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ISOL-BASED EXOTIC NUCLIDES IN POROUS SILICON FOR SIMULTANEOUS DIAGNOSTICS AND RADIOTHERAPY

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The study of targeted porous nanoparticles as drug carriers is a growing field in cancer-therapy research. The porosity of the particle enables anticancer drugs to be loaded inside the particle and its surface can be modified to include tumour targeting properties. The nanoparticles are then injected into the blood stream and through the properties of the carrier nanoparticles the anticancer drugs can be targeted to the tumour cells. Alongside anticancer drugs, the particles can also be loaded with radionuclides for diagnostics and radiotherapy. The implanted nuclides can, moreover, be chosen so that the specific radiative properties allow for both imaging and therapy at the same time. The resulting carrier particle is a theranostic (therapeutic and diagnostic) system that provides local radiotherapy, which can be observed on-line throughout the treatment by PET or SPECT imaging.

Recently, interest has been shown in theranostic nuclides or matched isotopic multiplets. In a matched multiplet one element includes chemically identical isotopes with different medically relevant radiative properties. One example is the theranostic quadruplet of terbium, where two isotopes are suitable for tomography (¹⁵²Tb for PET and ¹⁵⁵Tb for SPECT) and two isotopes have therapeutic properties (¹⁴⁹Tb alpha emission, ¹⁶¹Tb electron emission) [1]. These novel radionuclides are to date only available in suitable quantities and purities at large-scale radioactive ion beam facilities or nuclear reactors.

We use porous silicon (PSi) particles as carrier nanoparticles which are biocompatible, can be made biodegradable and are thus suitable for use in a living body [2-8]. To load the radioactivity into the PSi particles, we implanted ¹⁵⁵Dy into thin PSi foils at the ISOLDE facility. The nuclides were produced through proton-induced spallation in a tantalum target. The ions were thermally released, ionized, and accelerated to an energy of 50 keV. The extracted ions were mass-separated in the general-purpose separator and implanted into the PSi foils in a collection chamber. The final radionuclide of interest, ¹⁵⁵Tb, was obtained through the beta decay of ¹⁵⁵Dy that was available at high yield through resonant laser ionization. To characterise the implantation process, the implantation depth of ¹⁵⁵Dy in the PSi structure was studied through successive ion-beam etching of an implanted foil and by analysing the resulting radioactivity profile. The foils were then post-processed into particles through milling. The resulting particles were incubated in vitro in biocompatible fluids jto assess the stability of the radioactive PSi system over an observation period of 21 days.

Our results using ¹⁵⁵Tb will be presented with our recent activities in nuclear applications studying other rare-earth nuclides in a PSi carrier system for nuclear medicine.

References

[1] C. Müller *et al.*, J. Nucl. Med. **53** (2012) 1951-1959
[2] S. P. Low *et al.*, Biomaterials **30** (2009) 2873-2880
[3] T. Tanaka *et al.*, Int. J. Pharm. **402** (2010) 190-197
[4] S. Näkki *et al.*, Acta Biomater. **13(Supplement C)** (2015) 207-215
[5] M. A. Tölli *et al.*, Biomaterials **35** (2014) 8394-8405
[6] J.-H. Park *et al.*, Nat. Mater. **8** (2009) 331-336
[7] L. M. Bimbo *et al.*, ACS Nano **4** (2010) 3023-3032
[8] S. C. Bayliss *et al.*, Adv. Mater. **11** (1999) 318-321

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