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Evaluation of the Potential of Parametric Neutron Activation Analysis in the RINGAS Irradiation Positions of the SAFARI-1 Research Reactor

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Abstract content
 (Max 300 words)

This project involves a comparative study of neutron activation analysis. Firstly by using the deterministic calculations based on the simulated neutron flux, and secondly by measurement via parametric neutron activation analysis (NAA) with neutrons in a cadmium-shielded position. The goal of the project is to evaluate a variety of elemental standards (As, Au, Al, Ba, Cu, Co, Cr, Cd, Ca, Fe, I, Ni, Na, Sn, Se, Mo, Zn) directly in the reactor core. The elemental standards are chosen based on NAA requirements, which entail the target must be stable and the resultant product must be radioactive and emit gamma rays.

The irradiation of standards takes place in the RINGAS system of the SAFARI-1 research reactor. In this position there are both non-cadmium and cadmium covered positions with distinct neutron flux characteristics. The cadmium (Cd) in the RINGAS system is used as a filter for thermal neutrons, because of its large cross-section ($\sigma_{Cd} = 19910 \text{ barn}$). The non-cadmium position is located in the reactor core in a hollow fuel-element. Samples here are irradiated with the full neutron-energy spectrum, while the cadmium-covered is located next to the non-cadmium but on top of the core. In the latter position most of the reactions are induced by epithermal and fast neutron induced reactions, while the former favors thermal neutron induced reactions. This is due to the fact that Cd has cut-off energy at 0.55 eV for neutron absorption.

Comparison of the actual measured and simulation-based calculated induced activities will give an indication as to whether parametric neutron activation analysis can be successfully used at the cadmium-shielded irradiation position of the RINGAS system. In addition, discrepancies between the results obtained in the two methods will make a valuable contribution to the further refinement of the reactor simulation software.

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Level for award
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MSc

Main supervisor (name and email)
and his / her institution

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