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Nuclear spallation reactions in chromium, yttrium and terbium with 386 MeV neutrons

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Neutron-induced reaction cross sections serve as a comprehensive nuclear database for estimating residual radioactivities in accelerator facilities. These data are also important in the field of cosmochemistry for deciphering the cosmic-ray irradiation history. However, neutron cross sections in the energy range above 100 MeV have scarcely been measured experimentally except for those from few targets; C, Cu, Pb, Bi and so on. Those obtained from calculation codes are utilized and proton cross section data are also utilized on the basis of the assumption that neutron cross sections in higher energies than 100 MeV approximately equal to proton ones in the same energy range.
In this work, we measured reaction cross sections of radionuclides produced through nuclear spallation reaction from Cr, Y and Tb induced by neutrons at 386 MeV, which have never been reported. The irradiations were carried out using neutrons produced through Li-7 (p, n) reaction at N0 beam line in the Research Center for Nuclear Physics (RCNP), Osaka University. To estimate quasi-monoenergetic neutron induced cross sections, the target stacks of Cr, Y and Tb were irradiated on the two angles of 0 and 25 degrees for the axis of the primary proton beam. The yields of the spallation products were measured by gamma-ray spectrometry. Neutron cross sections were estimated by subtracting the yields produced in the samples placed on 25 degree from those of 0 degree to correct the contribution of the low energy tail in the neutron spectrum. The results obtained in this work will be compared to the cross section data for the same target materials with 287 MeV neutrons in our previous work. Since proton-induced cross sections for the same targets in the same energy range are also measured, neutron cross sections obtained can be compared to the proton ones.

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