

The use of ^{152}Tb in preclinical investigations: its mass separation and subsequent application for imaging

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Introduction: Terbium is a unique element as it provides a quadruplet of radionuclides suited for diagnostics and therapy in nuclear medicine [1]. As part of the PSI-ISOLDE collaboration, we concentrated on the collection and purification of ^{152}Tb (β^+ -emitter, $T_{1/2} = 17.5$ h), for significant PET imaging investigations.

Methods: Mass-separated beams of ^{152}Tb were implanted at ISOLDE-CERN into Zn-coated Au foils. With 4 to 6 hours of collection and 2 hours decay of co-implanted activities, up to 2 GBq ^{152}Tb (and its mass equivalents) could be shipped to PSI.

The ^{152}Tb was extracted from the Zn foils by dissolving them in $\text{HNO}_3/\text{NH}_4\text{NO}_3$, loaded on to a macroporous strongly acidic cation exchange resin and the Tb radionuclide eluted using dilute α -hydroxyisobutyric acid (α -HIBA). The product eluent was used directly for the radiolabeling process.

DOTANOC was labelled with ^{152}Tb and injected into AR42J tumor-bearing mice, which were imaged using a benchtop small animal PET/CT scanner (Genisys8, Sofie Biosciences).

Results: ^{152}Tb (~500 MBq) was effectively separated from Ce, Pr, Ba and La, yielding a radionuclidically pure product. The product in question was successfully labelled to DOTANOC at high specific activity of up to 10 MBq/nmol and radiochemical purity of >95%.

Tumor visualization was readily achieved with ^{152}Tb -DOTANOC and, due to the long half-life of ^{152}Tb , it was possible to also image the tumors at late time points after injection of the mice.

Conclusion: The latest run of experiments in the PSI/ISOLDE collaboration proved to be the most successful to date, with reproducible harvesting of ^{152}Tb and its subsequent chemical separation from impurities. The product was successfully labelled to peptides and injected into mice for imaging. Following these encouraging results, more ambitious studies are planned in future.

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References:

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