TERBIUM-161, IRRADIATION, SEPARATION AND RECOVERY OF TARGET MATERIAL

MAŁGORZATA ŻÓŁTOWSKA*, DARIUSZ PAWLAK, IZABELA CIESZYKOWSKA, ANNA FILIKS, PAWEŁ SAGANOWSKI, RENATA MIKOŁAJCZAK

Radioisotope Centre POLATOM, National Centre for Nuclear Research, Otwock, Poland

** Corresponding author e-mail: malgorzata.zoltowska@polatom.pl*

Terbium-161 (^{161}Tb, $t_{1/2}$ = 6.9625 (26) d [1]) is an β^- emitter. Its half-life, beta energy emission, and chemical properties are similar to lutetium-177 (^{177}Lu), which makes it useful in targeted radionuclide therapy. In addition, the emitted conversion and Auger electrons suggest that the therapeutic effect of ^{161}Tb is better than that of ^{177}Lu. To produce ^{161}Tb we used ^{160}Gd(n,γ)^{161}Gd→^{161}Tb nuclear reaction. Gadolinium oxide enriched in ^{160}Gd (97.5%) was activated in the Maria research reactor in a thermal neutron flux of 2×10^{14} ns^{-1}cm^{-2}. Extraction chromatography was used for the two-step separation of ^{161}Tb from the irradiated target material. First, ^{161}Tb was separated from the target material dissolved in 3M HCl on LN2 resin (Triskem). ^{161}Tb was eluted from the column with nitric acid in a gradient system. Then, ^{161}Tb as nitrate solution was concentrated on the DGA resin (Triskem) and eluted as a chloride with 0.05M HCl. Radionuclide purity was measured by gamma spectrometry with an HPGe detector. The suitability of ^{161}Tb solution was assessed by radiolabeling of the DOTA chelated peptide (DOTATATE, Radioisotope Centre POLATOM, NCBJ). Chemical purity was verified in ICP-OES measurements. A high separation efficiency of ^{161}Tb from gadolinium (>95%) was achieved. The efficiency of radiolabeling was over 99 %. To recover the target material after ^{161}Tb separation, to the fraction containing gadolinium-160 an excess of oxalic acid was added and Gd was precipitated as oxalate. The effect of the molar ratio of oxalic acid to gadolinium on the efficiency of precipitation was studied. The highest efficiency of precipitation up to 99 % was achieved at Gd:$C_2H_2O_4$ molar ratio of about 1.9 and pH=8. The gadolinium oxalate was thermally decomposed at 800°C to oxide. Further tests are scheduled on the recovered $^{160}Gd_2O_3$ irradiation in the Maria reactor.

[1] Carine Michotte et al, *Update of the BIPM comparison BIPM.RI(II)-K1.Tb-161 of activity measurements of the radionuclide 161Tb to include the 2022 result of the NPL (United Kingdom)*, 2024 Metrologia 61 06005DOI 10.1088/0026-1394/61/1A/06005

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