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Neutron total and capture cross section measurements of natEr at ANNRI

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The extension of the nuclear fuel life has always been seen as an effective method to improve the economic viability of nuclear reactors. Nonetheless, this has always been hampered by the ^{235}U 5 wt% limitation due to criticality concerns [1].An increase in ^{235}U above the 5 wt% threshold would mean a major reformulation of both reactor criticality and safety assessments for the present nuclear reactors. The Erbia-credit super high burnup (Er-SHB) fuel is an innovative configuration that allows for the fuel life to be extended while providing several physical improvements (i.e., less downgrade of the flux distribution, improving the intrinsic reactor safety parameters, better control of the transient power phase). Moreover, the negative reactivity introduced by Erbium offers a means to increase the enrichment of ^{235}U > 5 wt% while treating the fuel as if the enrichment of ^{235}U were to be lower than 5 wt% as in present LWR reactions. Meaning that, this new fuel configuration could be used in present LWR reactors without any major modification to the facilities [1,2]. Nonetheless, for this to be achievable, the accuracy of the nuclear data for the neutron capture cross section of Erbium needs to be improved [3].
The present experiments were performed in the Accurate Neutron-Nucleus Reaction Measurement Instrument (ANNRI) at the Materials and Life Science Facility (MLF) of the Japan Proton Accelerator Research Complex (J-PARC) using Li-glass detectors to measure the neutron total cross section; and NaI(Tl) and Ge spectrometers to determine the neutron capture cross section in separate measurements. Several samples of ^{nat}Er with different thicknesses were measured in the present experiment to improve the accuracy for the cross sections. In this study, the preliminary results for the ^{nat}Er neutron total and capture cross sections measured with Li-glass, Ge and NaI(Tl) detectors are presented and compared. For the neutron capture cross section, the preliminary results were obtained relative to the incident neutron flux determined with a boron sample measurement and normalized using an Au sample measurement.

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[3] Guglielmelli A. NEA Nuclear Data High Priority Request List [Internet]. Available from: https://www.oecd-nea.org/dbdata/hprl/hprlview.pl?ID=539.

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