

## Determination of Thermal Neutron Radiative Capture Cross Section and $k_0$ factors of ${}^6\text{Li}$

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### 1. Introduction

On the thermal capture cross section of  ${}^6\text{Li}(n,\gamma){}^7\text{Li}$ , only a few measured data were reported. However, these are not consistent well [1]. The radiative capture cross section of  ${}^6\text{Li}$  can be obtained from the sum of the partial cross sections for two primary transitions. The previous data for the radiative capture cross section vary by  $\sim 30\%$  from 29 to 53 mb. This study was performed to measure accurate capture cross section and  $k_0$  factor of  ${}^6\text{Li}$  by measuring the primary transition  $\gamma$ -rays.

### 2. Experiment

The measurements were performed at SNU-KAERI PGAA facility [2,3]. The true integrated neutron flux at the sample position was increased to  $1.0 \times 10^8$  n/cm<sup>2</sup>s. A HPGe detector was used and typical resolution(FWHM) was 2.5 keV for  ${}^{60}\text{Co}$  1332 keV  $\gamma$ -ray. To reduce the background  $\gamma$ -rays from Li capture reaction, the installed LiF tiles on the view line of the detector were replaced with borated plastic sheets. The uncertainty of efficiency was about 12% for the  $\gamma$ -rays in this study.

The Li target sample consists of 95.6 at% enriched  ${}^6\text{Li}_2\text{CO}_3$  powder.  ${}^1\text{H}$  was selected for the standard for capture cross section. The homogeneous mixture sample of  ${}^6\text{Li}_2\text{CO}_3$  and melamine( $\text{C}_3\text{H}_6\text{N}_6$ ) were prepared and irradiated with neutrons. The influences due to the self-shielding effect of the sample and the slightly varying irradiation condition were compensated. Two Li samples were prepared and measured. And the background with empty sample case and two graphite samples were measured to estimate the background variation due to scattering effect of the sample [4].

### 3. Analysis and Result

The measurement indicated that the backgrounds are dependent on the scattering effect of the target. Interfering background peaks were not resolve reliably because of the finite resolution of the detector. Hence the variation of the interfering background peak was studied by varying the scattering effect from the target sample.

The Ge 867.90 keV peak area was selected for the reference of the scattering effect, since it is detected from scattered neutrons entering the Ge crystal. The peak count rates for the 6768.81 keV  $\gamma$ -ray regions of  ${}^6\text{Li}$  as a function of the reference peak count rate are shown in the Figure 1. For the background for the

region  ${}^6\text{Li}$  7245.91 keV and  ${}^1\text{H}$  2223 keV, the net count rate was deduced in a similar way. The partial cross sections for producing each prompt  $\gamma$ -ray of  ${}^6\text{Li}(n,\gamma){}^7\text{Li}$  were obtained by normalizing to the thermal neutron capture cross section 332.6(7) mb [5] of  ${}^1\text{H}$  2223.25 keV  $\gamma$ -ray. The deduced partial cross section and the  $k_{0,H}$  factor were listed in Table 1. The determined radiative capture cross section is  $37.7 \pm 3.0$  mb.

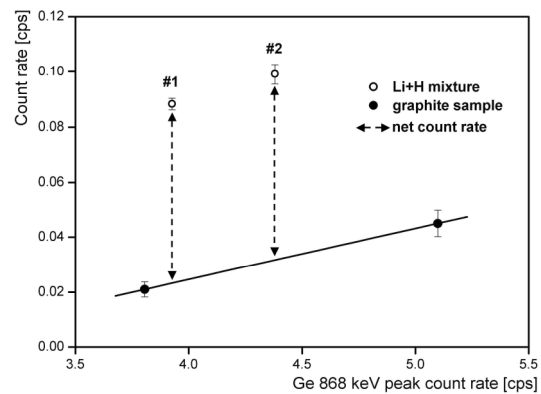


Figure 1. Derivation of the net count rate for  ${}^6\text{Li}(n,\gamma)$  6768.81 keV  $\gamma$ -ray peak.

Table 1. The obtained data of  ${}^6\text{Li}(n,\gamma)$  reaction.

$\gamma$ -ray energy [keV]	6768.81	7245.91
Absolute intensity [%]	$40.1 \pm 4.6$	$59.9 \pm 6.2$
Partial cross section [mb]	$15.1 \pm 1.8$	$22.6 \pm 2.5$
$k_{0,H}$ factor	$5.01 \times 10^{-4}$	$7.48 \times 10^{-4}$
	$\pm 4.89 \times 10^{-5}$	$\pm 6.46 \times 10^{-5}$

### 4. Conclusions

The relative measurement with comparator  ${}^1\text{H}$  was performed to consider the varying irradiation condition for the determination of the radiative capture cross section of  ${}^6\text{Li}$ . The interfering background in the peak region was effectively corrected by considering the scattering effect caused of sample.

### REFERENCES

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