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Production of 230Pa from proton-irradiated thorium and developing 230Pa/230U/226Th tandem generator

Targeted alpha-therapy of various oncology diseases is based on the coupling of alpha-emitting radionuclides to tumour-selective carrier molecules. 230U (T1/2=20.8 d) is accumulated via decay of 230Pa and has strong potential for alpha-therapy due to 5 emitting alpha - particles with total energy 33.5 MeV. It can be used directly or as a parent of 226Th in a generator system.

A prospective way for production of 230Pa/ 230U is irradiation of natural thorium with medium-energy protons. Curie amounts of 230Pa can be generated in one irradiation run together with other useful alpha-emitters 225Ac and 223Ra.

After dissolving Th-target in 6M nitric acid with the addition of catalytic amounts of hydrofluoric acid Pa was isolated by liquid extraction with octanol. The water phase may be further used for isolation of 225Ac and 223Ra according the method, proposed in [1, 2]. Namely, the most part of thorium was removed by liquid extraction with di(2-ethylhexyl)phosphoric acid in toluene. Organic phase was kept for accumulation 223Ra from parent 227Th. 225Ac and 223Ra were concentrated from aqueous phase and then separated and purified by extraction chromatography. After re-extraction 230Pa was purified on silica gel using different oxalic acid solutions. Up to 85% of 230Pa with radionuclidic purity >99% was recovered and stored for 230U accumulation.

Basing on distribution coefficients 230U was separated from 230Pa in diluted nitric acid solution on DGA resin. Obtained 230U may be used for development of 230U/226Th –generator. Distribution coefficients for U and Th were obtained for a wide range of extraction chromatographic resins. TEVA (mixture of trioctyl and tridecyl methyl ammonium chloride as an extractant) and WBEC (based on a mixture of tertiary octyl and decylamines) resins are most suitable for this purpose.

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