2 - 30 Production of Residual Nuclides in Pb Irradiated by 400 MeV/u Carbon Ions*

Ge Honglin, Zhang Xueying, Ma Fei, Chen liang, Zhang Hongbin
Ju Yongqin, Zhang Yanbin, Li Yanyan and Wang Bo

Irradiation experiment was performed at the HIRFL-CSR in Lanzhou. A Pb foil with 100 mm diameter and 0.15 mm thickness was used to measure the mass-yield distributions of induced radionuclides. A natural Pb cylinder with 100 mm diameter and 250 mm length was used as the beam dump behind the Pb foil. An ionization chamber was placed in front of the Pb foil to monitor the beam current. The carbon beam with an energy of 400 MeV/u was stopped in the Pb cylinder after through the Pb foil. The irradiation was lasted about 20 h to make the beam fluence enough. After irradiation, the gamma spectra of Pb foil were measured by a off-line γ-spectrometry method. The measurements were performed by using a high-purity germanium (HPGe) detector.

By using the off-line γ-spectroscopy method, about 32 kinds of nuclides were identified in the present work. The cross section of residual product in the Pb foil can be derived with the following equation

$$\sigma = \frac{C\lambda}{I_\gamma \epsilon_\gamma \bar{\Phi} N_\mathrm{t} D \mathrm{e}^{-\lambda t_\mathrm{d}}(1-\mathrm{e}^{-\lambda t_\mathrm{c}})(1-\mathrm{e}^{-\lambda t_\mathrm{irr}})} \ , \tag{1}$$

where C is the total counts of γ-ray peak area, I_γ is the abundance, ϵ_γ is the efficiency, $\bar{\Phi}$ is the average beam intensity, N_t is the atomic density of the Pb foil, D is the thickness of the Pb foil, λ is the decay constant, t_irr the irradiation time, t_d is the cooling time and t_c the counting time.

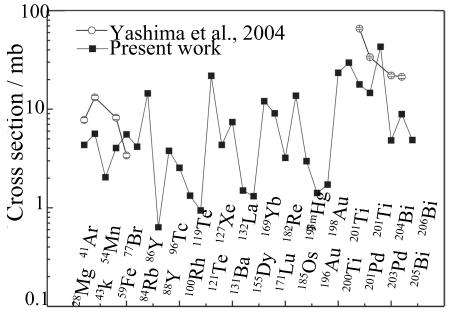

Fig. 1 Comparison of measured cross sections of residual radionuclides.

According to the Eq. 1, the cross sections of residual nuclides were deduced. Our data are compared with the results by Yashima et al, in Ref. [1], shown in Fig. 1. All eight nuclides in Ref. [1] are found in our work. The cross sections of residual nuclides in Ref. [1] are generally larger than ours except ^{59}Fe, but consistent in magnitude. More residual nuclides were observed in our experiment. It means that we could study deeply the production of residual nuclides by using this method.

Reference

[1] H.Yashima, Y.Uwamino, H.Iwase, et al., Nucl Instr and Meth B, 226(2004)243.

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