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#7-123 Determination of Absolute Activities and Neutron Fluence Rates Using a Coincidence Method

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This work focuses on determining the fluence rate of a moderated (α, n) neutron source, a key parameter required for assessing the activation levels in metal and concrete samples. Activation studies are an important tool for nuclear decommissioning. By activating material samples in controlled conditions in a known neutron fluence rate, the expected activity in decommissioning can be estimated. The fluence rate is determined by an absolute measurement of the accumulated activity of neutron-activated reference samples with a well known composition and a cross section using a $\beta\gamma$ coincidence setup. Accumulated activity determination requires both single β - and γ - detection, as well as coincidence data. A main advantage of this technique is that the resulting measurement is mostly independent of individual detector efficiencies. The current setup uses three detector combinations, consisting of three γ (High Purity Germanium (HPGe), 2×2 inch cylindrical cerium bromide ($CeBr_3$), and 3×3 inch cylindrical sodium iodide (NaI) scintillators) and two β detectors (a sample-enclosing and a 1 mm thick cylindrical plastic scintillators), paired with a multi-channel data acquisition system, separately recording hits in the β - and γ - channels including their timestamps. Coincidences are extracted in the offline analysis from the stored data. Having non- and coincident data in one dataset reduces the impact of certain corrections, e.g. dead time. Additionally, Monte Carlo techniques were implemented to assess γ - interactions in the β - detector and to account for finite energy resolution in γ - detectors. Samples, including aluminum (^{27}Al), gold (^{197}Au), silver (^{107}Ag and ^{109}Ag), Vanadium (^{51}V) and sodium chloride (NaCl) were activated. Calculated thermal fluence rates from different samples agree within uncertainties, with an average fluence rate of $(2.11 \pm 0.09) \times 10^5$ cm^{-2} s^{-1} (uncertainty is given with a coverage factor of 2, that is the true value is within 95 % probability within this interval). Reaction products from (n, p) and (n, 2n) reactions induced by fast neutrons are also detected. Their fraction is, however, too low to be exploited quantitatively.

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