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A new fast neutron facility for materials analysis at UCT

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Abstract

Neutron-based nuclear techniques such as fast neutron analysis (FNA) and thermal neutron analysis (TNA) are among the most powerful techniques for elemental analysis in small and bulk samples [1, 2]. The techniques are rapid, non-destructive, and are capable of multi-elemental analysis of samples with complex matrices. Neutron-based techniques are often used in the minerals industry, where fast neutrons are used for on-line analysis of coal, and the safety and security industry, where neutrons can be used for detection of contraband and explosives in cargo containers and in vehicles [3, 4]. Analysis of materials using neutron-based techniques involves irradiating a sample with a field of neutrons with a known energy distribution and neutron flux. The interaction of incident neutrons with the sample nuclei leads to an emission of several signatures – mainly gamma-rays, scattered neutrons and transmitted neutrons, which are characteristic to the elemental composition of the sample [3, 5].

In 2017, the Metrological and Applied Sciences University Research Unit (MeASURe) within the UCT Department of Physics commissioned the n-lab, a fast neutron laboratory [6] centred around a Thermo MP-320 deuterium-tritium sealed tube neutron generator (STNG) and a 220 GBq Americium-Beryllium (Am-Be) radioisotopic source. The aims of this project are to characterise the n-lab as a facility for FNA and TNA, and to develop standardised analysis protocols for the elemental analysis of bulk materials. Fundamental to FNA and TNA is the knowledge of the number and energy distribution of neutrons incident upon the sample of interest. The fast neutron yield of the STNG has been measured to be (1.23 ± 0.29) x 10^8 s^{-1} using the foil activation method, and is in agreement with the expected value for this particular device.

References

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