Purification of ^{44}Ti

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Introduction: For preparation of ^{44}Ti/^{44}Sc radionuclide generators, several radiochemical criteria are relevant, such as effective separation strategies providing high ^{44}Sc elution yields and low ^{44}Ti breakthrough, high long-term stability, and type of Sc eluates useful for subsequent labelling reactions (i.e. low volume, low pH, high purity etc.), e.g. [1.2].

About 5 mCi of ^{44}Ti were obtained following initial separation of ^{44}Ti from 1.5 g massive scandium targets using cation exchange chromatography on a large column (^{44}Ti / ^{nat}Sc purification, AG-50Wx8, 200-400 mesh, H^+-form) [3].

In this study ion purification experiments have performed systematically using AG-1x8 (200-400 mesh Cl^--form) resins eluted with HCl solution of various concentration.

Experimental: The first purification was made on medium-scale column (H=170 mm, D=3 mm, V_0=0.6 ml) with AG-1x8, 200-400 mesh (Cl^--form). The column was washed with 10 ml 12 M HCl, 10 ml 1 M HCl, 10 ml H_2O and 10 ml 12 M HCl, consecutively. The probes N 23-24 (802.0 and 221.2 MBq) (c.f. [3]) were brought in the column, then 8.6 ml 12 M HCl, 4.5 ml 8 M HCl, 8 ml 1 M HCl consecutive. Results for the ion exchange chromatography are shown in Fig. 1. Activities have been analysed using a Curie-meter at two different time points.

The second purification was made on a bit smaller column (H=150 mm, D=3 mm, V_0=0.55 ml) using cation exchange chromatography with the resin AG-50x8, 200-400 mesh (H^+-form). The column was washed with 40 ml 4 M HCl and 5 ml H_2O consecutive. The ^{44}Ti activity fraction N 4 (47 ml, 180 kBq) as isolated in the anion exchange chromatography in of 2 ml HCl, as well as the probes 22 (30 ml, 540 kBq), 25 (30 ml, 60 kBq), 13-18 (7.1 ml, 8.648 kBq) as obtained in the initial separations (c.f. [3]) in 2 M HCl were brought in the column, then 10 ml 1 M HCl and 20 ml 0.3 M HCl were applied. The ^{44}Ti was eluted with 1 M HCl and Sc with 4 M HCl (beginning with fraction 122). Results are summarized in Fig. 3.

Results and Discussion:

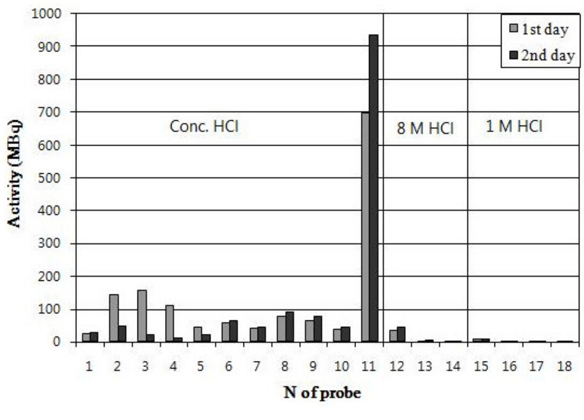

Fig. 1. The distribution of ^{44}Ti (as measured with a Curie-meter in relative units) after the 1st purification on AG-1x8 (200-400 mesh Cl^--form). Each fraction volume is 1.2 ml.

Interestingly, some fractions show coloured solutions, e.g. fractions 6 – 8, cf. Fig. 2.

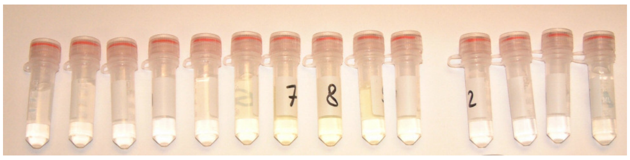

Fig. 2. Indication of coloured fractions for the anion exchange purification for # 6 – 9. Fraction # 11 was removed because of its high radiation dose.

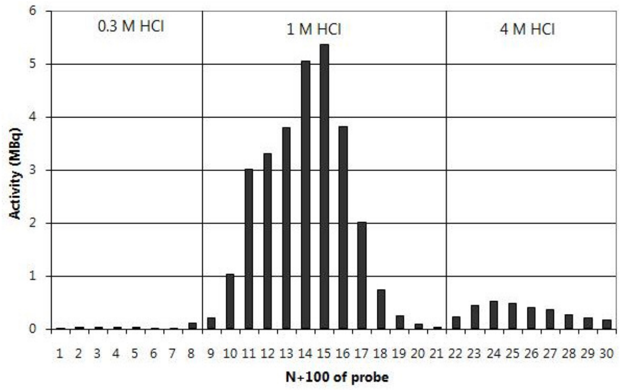

Fig. 3. The distribution of ^{44}Ti (Curie-meter) after the 2nd purification on AG-50x8 (200-400 mesh H^+-form). Each fraction volume is 2 ml.

Conclusions: The highly-pure ^{44}Ti probes N 11 with > 95% of the overall ^{44}Ti activity as well as the low activity fractions 108-109 and 112-118 were kept in depository. Those fractions were later on used to prepare the first prototype of a ^{44}Ti / ^{44}Sc generator, cf. [4].

In order to investigate the radiochemical design of ^{44}Ti / ^{44}Sc generators in terms of high ^{44}Sc elution yields and low ^{44}Ti breakthrough, but also high long-term stability, and type of Sc eluates useful for subsequent labelling reactions, the probes N 110-111 were used for the preparation of two low-activity pilot-generators [5].

References:

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