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A production challenge of Ac-225 from RaCO3 target activated by vertical beam

[Introduction] Ac-225 (T1/2 = 10 d) is regarded as a promising alpha emitter for the targeted alpha therapy (TAT). Considering biodistribution of conjugated antibodies, as well as logistics in worldwide supply, a physical half-life of 10 days would be tolerable for keeping certain radioactivity in each case. Actinium shows a good compatibility to DOTA that is favorable in radiochemistry to enhance the fusion of diagnosis and therapeutic studies including novel radiopharmaceuticals development. However, the current capability of Ac-225 supply is very limited at around 2 Ci/year that mainly relies on the natural source of Th-229 stocked in a few institutes; therefore, any artificial production ways of Ac-225 would be highly desired. Among possible channels of Ac-225 production, protons on Ra-226 (T1/2 = 1600 y) is the sole option we can employ practically, due to the accessibility of target material under the current regulation in our country/institute and high cross-section of this reaction that can be performed on medical cyclotron platforms.
[Methods] Radium-226 used in this study was originated from 1–4 mCi of 'legacy needles', presumably being filled as sulfate or bromide with or without carrier Ba, and we successfully collected soluble Ra in HCl followed by the Ref [1]. Then, enriched 40CaCO3 (as carrier), ammonium solution (to make pH>9) and (NH4)2CO3 (to precipitate) in turn were added into 100–500 μCi of Ra/HCl to obtain practically insoluble radium carbonate. The sediment contained RaCO3 was isolated on a filter made of silicon carbide to make Ra target disk, which can be activated directly at our vertical beam station owing to the heat and chemical resistance of SiC, as well as gravity-supported target holding.
Irradiations were performed with 18 MeV protons at 3 μA for 3 h (on target 16.7 MeV). The activated target, allowed to decay for about 3 days, was dissolved in 1 M HCl, and then purified to obtain Ac-225 fraction as the final product.
[Results and Discussion] Production yield of Ac-225 was roughly estimated to be about 1/200 of Ra-226 activity by this activation condition (1.6 μCi of Ac-225 at the EOB from 360 μCi of Ra-226, in average). Ac-226 (T1/2 = 29 h) was the primal impurity found in our sample that was about 30% with regards to the activity of Ac-225, corrected to the EOB.
Although our study is still in development, we concluded that the Ac-225 production from Ra-226 target is feasible that could give sufficient quantity and quality of Ac-225 also in a scaled-up condition with appropriate energy window, cooling time and chemical separation processes.
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[Reference] [1] Matyskin, A.V. et al. J. Radioanal. Nucl. Chem. 310 (2016) 589–595

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Presentation Type

Poster

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