


(※本報告書は英語で記述してください。ただし、産業利用課題として採択されている方は日本語で記述していただいても結構です。)

 MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2012B0093 実験課題名 Title of experiment Measurement of neutron capture cross-section of Gd-157 実験責任者名 Name of principal investigator Atsushi Kimura 所属 Affiliation Nuclear Science and Engineering Directorate, Japan Atomic Energy Agency	装置責任者 Name of responsible person Hideo Harada 装置名 Name of Instrument/(BL No.) BL04 実施日 Date of Experiment Feb./7/2013–Feb./13/2013

試料、実験方法、利用の結果得られた主なデータ、考察、結論等を、記述して下さい。(適宜、図表添付のこと)
 Please report your samples, experimental method and results, discussion and conclusions. Please add figures and tables for better explanation.

1. 試料 Name of sample(s) and chemical formula, or compositions including physical form. Gd foil samples <ul style="list-style-type: none"> ● 20 mm x 20mm x 100μmt ● 20 mm x 20mm x 10μmt ● 20 mm x 20mm x 5μmt ● 5 mm x 5mm x 10μmt are used.
--

2. 実験方法及び結果 (実験がうまくいかなかった場合、その理由を記述してください。) Experimental method and results. If you failed to conduct experiment as planned, please describe reasons. Because Gd-157 has large capture cross sections at thermal energy (0.0025eV), estimated event rates are significantly different between a low energy region (Region-1: <0.2eV) and a high energy region (Region-2: >0.2eV). Therefore, in this experiment, both an experiment for the Region-1 and that for the Region-2 were done separately. <i>(1) experiment for the Region-1 (0.01 to 0.2 eV)</i> Gd foil samples (20 mm x 20mm x 100 μ mt and 20 mm x 20mm x 5 μ mt) were used. Each sample was put in a bag of fluorinated ethylene propylene (FEP) films and attached to a sample holder. The samples were irradiated at the position of 28m from the neutron source of MLF and prompt- γ rays from the samples were measured with the NaI(Tl) spectrometers at ANNRI. The measurement time was totally about 72 hours.
--

2. 実験方法及び結果(つづき) Experimental method and results (continued)

In this experiment, a ratio of measurement yields of the thick Gd foil sample and the thin Gd foil sample, $R(E_n)$, is described as the following equation,

$$R(E_n) = \frac{\varphi(E_n) \times k_{Gd} \times (1 - \exp(-\sigma(E_n)N_{thin}))}{\varphi(E_n) \times k_{Gd} \times (1 - \exp(-\sigma(E_n)N_{thick}))} = \frac{1 - \exp(-\sigma(E_n)N_{thin})}{1 - \exp(-\sigma(E_n)N_{thick})} \quad (1).$$

Here, E_n is neutron energy, $\varphi(E_n)$ is neutron flux at neutron energy of E_n , k_{Gd} is averaged detector efficiency for the prompt- γ rays of Gd, $\sigma(E_n)$ is neutron-capture cross section for ^{nat}Gd at neutron energy of E_n , and N_{thin}, N_{thick} are areal density of the both samples. By taking the ratio of yields of these two measurements, efficiencies of the detector and the incident neutron intensities are cancelled out and the absolute cross section for ^{nat}Gd at thermal energy is calculated accurately.

Furthermore, in this region, almost all neutrons were captured by the thick sample. Therefore, $\exp(-\sigma(E_n)N_{thick}) \cong 0$ and the equation (1) is simply described as the following equation,

$$R(E_n) = 1 - \exp(-\sigma(E_n)N_{thin}) \quad (2).$$

Obtained preliminary neutron capture cross-sections for ^{nat}Gd is shown in Fig. 1.

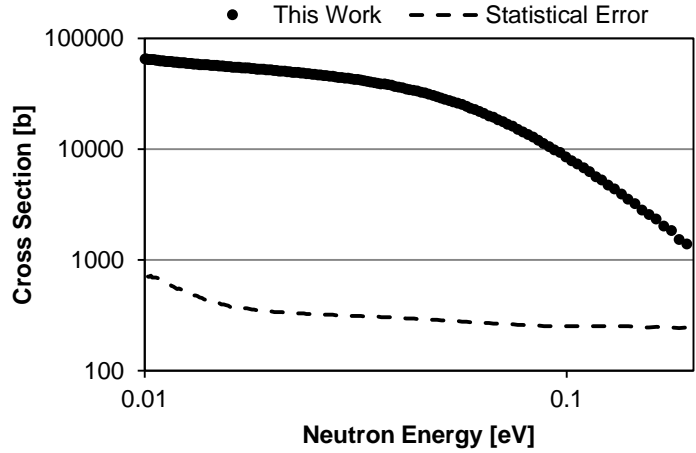


Fig.1. Preliminary results of the neutron-capture cross-sections for ^{nat}Gd .

(2) experiment for the Region-1 (0.2 to 1000 eV)

A Gd foil sample (5 mm x 5mm x 10 μm t) was used. The sample was also put in a bag of fluorinated ethylene propylene (FEP) films and attached to a polytetrafluoroethylene sample holder. The samples were irradiated at the position of 21.5m and prompt- γ rays from the samples were measured with the Ge spectrometers at ANNRI. For the background estimation, measurements for a sample holder with an empty FEP bag and a ^{208}Pb sample with a diameter of 5 mm, a weight of 159.7 mg, and an isotopic enrichment of 99.60 mole% were also carried out. Random timing pulses were fed into every pre-amplifier from a random pulse generator in order to make a dead-time correction. The total measuring time was about 38 hours for the ^{nat}Gd , about 23 hours for the empty FEP bag sample and 17 hours for the ^{208}Pb sample.

Analysis of the obtained data is in progress.