

Capabilities of JSC “SSC RIAR” in Producing $^{227}\text{ThCl}_4$

^{227}Th is considered to be one of the promising radionuclides for target radionuclide therapy of cancer. Its advantages are chemical properties which are good for the synthesis of the complexes with chelating agents and emission of five alpha particles with complete decay of one ^{227}Th nucleus. The apparent disadvantage is the presence of ^{223}Ra among daughter products the chemical properties of which are fundamentally different from thorium that can cause its redistribution in the human body. A rather big half-life of ^{227}Th (18.7 days), on the one hand, is good for the preparation production and shipment, and on the other hand, it specifies high-level requirements to the preparation stability in the human body.

In addition to using ^{227}Th for radiopharmaceutical synthesis, it can be applied in manufacturing ^{223}Ra generators. While such generators have a rather small period of use, they have a number of advantages over $^{227}\text{Ac}/^{223}\text{Ra}$ generators. In particular, there is no need to check every batch for the ^{227}Ac content, and there are no long-lived radioactive wastes.

JSC “SSC RIAR” performs experiments to produce trial samples of ^{227}Th by generating from long-lived parent radionuclide ^{227}Ac extracted from the ^{226}Ra targets irradiated during 20-25 days in the SM reactor neutron trap. To separate ^{227}Th and ^{227}Ac , thorium is sorbed on BioRad AG 1x8 (NO_3^-) strongly basic anion-exchange resin from 8M HNO_3 with further elution using 0.1-0.5 M HNO_3 or HCl . To produce the preparation of desired radionuclide purity, the purification process must be carried out at least twice. The key challenge in producing ^{227}Th is determination of the ^{227}Ac content. It is not possible to directly determine ^{227}Ac by its own alpha radiation at its activity of less than 1% of the ^{227}Th activity. The yield of alpha radiation in ^{227}Ac decay is only 1.38 %, and its peak in the spectrum is on the low-energy tail of ^{227}Th and its daughter products. ^{227}Th conversion electrons and beta radiation of the daughter products, namely ^{211}Pb and ^{211}Bi , are obstacles in measuring the ^{227}Ac activity by beta radiation. The presentation discusses possible methods to check the content of ^{227}Ac with its preliminary chemical extraction from a preparation aliquot and gives the characteristics of ^{227}Th experimental samples.

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