A New Technique to Measure Double-differential Charged-particle Emission Cross Sections Using Pencil-beam DT Neutrons

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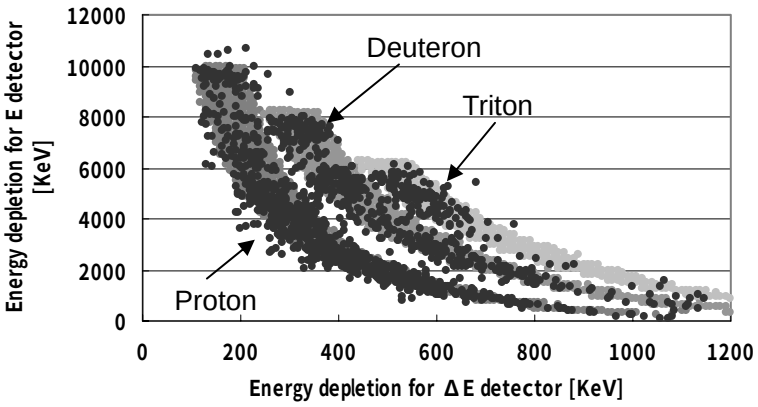
Double-differential charged-particle emission cross sections (DDXc) are necessary to calculate nuclear heating and fundamental values to evaluate material damages, i.e. PKA spectra, gpa and dpa cross sections. Particularly DDXc data in the whole energy range of emitted charged-particles of light nuclei such as beryllium, carbon and lithium are important for the development of a nuclear fusion reactor. However, only a few measurements have been carried out because of a difficulty of the experiment due to a high background condition. Therefore the development of a new technique for precise measurements of DDXc is quite important.

Recently we successfully developed a new spectrometer for the measurement of DDXc using a pencil-beam DT neutron source of the Fusion Neutronics Source (FNS) in Japan Atomic Energy Research Institute (JAERI). In the measurement system, a telescope system with two silicon surface barrier detectors of ΔE and E, and a two-dimensional multi-channel analyzer are equipped. In the present study we carried out measurements of DDXc of ^{9}Be, ^{19}F and ^{27}Al using the spectrometer. We choose aluminum for standard sample in order to confirm the validity of the new technique. Beryllium-9 is regarded as one of the most important materials in a fusion reactor development, especially in the blanket region.

For the ^{27}Al(n,xα) reaction, the total cross section was obtained by integrating DDX over energy and the angular distribution function fitted with Legendre polynomials. The total cross section well agreed with the data of JENDL 3.3. From this result, we conclude that our new technique is valid. For ^{9}Be, we obtained α-particle, ^{6}He and triton emission DDX. Angular distributions for the ^{9}Be(n,α_0)^{6}He and the ^{9}Be(n,α_1)^{6}He*$_{1st\ Ex.}$ reactions were extracted from obtained DDX. These are compared with evaluated values and past studies.



Measured 2D-spectrum for ^{19}F(n,CP) reactions at 30deg.