Contribution ID: **127** Type: **Invited Lecture**

INVITED LECTURE - ⁶⁸Ge-⁶⁸Ga production revisited: new excitation functions, target preparation and separation chemistry

Wednesday 19 September 2012 08:30 (20 minutes)

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The use of ⁶⁸Ga (T_{1/2}= 67.7 m, &beta⁺ decay branching 89.1%) for clinical diagnostic PET imaging is increasing.
The fact that it can be obtained from a generator system with long lived ⁶⁸Ge (T_{1/2} = 288 d) as parent and its versatile chemistry could make it the PET analogue of the ⁹⁹Mo-^{99m}Tc pair.
The preferred route to produce ⁶⁸Ge is intermediate energy proton bombardment of Ga-containing targets. The long half-life however means that long irradiations at high particle flux are needed to produce enough activity for a useful generator (typically 750 MBq). We developed high beam power withstanding targets using electro-deposition of Ga/Ni alloy (70/30%) on industrially used thick Cu backings covered by a 20 µm protective Au layer. Using AC Constant Current Electrolysis (current density 34 mA/cm²) a uniform layer containing 51 mg/cm² Ga is deposited in 7 h from an acid bath containing Ga₂SO₄, NiSO₄ and H₂SO₄.
Using thin Ga/Ni targets produced with this technique (6 mg/cm² Ga) we measured cross sections for reactions, induced by protons (up to 65 MeV) and deuterons (up to 50 MeV), producing &gamma-emitting radioisotopes with halflife longer than 2 h. With a stacked foil irradiation, followed by high resolution &gamma-spectrometry, excitation functions for ^{68,69}Ge, ^{66,67,72}Ga, ^{69m,65}Zn were determined, relative to the monitor reaction ^{nat}Cu(p or d,x)⁶²Zn. The results are compared to the scarce literature values while from derived thick target yields possibilities to use the deuteron reaction are discussed.
A PC-controlled automated set up for delivery of nca ⁶⁹Ge is developed and implemented in an industrial system ready to be mounted in a hot cell.
The target layer is dissolved in a mixture of H₂SO₄ and H₂O₂ using a heated,flow trough stripper. Prior to the extraction into toluene, concentrated HCl is added (normality of the solution 0.4 M HCl). The back extraction of the nca ⁶⁸Ge is performed using very diluted HCl. As a last purification step, a cation exchange column is used to adsorb traces of Ga and Ni. Samples are collected for radionuclide and chemical purity analysis. The 40 ml bulk is passed trough a 0.22 µm filter for final filtration-sterilisation.
Overall chemistry yield, tested by ⁶⁹Ge tracer, is higher than 90 %.

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Session Classification: Session 7 - Nuclear Chemistry, Radionuclide Production, High-Power Targetry

Track Classification: Nuclear Chemistry, Radionuclide Production, High-Power Targetry