FORMATION MECHANISMS OF INCLUSIVE CROSS-SECTIONS OF (p,*x*p) AND (p,*x*α) REACTIONS ON Cu NUCLEUS

Duisebayev A.[1], Duisebayev B.A.[1], Zholdybayev T.K.[1], Sadykov B.M.[1], Ismailov K.M.[2]
[1]*Institute of Nuclear Physics, Almaty, Kazakhstan;*
[2]*Nazarbayev University, Astana, Kazakhstan*
E-mail: zholdybayev@inp.kz

The development of the new generation of nuclear energy systems with a high level of safety (Accelerator Driven System (ADS)), consisting of a proton accelerator, the neutron production target and sub critical reactor are deployed in many countries. At creation of such devices for correct modeling of the neutron flux the data on the spectral composition and angular distributions of secondary protons and light charged particles produced by primary proton beam are required. Copper was selected as one of the widely used constructional materials in various nuclear facilities.

Inclusive spectra of protons and α-particles emitted from proton induced reactions on Cu nucleus at E_p=30 MeV in angular range 15÷135° with the step 15° was received on isochronous cyclotron U-150M of Institute of Nuclear Physics. The thicknesses of two silicon detectors were equal to 30 micron and 2000 micron for reaction Cu(p,*x*α). In case of reaction Cu(p,*x*p) thin silicon detector of 100 micron and CsI(Tl) detector of full absorption (2.5 cm) were used. The solid angles subtended by a telescope of detectors were equal to $\Omega=5.34\cdot10^{-5}$ sr and $\Omega=4.62\cdot10^{-5}$ sr respectively. The self-supporting foil of Cu with thickness of 2.7 mg/cm^2 was used in these experiments.

The energy calibration of a spectrometer was carried out on kinematics of levels of residual nuclei in the reaction ^{12}C (p,*x*p) and protons of recoil. The total system energy resolution, equal to 400 keV, mainly has been determined by the beam energy resolution. The energy dispersion of beam was equal to 0.4 %. The whole systematic error was less than 10 %. The statistical uncertainties were less than 10 % for protons and less than 20 % for α-particles.

The analysis of the experimental results has been conducted in the Griffin exciton model [1] of the preequilibrium decay of nuclei. The code PRECO-2006 [2], which describes the emission of particles with mass numbers from 1 to 4, has been used in our theoretical calculations. A satisfactory agreement between experimental and calculated values in the energy region corresponded to the pre-equilibrium mechanism has been achieved.

1. J.J.Griffin // Phys. Rev. Lett. 1966. №9. P.478.
2. C.Kalbach. PRECO-2006: Exiton model preequilibrium nuclear reaction code with direct reaction. Durham NC 27708-0308, 2007.