Estimation of the effect of positron production amount by installing Cd-cap in the KUR slow positron beamline

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As well as other reactor-based positron beam facilities [1–3], a Cd-cap is used in the slow positron beamline at Kyoto University research Reactor (KUR) in order to enhance the gamma-ray intensity irradiated to a tungsten positron converter [4]. During KUR maximum power operation (5 MW), the temperature around the Cd-cap reaches up to several tens of degrees below the melting point of Cd (321°C) due to nuclear heating. The Cd-cap-installed beamline requires extra attention and/or effort due to the low melting point material. Thus, to estimate how much the Cd-cap contributes to positron production is important for reactor-based positron beam facilities. In this study, the change of positron production amount with and without the Cd-cap at the KUR beamline was estimated by Monte Carlo simulation.

Figure 1 shows the change in the amount of positron emission from the tungsten positron converter with and without the Cd-cap, assuming that only neutrons are emitted from the reactor core. In the calculation, the structure of the positron production unit of the KUR beamline shown in Fig. 2 was modeled as truly as possible including reactor coolant water. Since gamma-rays derived from neutrons are also emitted from materials around the converter, positrons are produced to some extent even without the Cd-cap as shown in Fig. 1. However, the amount of positron emission was found to increase 6.0 ± 0.2 times by installing the Cd-cap. Although the above calculation considers only neutrons, in fact, gamma-rays emitted from the reactor core also contribute to positron production. In the presentation, the change in the total amount of positron production with and without the Cd-cap will be discussed.

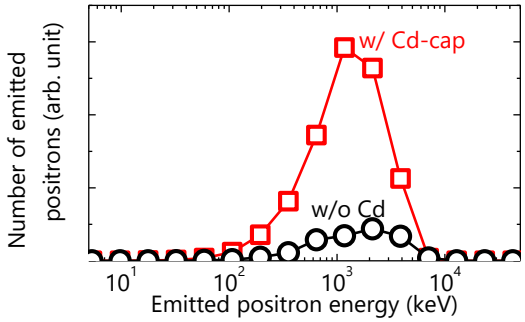

Figure 1 *The number of emitted positrons from a tungsten positron converter as a function of emitted positron energy. Note that only neutrons are considered in this calculation.*

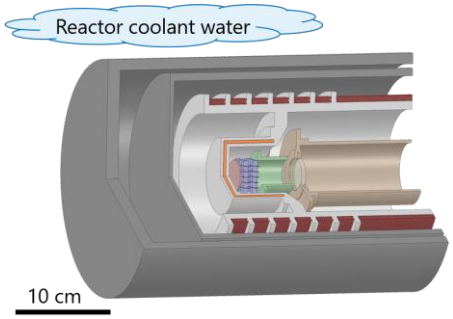

Figure 2 *Schematic diagram of positron production unit of the KUR beamline. Note that this is not the model used in the calculation.*

References

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