INTERNATIONAL CONFERENCE ON ELECTROMAGNETIC ISOTOPE SEPARATORS AND RELATED TOPICS

EMIS XVIII

CERN GENEVA / SWITZERLAND / 16 - 21 SEPTEMBER 2018

Contribution ID: **159** Type: **Submitted Oral**

Very high specific activity Er-169 production

Thursday 20 September 2018 15:15 (15 minutes)

The new facility CERN-MEDICIS produces isotopes using the CERN proton beam at 1.4 GeV coming from the CERN Proton Booster. The produced radioisotopes are dedicated for medical applications. A wide range of innovative radionuclides can be produced through its off-line mass separator. Indeed the mass separation allows the production of radionuclides which are not available at sufficient specific activity using conventional chemical separation methods only, in particular in the lanthanides region.
One radiolanthanide with very promising decay properties for targeted radionuclide therapy is Er-169. It shows favorable nuclear decay characteristics among β- emitters with about one week half-life, as it has the lowest beta energy and no disturbing gamma rays. More elaborated dosimetry calculations have validated that Er-169 would provide one of the best ratio of absorbed dose to the tumor versus normal tissue [1]. Unfortunately, Er-169 cannot be produced directly with high specific activity. Reactor irradiation of highly enriched Er-168 leads to specific activities of 0.4–4 GBq/mg (for thermal neutron fluxes of 1014–1015 cm-2s-1 and irradiation for one half-life). This corresponds to a "dilution"of the radioactive Er-169 with 8000 or 800 times more stable Er-168 respectively. This low specific activity carrier-added Er-169 is actually in clinical use, but only for radiosynovectomy of finger joints in the therapeutic management of arthritis [2,3], where the low specific activity is acceptable. Therefore higher specific activities could allow no-carrier-added Er-169 being considered for receptor targeted therapies.
The production of Er-169 with the off-line mass separator, allows to significantly increase the specific activity and to spread the potential applications of this radionuclide in medicine. For this reason in the spring 2018 a highly enriched Er-168 target will be irradiated in ILL reactor and shipped to CERN where the mass separation will be performed. We will present the experimental results of the irradiation and separation in comparison to the yields estimated from off-line experiments. Future improvements of the overall process efficiency will be discussed.

[1] H Uusijärvi et. al., Electron- and positron-emitting radiolanthanides for therapy: aspects of dosimetry and production. J Nucl Med 2006;47:807–814.
[2] K Liepe. Radiosynovectomy in the therapeutic management of arthritis. World J Nucl Med 2015;14: 10–15.
[3] R Chakravarty et. al., Reactor production and electrochemical purification of 169Er: a potential step forward for its utilization in in vivo therapeutic applications. Nucl Med Biol 2014;41:163–170.

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Session Classification: Session 13 - Applications of radioactive ion beams

Track Classification: Applications of radioactive ion beams