

**【Grant-in-Aid for Scientific Research(S)】  
Science and Engineering (Engineering II)**



**Title of Project : Systematic Study on Neutron Capture Reaction  
Cross Sections for the Technological Development  
of Nuclear Transmutation of Long-Lived Nuclear  
Wastes**

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Research Area : Engineering

Keyword : Reactor Physics/Nuclear Data

**【Purpose and Background of the Research】**

The current national policy for the management and disposal of long-lived nuclear wastes (LLNW) generated in fission reactors is a sequence of vitrification, interim storage, and then depositing underground together with other nuclear wastes.

Alternatively, if LLNW are extracted and transmuted into stable nuclides, the environmental loading in the geological repository becomes very small. Moreover, the ethical problem that LLNW are undesirable property for our far descendants will be solved.

From this viewpoint, the nuclear transmutation of LLNW is a very attractive subject, and neutron capture reaction is the most promising transmutation reaction. Therefore, databases on neutron capture reaction cross sections are indispensable for developing the transmutation technology. However, the accuracy of databases is quite poor both in quality and quantity at the present time. Therefore, the improvement of the database accuracy is an urgent task.

The objective of the present study is to contribute to the improvement of the database accuracy, by making the precise measurements of capture cross sections of LLNW, analyzing the measured results theoretically, elucidating the capture reaction mechanism of LLNW, and supplying reliable calculated capture cross sections for all LLNW and in the whole neutron energy region.

**【Research Methods】**

The measurements will be performed by using the Neutron-Nucleus Reaction Instrument (NNRI) in the Materials and Life Science Facility (MLF) in the Japan Proton Accelerator Research Complex (J-PARC) as well as other facilities. By comparing the results from all facilities, systematic errors will be excluded, and the reliable experimental results will be derived. The derived capture cross sections and gamma-ray spectra will be theoretically analyzed simultaneously. As a result, the capture reaction mechanism will be elucidated. Finally, theoretical calculation will be performed for all LLNW and in the whole neutron energy region.

**【Expected Research Achievements and Scientific Significance】**

The final results of the present study will be the accurate data for the neutron capture cross sections of LLNW such as Zr-93, Tc-99, Pd-107, I-129, Np-237, Am-241, Am-243, Cm-244, and Cm-246. This nuclear data will be very significant for the technological development of nuclear transmutation of LLNW.

**【Publications Relevant to the Project】**

- Nuclear data study at J-PARC BL04: M.

**Strong Points of the Present Study**

- Originality: **Simultaneous Measurements** of Capture Cross Sections and Gamma-Ray Spectra
- Innovativeness: Use of the Most Powerful Facilities in the World such as **NNRI**
- Ripple Effect:
  - a. Acceleration of **Technological Development of Nuclear Transmutation of LLNW**
  - b. Acceleration of Study on **Nuclear Data**
  - c. Acceleration of Study on **Nucleosynthesis in the Universe**
  - d. Acceleration of Study of **Nuclear Reaction Theory**
- Universality: **Global Standard** of Nuclear Database

Igashira, Y. Kiyonagi, and M. Oshima; Nucl. Instr. Meth., **A600**, 332-334 (2009).

- Thermal Neutron Capture Cross-Section and Resonance Integral of Americium-241: S. Nakamura et al.; J. Nucl. Sci. Technol., **44**, 1500-1508 (2007).
- Measurement of Neutron Capture Cross Section of  $^{237}\text{Np}$  from 0.02 to 100eV: O. Shcherbakov et al.; J. Nucl. Sci. Technol., **42**, 135-144 (2005).

**【Term of Project】** FY2010-2014

**【Budget Allocation】** 166,800 Thousand Yen

**【Homepage Address and Other Contact Information】**

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