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Cyclotron produced ⁴⁵Ti –production, purification and yields

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Studies of the environmental fate of nanoparticulate TiO₂ require suitable tools for tracing the nanoparticles in complex environments and media. A promising method is the isotopic radiolabelling of the TiO₂-nanoparticles with ⁴⁴Ti (T_{1/2} = 47.3 a) or ⁴⁵Ti (T_{1/2} = 3.08 h). Due to the different decay modes and half-lives, different experimental setups are accessible with these radioisotopes. The presented work is focused on the production and purification of the short –lived positron-emitting radionuclide ⁴⁵Ti (n.c.a.).
For this purpose, we used the nuclear reaction ⁴⁵Sc(p,n)⁴⁵Ti [1]. The irradiation was done at a COSTIS target station mounted at a 2 m beam transfer line of a Cyclone® 18/9 (IBA molecular). The mono-isotopic natural scandium allowed an easy target design. A scandium foil (thickness: 100 µm) was put together with an energy-degrading foil into a disk-like sample holder and was then transferred into the COSTIS target station. The irradiation was carried out with 12 MeV protons and a current of 20 µA for 20 min –30 min.
Radionuclide separation and purification was done by means of ion exchange chromatography [2] or liquid-liquid extraction [3]. Both methods were compared. Higher yields and better purification results were obtained with liquid-liquid extraction. The yield of the liquid-liquid extraction was about 75 % - 80 %, n.c.a. ⁴⁵Ti stock solution (1 M HCl) had a activity concentration of up to 120 MBq/mL.

References
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Primary author: Dr FRANKE, Karsten (Dept. Reactive Transport, Institute of Resource Ecology, Helmholtz-Zentrum Dresden-Rossendorf, Leipzig-Site, Germany ; Dept. Neuroradiopharmaceuticals, Institute of Radiopharmacy, Helmholtz-Zentrum Dresden-Rossendorf, Leipzig-Site, Germany)

Co-authors: Dr MANSEL, Alexander (Dept. Reactive Transport, Institute of Resource Ecology, Helmholtz-Zentrum Dresden-Rossendorf, Leipzig-Site, Germany); Dr HILDEBRAND, Heike (Dept. Reactive Transport, Institute of Resource Ecology, Helmholtz-Zentrum Dresden-Rossendorf, Leipzig-Site, Germany)

Presenter: Dr FRANKE, Karsten (Dept. Reactive Transport, Institute of Resource Ecology, Helmholtz-Zentrum Dresden-Rossendorf, Leipzig-Site, Germany ; Dept. Neuroradiopharmaceuticals, Institute of Radiopharmacy, Helmholtz-Zentrum Dresden-Rossendorf, Leipzig-Site, Germany)

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