^{203}Pb with High Specific Activity for Nuclear Medicine

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Introduction

The heavy metal pollution due to their industrial production, waste repository or accident as the cyanide spill in river Tisza in 2002, increase the scientific interest for using an ideal trace isotope for monitoring these type of events. Lead is one of the most toxic and commonly used heavy metal, its poisoning is often deadly because very difficult to recognize and identify. The neuro-scientific study of biodegradation effect of lead could be an impressive scientific field of application of ^{203}Pb radioisotope. Furthermore, the targeted radionuclide therapy viaα-emitting radioisotopes is also of interest and employed tracers such as ^{213}Bi and ^{212}Pb [1,2]. Therefore ^{203}Pb is a potential radioisotope for this role due to its γ-radiation and as heavy metal element to trace the therapy.

Experiment

The production of ^{203}Pb was carried out from metal ^{nat}Tl by the nuclear reaction of ^{203}Tl(p,n)^{203}Pb with proton beam 14.5 MeV energy and beam current of 5 μAs. The irradiation time was 18 hours and the produced activity was 80 MBq at EOB. The irradiated Thallium was dissolved in mix of diluted nitric and chloric acid. The excess acid was evaporated slowly. The nitrate form was transferred to chloride form by 8 mol/dm^3 HCl and the Thallium was kept in 3+ oxidation stage by hydrogen peroxide. The separation was carried out on the anion exchange column (DOWEX 1x4, 200/400 mesh, 15 cm long and 0.5 cm i.d.) in 8 mol/dm^3 HCl media, based on literature [3]. The radioactive ^{203}Pb was collected in the effluent. The target material Tl remained on the column. The regeneration of the column, i.e. collection of Thallium was made by washing of the column with deionized water. The collected fraction of ^{203}Pb was evaporated to wet dryness and take back with saline of 0.8 ml.

Results

The separation yield was 63%±12%, corrected by decay. Due to the necessary longer cooling time (1 day, approximately) and the time-consuming separation the chemical yield is low. At the same time, no contaminating radioisotopes were detected in the product as can be seen in Fig. 1.

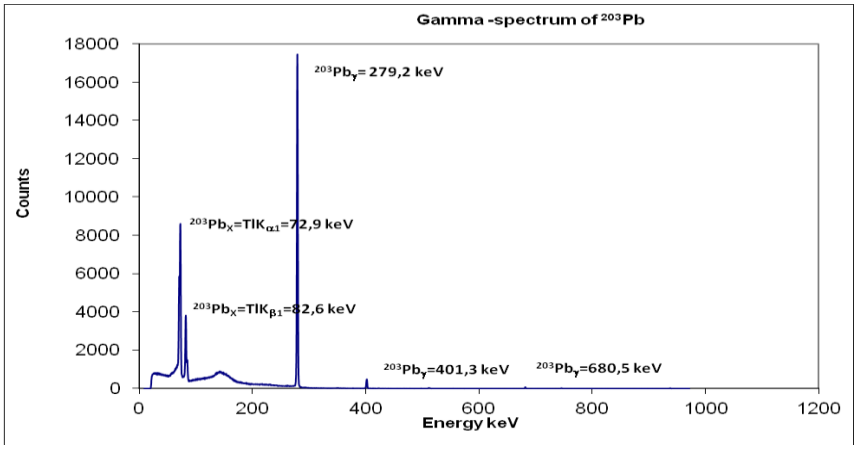

Fig.1.: Gamma-spectrum of separated ^{203}Pb

The amount of Tl in the end-product was 7 μg, which is much less than the tolerable level for the mice [4]. The specific activity of ^{203}Pb was determined by ICP-MS, which is 7,2 Ci/mmol. The stock solution of ^{203}Pb with above mentioned quality is ready to use in nuclear medicine for labelling as well as for SPET- diagnosis of bone tumours.

Conclusion

The ^{203}Pb radioisotope with high specific activity was successfully produced by the ^{nat}Tl(p,n)^{203}Pb nuclear reaction in reasonable amount (1mCi) for the preliminary animal experiment (I. phase) in nuclear medicine, as trace radioisotope for α–emitter radionuclid therapy.

References

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