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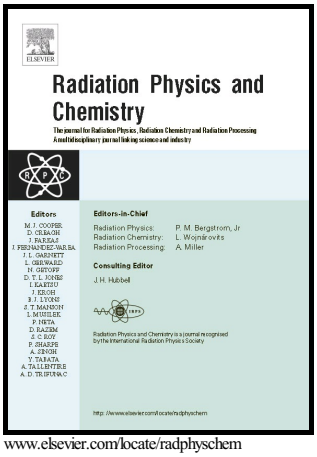


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# Thermal neutron cross-section and resonance integral of the $^{152}Sm(n,\gamma)^{153}Sm$ reaction induced by pulsed neutrons

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ABSTRACT

We measured the thermal neutron cross-section ($\sigma_0$) and resonance integral ($I_0$) of the $^{152}Sm(n,\gamma)^{153}Sm$ reaction relative to that of the $^{197}Au(n,\gamma)^{198}Au$ reaction. Sm and Au foils with and without a cadmium cover of 0.5 mm were irradiated with moderated pulsed neutrons produced from the electron linac. The induced activities of the reaction products were determined via high energy resolution HPGe detector. The present results: $\sigma_{0,Sm}$ = 212±8 b and $I_{0,Sm}$ = 3.02±0.19 kb are consistent with most of the existing reference data.

*Keywords:*
Thermal neutron cross-section; Resonance integral; $^{152}Sm(n,\gamma)^{153}Sm$; $^{197}Au(n,\gamma)^{198}Au$; Activation method

## Introduction

Neutron capture cross-sections are required in both fundamental nuclear physics research and in various fields of applications. In this work, we measured the thermal neutron capture cross-section and resonance integral for the $^{152}Sm(n,\gamma)^{153}Sm$ reaction with pulsed neutrons produced from the electron linac. Samarium (Sm) is a rare earth element that can be used in nuclear reactors as a neutron absorber because it has some isotopes, including the $^{152}Sm$ having high thermal and epithermal neutron cross-sections. Besides, the $^{153}Sm$ produced from the $^{152}Sm(n,\gamma)^{153}Sm$ reaction is one of the medically important radioisotopes, which is widely used for tumor therapy and bone pain palliation due to its high local beta dose per disintegration and suitable half-life (Wilky and Loeb, 2013). Therefore, the knowledge of the thermal neutron capture cross-section and resonance integral of the $^{152}Sm(n,\gamma)^{153}Sm$ reaction would become important in the production of $^{153}Sm$.

So far, most of the thermal neutron capture cross-sections and resonance integrals for the $^{152}Sm(n,\gamma)^{153}Sm$ reaction have been measured with fission neutrons of the nuclear reactors. There are still discrepancies among the recently measured data with old ones. This work is aimed to measure with pulsed neutrons produced from the electron linac. The measurements were carried out by using the Cd-ratio method in order to clarify the existing differences in the neutron cross-section and the resonance integral of the $^{152}Sm(n,\gamma)^{153}Sm$ reaction. In order to reduce the uncertainties, the corrections for the thermal neutron self-shielding ($G_{th}$) and the resonance neutron self-shielding ($G_{epi}$) effects, as well as the γ-ray attenuation ($F_g$) correction were made. In addition, the epithermal neutron spectrum is