

Technetium-95m Production and Characterisation for use in Accelerator Mass Spectrometry of Technetium-99

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The content of technetium-99 has increased throughout the global environment due to anthropogenic nuclear actions. Because of its long radioactive half-life (2.111×10^5 a) and high mobility in the environment, technetium-99 is considered an important environmental tracer for understanding ecological radioactivity transport (e.g. movement of material in ocean currents and safety assessments of nuclear waste management) [1]. Sensitive measurements are required however to take advantage of this, and Fifield et al. [2] and Wacker et al. [3] have shown Accelerator Mass Spectrometry (AMS), an ultrasensitive analytical technique for the determination of isotopic ratios, can detect technetium-99 to the femtogram level in environmental samples.

AMS assay requires chemical sample preparation, where stable or shorter-lived isotopes of an element can serve as yield monitors. Since technetium has no stable isotopes to act as yield monitors, the use of technetium-95m ($T_{1/2} = 61$ days) is investigated for the AMS measurement of technetium-99. This investigation develops a standardized analytical method for the production and characterisation of technetium-95m for this purpose. The isotope is produced through the proton irradiation of a natural molybdenum foil and its presence is confirmed via gamma spectrometry. Subsequent chemical extraction processes are undertaken, and further gamma spectrometry analysis done to characterise the process.

[1] K. Shi et al. Determination of technetium-99 in environmental samples: A review. 2012. doi: <https://doi.org/10.1016/j.aca.2011.10.020>.

[2] L.K. Fifield et al. "Accelerator Mass Spectrometry of ^{99}Tc ". In: Nuclear Instruments and Methods in Physics Research B 168 (2000), pp. 427–436. doi: [https://doi.org/10.1016/S0168-583X\(99\)01094-0](https://doi.org/10.1016/S0168-583X(99)01094-0).

[3] L. Wacker, L.K. Fifield, and S.G. Tims. Developments in AMS of ^{99}Tc . 2004. doi: <https://doi.org/10.1016/j.nimb.2004.04.038>.