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Thermochromatographic isolation of ^{45}Ti from irradiated Sc

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Titanium-45 (^{45}Ti, $t_{1/2}$ = 3.08 h) is an important non-standard radio nuclide exhibiting favorable decay properties for PET imaging due to its relatively low maximum positron energy (E_{max} =1040 keV, E_{avg}= 439 keV) and high β^+ intensity ($I_{\beta+}$ = 84.8%). Furthermore, ^{45}Ti might be of high interest since titanium(IV) complexes with high therapeutic anti-cancer potential have been reported[1,2]. Therefore, labelled Ti-complexes have the potential to gain information about the biodistribution and therapeutic efficiency of Ti-complexes.

However, application of ^{45}Ti is hampered by the lack of separation methods which enable to obtain ^{45}Ti in a chemical form suitable for radiometal complex syntheses. The aim of this work was to isolate ^{45}Ti from scandium by the formation of volatile [^{45}Ti]titanium(IV)chloride, which can be used for further conversions and the synthesis of tetravalent titanium complexes.

For ^{45}Ti production a scandium metal disc was irradiated with 16 MeV protons. The irradiated scandium was heated in a stream of chlorine-argon gas to 900°C yielding scandium(III)chloride and [^{45}Ti]titanium(IV)chloride. Both compounds can be separated by exploitation of their different sublimation points. Hereby, [^{45}Ti]titanium(IV)chloride was trapped at -29°C either directly in a dry vessel or in dry acetonitrile while the scandium(III)chloride was deposited before. First experiments showed a ^{45}Ti-recovery of 25%. The trapped [^{45}Ti]titanium(IV)chloride was directly used for further conversions.

To demonstrate the reactivity of trapped [^{45}Ti]titanium(IV)chloride, the complex ligand FL^4 was added to afford the hydrolytically stable [^{45}Ti]Ti(IV)salan complex [^{45}Ti]TiFL^4. The reaction was carried out in the trapping vessel using dry acetonitrile as a solvent at -29°C in 30 min reaction time. N-ethyl-N-(propan-2-yl)propan-2-amine (DIPEA) was used to activate the salan ligand and to neutralize formed HCl. The radiolabelled complex was obtained in a RCY of 40% (HPLC) and its identity and purity was determined by HPLC analysis using a non-radioactive standard as a reference.

The thermochromatographic work up of the scandium target enabled the isolation and recovery of ^{45}Ti as the corresponding ^{45}Ti-tetratchloro compound which in the future can be converted to clinically relevant complexes.

References

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