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Solid phase extraction based Lu-177m/Lu-177 radionuclide generator to produce Lutetium-177

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The radionuclide lutetium-177 has become one of the preferred radionuclides for targeted therapy. The low tissue penetration of the emitted β- particles assures an efficient energy deposition on small size tumours (less than 3 mm) and a low radiation dose to the surrounding healthy tissue. This is especially useful when ¹⁷⁷Lu is combined with different targeting molecules, which are internalized within tumour cells, being then possible to treat small primary and metastatic tumours, like prostate, breast, melanoma, lung and pancreatic tumours as well as bone metastasis. Recently we have proposed a ^{177m}Lu/¹⁷⁷Lu radionuclide generator as a new method for the production of lutetium-177 [1]. The reported separation method, increases the ¹⁷⁷Lu/^{177m}Lu activity ratios from 0.25 (in equilibrium) to values around 250 [2]. In our current research we are exploiting the convenience of solid-liquid phase extraction for the separation of the two isomers.
In order to achieve this separation, the surface of amino propyl silica has been chemically modified by reacting it with different chelating groups like : 1,4,7,10-tetraazacyclododecane-1,4,7,10-tetraacetic acid (DOTA), and its analogous namely, 2,2′,2”-(10-(2,6-dioxotetrahydro-2H-pyran-3-yl)-1,4,7,10-tetraazacyclododecane-1,4,7-triyl)triacetic acid (DOTAGA-anhydride) and Tri-tert-butyl 1,4,7,10-tetraazacyclododecane-1,4,7,10-tetraacetate (DOTA-tris(tert-butyl ester)). The modified silica surfaces are characterized with several techniques including infrared spectroscopy, solid-state 13C-NMR and TGA analysis. The chelator bearing particles are then packed in a column and loaded with ^{177m}Lu. Periodically the produced ¹⁷⁷Lu is eluted an its quality and the efficiency of the process are quantified by gamma spectroscopy.
This system offers advantages like easy of operation and reliability that together with the low kinetics of the chelating moieties make the system a great candidate to be the final design of the ^{177m}Lu/¹⁷⁷Lu generator.

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2. Bhardwaj, R., et al., Separation of nuclear isomers for cancer therapeutic radionuclides based on nuclear decay after-effects. Scientific Reports, 2017. 7: p. 44242.

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