Numerical Calculation and Experimental Research of 14 MeV Neutron Yields of ^{6}Li Conversion Target in XAPR

Shi Quanlin, Shang Jianbo, Dai Yihua, Bai Tao, Xu Chenxi

Northwest Institute of Nuclear Technology, Xi'an 710024, China

Abstract: It is significant important to convert thermal neutrons into 14 MeV neutrons by irradiating ^{6}LiD with thermal neutrons in Xi'an Pulse Reactor (XAPR) in NINT for the irradiation test of materials in the high energy neutron field for both high intensive neutron irradiation effect and nuclear reaction. An approach of numerically calculating of 14 MeV neutron yields of a ^{6}LiD conversion target is considered as following. Firstly, the energy, position and emission direction of tritium particles between the neutron and ^{6}Li reaction were determined by tracking the neutron transport process. Then, the energy loss per unit distance of tritium particles during transport was calculated by SRIM program. Finally, the yields of high energy neutrons produced from the reactions of T+D and T+^{6}Li are calculated according to the cross section data, respectively. Based on the cross section data of ENDF BVII.1, a Monte Carlo simulation had been undertaken to get the high energy neutron yields from the ^{6}LiD target with a thermal neutron, which were calculated to be 1.54×10^{-4} of T+D reaction, and 7.6×10^{-5} of T+^{6}Li reaction, with the sum of 2.30×10^{-4}. The result was similar to the yields calculated by Wang Guanbo in 2013, which were 2.15×10^{-4} where the deviation may derived from the careful consideration of tritium energy loss during transportation in our simulation. 2 grams of D ^{6}LiO.D_2O powders were pressed into a circular die of 3.5 cm diameters with 1.5 mm thickness as a conversion target (the atom densities of ^{6}Li, ^{7}Li and D in the target were 1.82×10^{22}/cm^3, 3.71×10^{20}/cm^3, and 5.57×10^{22}/cm^3 respectively) to be irradiated in XAPR and its 14 MeV neutron yields were calculated to be 6.76×10^{-5} according to the neutron spectrum of XAPR. The target and a piece of Zr metal were irradiated together in XAPR where the activation ratio of ^{90}Zr(n,2n)^{89}Zr were measured to experimentally determine the high energy neutron yields of the conversion target. The experimental results of high energy neutron yields were estimated to be 7×10^{-5}, which is consistent with the MC simulation.

Key Words: Neutron, ^{6}LiD, Conversion target