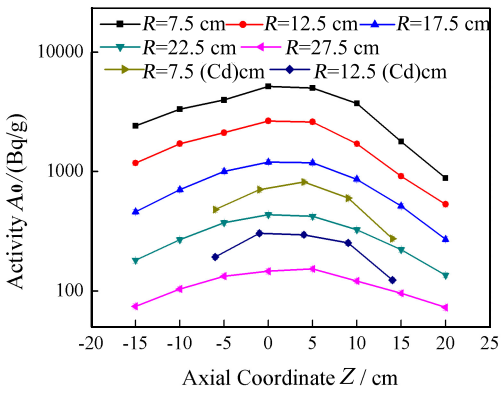

Fig. 1 (color online) Activity distributions of ^{198}Au with and without Cd cover.

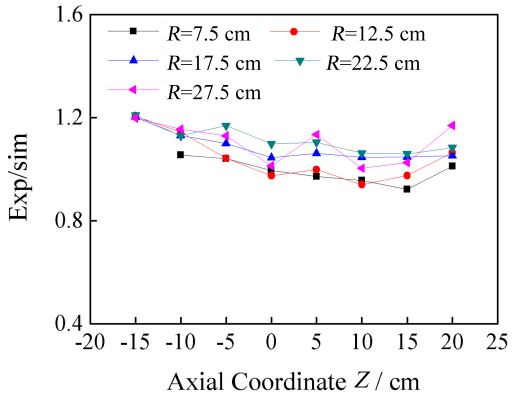

Fig. 2 (color online) Comparison of the experimental neutron flux versus the calculated results by considering the influence of Au foils with Cd cover.

The neutron yield and neutron flux in the water bath were calculated with MCNPX2.7.0 code[2]. Fig. 2 shows the comparison between measured and calculated thermal neutron flux distributions where the influence of Au foils with Cd cover on the neutron flux was considered in the simulation. As shown in Fig. 2, the simulated value are good consistent with the experimental results for the axial (Z) distributions at radius direction of R = 7.5 and 12.5 cm, where the maximum difference is less than 8%. For the other positions, the measured results are overall higher than the calculated value, but the discrepancies do not exceed 20%. It was also found out that the Au foils with cadmium cover significantly changed the spacial distribution of the thermal neutron field. By considering the influence of the Cd cover on the thermal neutron flux, the measured yield of the neutrons emitted from the target was determined to be 2.23±19 n/proton.

References

[1] K. H. Beckurts, K. Wirtz. Neutron Physics, Chapter 14, Springer-Verlag, Berlin, (1964).

[2] M. B. Chadwick, P. G. Young, S. Chiba, et al., Nucl Sci Eng, 131(1999)293. mcnpx.lanl.gov/data.html.

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