2- 35 Investigation of Neutron Induced Reactions on Gallium Sample by Using Talys1.6

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We investigate the neutron induced reactions on gallium sample, and its experimental neutron leakage spectra at the neutron incident energy of ∼ 14.8 MeV are compared with the Talys1.6[1] calculated results at 60 ° and 120 ° . In the Talys code, the neutron-induced reaction is divided in three physical processes, *e.g.*, direct, pre-equilibrium and compound nucleus reactions. Calculated total neutron leakage energy spectrum and the contributions from three processes are shown in Fig. 1 (a). Natural Ga (60.11% ^{69}Ga and 39.89% ^{71}Ga) samples were used in the plots. The calculated total cross section shows three characteristic features, an elastic peak, an inelastic peak and a broad bump in the low energy side. The elastic and inelastic peaks are generated by the direct process. The broad bump at the low energy is dominated by the compound nucleus process. The contribution from the pre-equilibrium process is dominated at the energy range of E_n ∼ 5-10 MeV. In Figs. 1 (b) and (c), the experimental energy spectra at 60 ° and 120 ° are compared with the calculations, respectively. The experimental spectra are well reproduced by the calculated cross sections for the Ga sample, including the inelastic peaks at both angles. Individual contributions of ^{69}Ga and ^{71}Ga to those of the Ga sample are also shown by dotted and dashed lines. As shown clearly in the inserts, the inelastic peaks are mainly generated from the direct process of ^{69}Ga, but not of ^{71}Ga though a very small contribution from ^{71}Ga is observed at 120 ° at a slightly (∼ 1 MeV) lower neutron energy. In Fig. 2, the contributions of different reaction channels to the total reaction cross sections are plotted as a function of the leakage neutron energy for natural Ga sample. The (n, n') cross section is the sum of those from the discrete and continuum states calculations. The (n, n') channel dominates in the direct and pre-equilibrium contribution at 5 MeV≤ E_n≤12 MeV. At E_n < 5 MeV, the compound nucleus contribution of the (n, 2n) process is dominated and (n, np) and (n, nα) channels show minor contributions. The Talys calculated results reproduce the experimental spectra very well in the whole energy range.

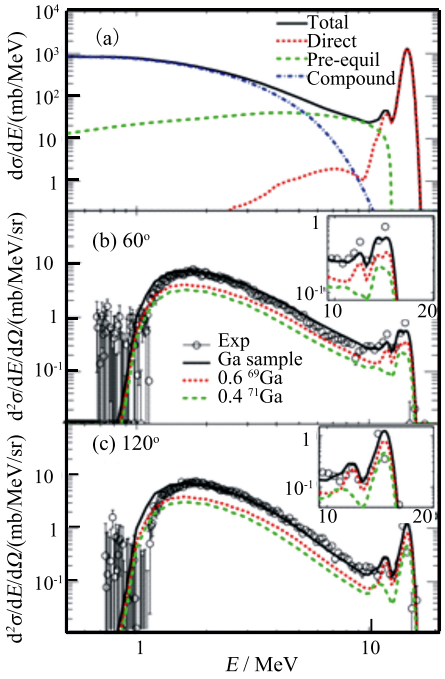

Fig. 1 (color online) (a) The total neutron leakage energy spectrum and the contributions from the direct, pre-equilibrium and compound processes calculated by Talys code. The experimental spectra at 60 ° (b) and 120 ° (c) are compared with the Talys calculated for natural Ga, ^{69}Ga and ^{71}Ga, respectively.

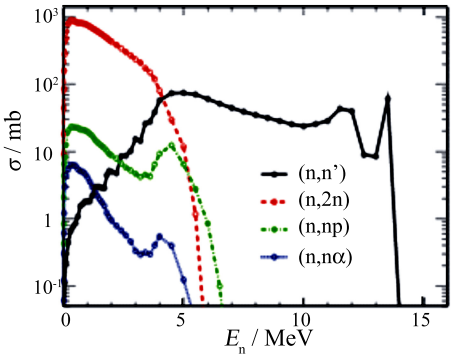

Fig. 2 (color online) The contributions of inelastic reaction from (n, 2n), (n, np), (n, nα) channels and a emission neutron in the continuum states (0∼12 MeV) and discrete levels (12∼14 MeV) from (n, n') channel in natural Ga sample.

Reference

[1] A. Koning, S. Hilaire, S. Goriely. Nuclear Research and Consultancy Group, (2013),http://www.talys.eu/.