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## Generation of isotope-enriched $^{152}\text{Sm}$ from $^{153}\text{Gd}$ production waste

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Samarium-153 is a part of chemicals used for therapy of cancerous growth and inflammatory disease of bone tissue.  $^{153}\text{Sm}$  is generated by irradiating  $^{152}\text{Sm}$  in either a nuclear reactor or charged-particle accelerator. A natural mixture of samarium isotopes contains only 26.75% of  $^{152}\text{Sm}$ ; when irradiated, the specific activity of the generated  $^{153}\text{Sm}$  is not enough to use it for the nuclear medicine purpose. Therefore, the initial material enriched in  $^{152}\text{Sm}$  is used to produce  $^{153}\text{Sm}$ . Nowadays, the material is enriched by an electromagnetic mass-separation.

JSC SSC RIAR produces  $^{153}\text{Gd}$  from europium targets irradiated in the BOR-60 reactor. When irradiating europium in a fast spectrum, a short-lived isomeride  $^{152m}\text{Eu}$  generates, of which decay takes place in two directions: generation of  $^{152}\text{Gd}$  (72%) and generation of  $^{152}\text{Sm}$  (28%). The generated  $^{152}\text{Sm}$  is practically monoisotopic. Impurities of other samarium isotopes result from reaction  $^{153}\text{Sm}(n,\gamma)$  and threshold reactions with a participation of fast neutrons. When extracting  $^{153}\text{Gd}$  from irradiated targets, it is purified from impurities, including samarium, europium and terbium. Thus, highly-enriched stable isotope  $^{152}\text{Sm}$  is a side product of the  $^{153}\text{Gd}$  production and it can be separated from the production waste. Under this work, an experimental sample of  $^{152}\text{Sm}$  was separated from a fraction resulted from the purification of commercial batches of  $^{153}\text{Gd}$ . The separation and purification were performed by an extraction chromatography using sorbent DAF/Teflon. The DAF content was 25%wt. The  $^{152}\text{Sm}$ -containing solution was evaporated to dryness. The residual was dissolved in 50ml of 0.1M  $\text{HNO}_3$  and the solution was then put through a column 50ml in volume. Samarium, europium and gadolinium were eluted with 0.65M  $\text{HNO}_3$  1.2l in volume. The activity of impurity isotopes in the column effluent was measured using gamma-spectrometry; the samarium content was evaluated by an atomic-emission analysis.

As a result, a 99.52%-enriched experimental sample  $^{152}\text{Sm}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$  was generated, of which enrichment exceeds the one of  $^{152}\text{Sm}$  in the commercial off-the-shelf chemicals produced by the electromagnetic mass-separation. The content of other samarium isotopes is as follows:  $^{147}\text{Sm}$  - 0.01%,  $^{148}\text{Sm}$  - 0.02,  $^{149}\text{Sm}$  - 0.19,  $^{154}\text{Sm}$  - 0.26%. The content of radioactive isotopes  $^{152}\text{Eu}$  and  $^{154}\text{Eu}$  makes up ~560 and 620Bq/g, respectively.

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