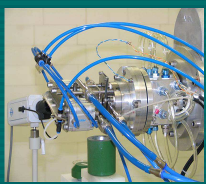
Production of ^{124}I and ^{64}Cu on an 18/9 MeV cyclotron as a starting material for radiopharmaceuticals preparation.

P. Rajec[1,2], V. Csiba[1], M. Leporis[1], M. Štefečka[1], E. Losonczi Pataky[1] , M. Reich[1], J. Ometáková[2]
[1] Biont a.s. Karloveská 63, 842 29 Bratislava, Slovakia
[2] Faculty of Natural Science, Department of Nuclear Chemistry, Comenius University, Mlynská dolina, 842 15 Bratislava, Slovakia

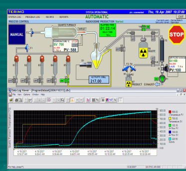
Iodine-124 ($T_{1/2}$ = 4.18 d) and Cu-64 ($T_{1/2}$ = 12.7 hrs) are two very important radionuclides for radiopharmaceuticals production in preclinical research using positron emission tomography (PET). The method for producing ^{124}I was based on a dry distillation technique of ^{124}I from a solid [^{124}Te]TeO_2 target. The platinum target disk was used as a base for TeO_2 melt and irradiated on COSTIS target station installed on the end of the external beam line of the IBA Cyclone 18/9 cyclotron. The target station was equipped with a 25 µm aluminum or 250 µm Nb window foil in front of the target, which results in a final beam energy of 17.7 or 13.5 MeV respective. The TERIMO module was placed in a GMP class “D” research laboratory in a suitable hot cell. Isotope ^{64}Cu ($I_{\beta+}$= 17.6 %, $E_{\beta+}max$=653 keV, Iβ-= 38.5 %, Eβ-max=579.4 keV) is a positron emitters and with half-life 12.7 hrs. The $^{64}Ni(p,n)^{64}Cu$ reaction route is used for ^{64}Cu preparation because its entrance channel is accessible at low energies and a yield of the reaction is quite high. Disadvantage of the reaction used is a high price of the enriched ^{64}Ni. The gold or platinum target were used for a thick ^{64}Ni target preparation by electro deposition. Since the external beam line of the cyclotron has no beam diagnostic devices, several aluminum plates were irradiated in the COSTIS target station with a 5 µA proton beam for 5 min with different settings for the beam focusing quadrupole magnets. After 15 minutes decay time the plates were scanned by a TLC scanner along the horizontal and vertical central axes of the plates in order to visualize the beam shape. The settings providing the most homogeneous beam spot on the target were selected and used further for the actual target irradiations. The radionuclidic purity of the product was determined by γ-spectrometry.



COSTIS target station connected with the external beam of the IBA cyclotron

Irradiated $^{124}TeO_2$ target

TERIMO module was placed in a GMP class “D” research laboratory in a hot cell

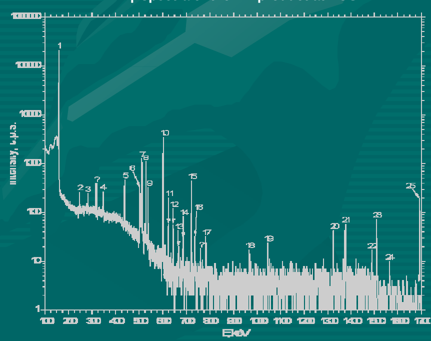


Terimo - scheme from the computer screen

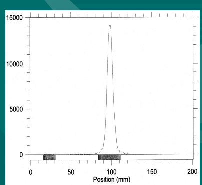
γ-lines of the spectra with their energy and intensity

Peak	Nuclide	E, keV	Intensity, %	Peak	Nuclide	E, keV	Intensity, %
1	^{123}I	158.97	83.3	14	^{123}I	687.95	0.0267
2	^{123}I	247.96	0.071	15	^{124}I	722.78	10.35
3	^{123}I	281.03	0.079	16	^{123}I	735.78	0.062
4	^{123}I	346.35	0.126	17	^{123}I	783.59	0.059
5	^{123}I	440.02	0.428	18	^{124}I	968.22	0.435
6	^{123}I	505.33	0.316	19	^{124}I	1045.0	0.441
7	^{124}I (annih.)	511.0	46.0	20	^{124}I	1325.50	1.561
8	^{123}I	528.96	1.39	21	^{124}I	1376.0	1.75
9	^{123}I	538.54	0.382	22	^{124}I	1488.9	0.199
10	^{124}I	602.72	62.9	23	^{124}I	1509.49	3.13
11	^{123}I	624.57	0.083	24	^{124}I	1559.8	0.165
12	^{124}I	645.82	0.988	25	^{124}I	1691.02	10.88
13	^{124}I	662.4	0.056				

γ-spectra of the ^{124}I product at EOS



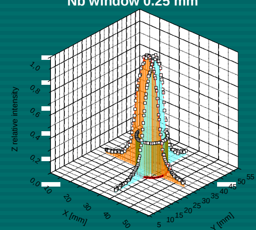
Paper chromatography $^{124}I^-$ *Rf=0.783*

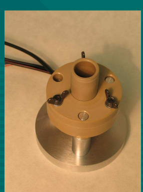


Yield of ^{124}I in the EOB time

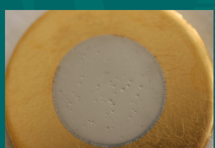
Energy [MeV]	^{124}I Yield EOB [MBq/µAh]	Yield ratio of ^{123}I / ^{124}I
17.7→13.5	4,99	29,2
13.5→10.5	13,9	6,4

Beam profile measured on Al disk; Nb window 0.25 mm

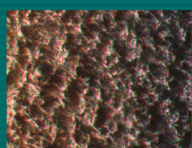




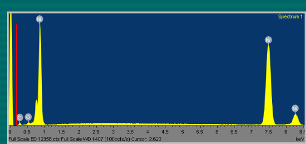
The electrochemical cell



Ni electrodeposited onto gold disk



Ni Surface enlargement ~ 500x



EDX of electrodeposited Ni

The authors are indebted to IAEA Vienna for financial support during realization of TC Project SLR/4/010 Production of the Positron Emitting Radionuclides and the work connected with Cu-64 production was supported by the Slovak Research and Development Agency under the contract No. VMSP-P-0075-09