Developmet of direct flow, rapid separation strategy for isolation of no-carrier added ^{90}Nb from Zr and Mo targets, for application in *immuno*-PET.

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Objectives: ^{90}Nb is a potential PET nuclide ($T_{1/2}$ = 14.6 h and high positron branching 53%). Promising results in labeling and *in vitro* evaluation of ^{90}Nb-labeled monoclonal antibodies confirm expectation about ^{90}Nb as an appropriate isotope for *immuno*-PET. In this work, direct flow separation strategy to isolate ^{90}Nb from Zr or Mo irradiated targets was developed.

Methods: In our previous study [1], we described a two steps procedure for the separation of no-carrier-added niobium from an irradiated zirconium target. A similar procedure for the crude separation from Zr or Mo target was applied.

2 mL of 21M hydrofluoric acid containing the irradiated zirconium target were passed through the cation exchange column (DOWEX 50x8, 200-400 mesh 10x5 mm) resin in F^- form (100 mg, 10x5 mm) for removal of colloids, unsolved target particles and possible trace contamination of 2+ and 3+ charged metal cations, such as for example Cu^{2+} or Fe^{3+} from target holder. The column was additionally washed with concentrated hydrofluoric acid (1 mL). The solution (3 mL) which passed the cation exchange resin was transferred to an anion exchange column (300 mg, 25x5 mm) filled with AG 1x8 (200-400 mesh) resin in F^- form. Nb^V remained on this resin and the bulk amount of Zr^{IV} passed through. The column was washed with concentrated HF (4.5 mL) to elute traces of Zr^{IV}, while ^{90}Nb stays on the column. A small column (100 mg, 10x5 mm) was filled with UTEVA resin. Anion exchange column was connected with UTEVA and 7 mL of 0.3 M oxalic acid/ 7.5 M HCl were passed through the both column.

The UTEVA was next washed with 5 M HCl (5 mL). Traces of zirconium(IV) and molybdenum(VI)passed through the UTEVA, while Nb^V remains absorbed on the column. For elution of ^{90}Nb 0.1 M oxalic acid was applied. The column was washed with 200 µL and Nb eluted with another 400 µL of 0.1 M oxalic acid.

Results: Similar results were obtained for the separation of Mo and Zr targets. Just slightly different procedures for the dissolution were applied.

Developed separation procedure provide separation not just from target material but as well from other no carrier added radionuclides which is produced during the irradiation. No other radionuclides were detected in the final fraction.

The overall separation proceeds with a separation yield 93-95% in final 0.1 M oxalic acid (400 µL). The whole separation procedure takes less than one hour which is almost 4 times faster than the previous separation method [2]. Total decontamination factor was $3 \cdot 10^8$.

Conclusions: Developed direct flow separations expressively simplify automation of separation. Separation yield was varied between 93-95% with decontamination factor of $\geq 10^8$. Separation time doesn't exceed 1 hour including columns preconditioning. Direct flow strategy was applied for two targets material and provides similar separation characteristic. Developed strategy allow separate Nb^V from other nca radionuclides from Ist to VIIth groups of periodic table, such as Rb^I, Sr^{II}, Y^{III}, Zr^{IV}, Mo^{VI} and Tc^{VII}.

Tab. 1 *- Example of radionuclide content for Mo target irradiated at Phasotron facilities with 100 MeV for 30 minutes with 3 µA at EOB*

Radionuclide	Half-life, $T_{1/2}$, h	Activity, MBq, EOB
^{93}Tc	2.7	767
^{95m}Tc	1440	6
^{95g}Tc	20	92
^{96}Tc	103.2	41
^{90}Mo	5.7	423
^{93m}Mo	6.9	179
^{90}Nb	14.6	350
^{92}Nb	243.6	7
^{86}Zr	16.5	100
^{89}Zr	78.4	134
^{86}Y	14.6	209
^{87g}Y	80.3	45
^{87m}Y	3	449

Finally developed direct flow separation strategy provide source of ^{90}Nb with appropriate purity and in appropriate conditions for following medical application.

Acknowledgments: The authors thank the teams of TRIGA reactor Mainz for the production of ^{97}Zr the research reactor BRII at Helmholtz Centrum Berlin, Germany for production of ^{95}Zr.

Many thanks for the teams of Phasotron operators at JINR for for irradiation of Mo and Zr targets.

Specially thanks to Dr. Happel for providing of UTEVA resin.

References

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Acknowledgements

The works was supported by the DFG grant RO 985/34-1 and by Internal grant University of Mainz.