User project report

The FIAPo project: Feasibility of increased ^{211}At production by ^{210}Po assessment.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101008571 (PRISMAP). This document reflects only the view of the author(s). The Agency is not responsible for any use that may be made of the information it contains.

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2. Context of the project (800 characters max. including spaces)

A limitation to the availability of ^{211}At via ^{209}Bi(α,2n) is the restriction of the incident α-beam energy during production to avoid the co-production of ^{210}At which decays predominantly to ^{210}Po. However, recent data measured a significant increase in ^{211}At activity at increased beam energy, highlighting the need for an optimised approach and stressing the importance of studying the radiochemical separation during target processing and impact of ^{210}At/^{210}Po on dosimetry. The current projected investigated the radiochemical separation capabilities of solid phase extraction using 3-octanone impregnated resin technology.

3. Results and discussion (1000 characters max. including spaces)

Figure 1 illustrates the dissolution (decay corrected) yields: > 84% and >90% were observed for ^{211}At and ^{210}At respectively.

Encouraging extraction yields decay corrected (>80%) were achieved and the obtained (Figure 2) results are similar to the results obtained by McIntosh et al., 2023. This method could potentially open the access to ^{211}At with minimal investment.

Figure 3 shows the activity balance of ^{210}Po at maximal ingrowth (70.2h post collection) during extraction chromatography. It is observed that the majority (80-90%) of formed ^{210}Po the moment before executing extraction chromatography is collected in the first fraction. ^{210}Po is still present in the following fractions and steadily decreases during the rinsing and flushing step. A larger fraction of ^{210}Po is noted in the EtOH as a sole result of extracted ^{210}At.

Radiochemical separation of ^{211}At by extraction chromatography allows in the current setup maximal separation of ^{210}Po and ^{211}At while maintaining a good extraction profile.

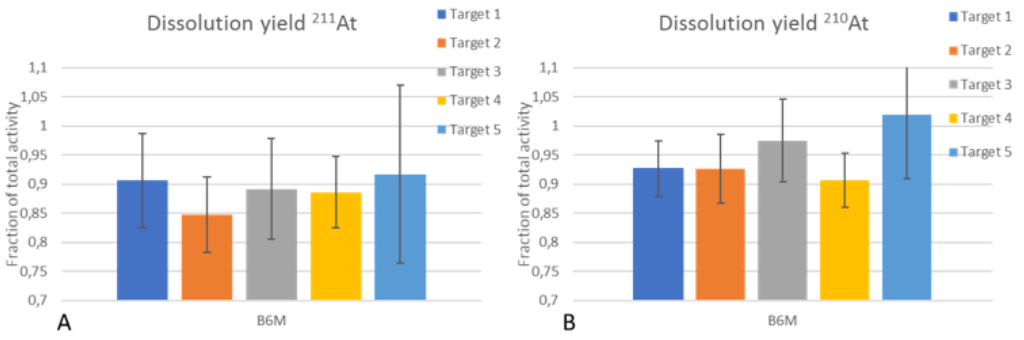

Figure 1: Decay corrected dissolution yields for 211At (A) and 210At (B) relative to the activity on the target

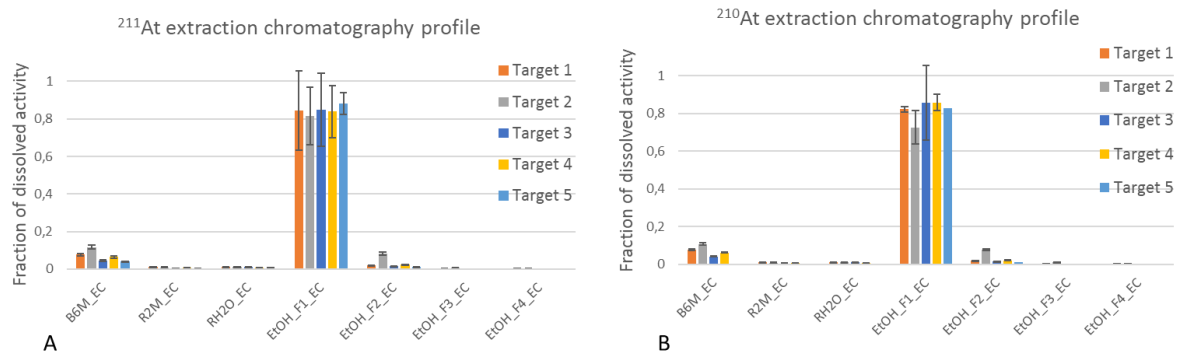

Figure 2: Decay corrected extraction chromatography profiles for ^{211}At (A) and ^{210}At (B) relative to the activity in the dissolved target

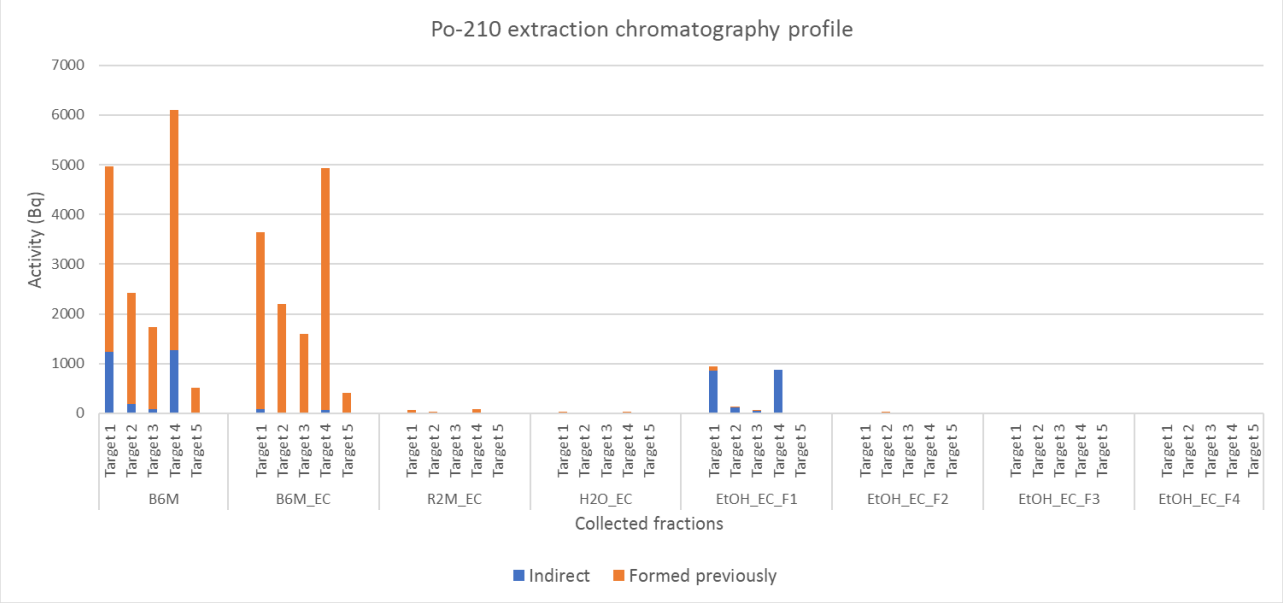

Figure 3: ^{210}Po extraction chromatography profile for the different targets 1-5 with 'formed previously' (formed ^{210}Po before each step) and indirect (^{210}Po formed in the respective vial due to the presence of ^{210}At)

4. Conclusions (800 characters max. including spaces)

Radiochemical separation of astatine by extraction chromatography was first reported by Burns et al., 2021. We confirm that extraction chromatography is a promising and easy hands-on tool for radiochemical separation of ^{211}At. With an optimized setup encouraging extraction yields can be obtained within a reasonable time. This work has also shown the effective separation of ^{210}Po from ^{210}At/^{211}At. On-site removal of the formed impurities until the performance of radiochemical separation will prove to be an asset for laboratories and future clinical trials working with ^{211}At not only for the patient but also for the staff and the environment by safely containing ^{210}Po.

Next steps include studying the impact of ^{210}At/^{210}Po on the biodistribution and the dosimetry by administering ^{210}At/^{211}At labelled sdAbs to tumour bearing mice.

5. Involvement of the PRISMAP services (600 characters max. including spaces)

PRISMAP has proven to be a reliable and promising network to acquire radionuclides not easily accessible. The shipment of the targets allowed the current project to be carried out in a successful manner effectively contributing to the state-of-the-art knowledge resulting in a paper, currently under review.

6. Feedback to PRISMAP (600 characters max. including spaces)

The total amount of activity per shipment was not clearly defined at the start which resulted in an adaptation of the schedule.

7. Publications and other dissemination activities (conferences etc.)

Conferences:

- Currently submitted in EANM for October 2024: **Optimized ^{211}At production: a study to unravel the impact of the ^{210}At-contaminant.**

Paper:

- Currently under revision at Radiation physics and chemistry: **Optimised cyclotron production of astatine: activity balance of ^{211}At, ^{210}At and ^{210}Po after extraction chromatography**

Appendix 1. Dissemination guidelines for user projects as agreed in the signed User Agreement

Dissemination rules

Only user groups that are allowed to disseminate the results which they have generated under the project may benefit from the access, unless they are working for SMEs.

For each user group project, a publishable project summary and a publishable summary of the results will be published on the European Union Horizon 2020 PRISMAP project website www.prismap.eu. The publication of results in journals or at conferences is strongly encouraged.

To ensure the long-term sustainability of the PRISMAP initiative, proper recognition of the contributing facilities, their services and the involved persons is necessary. All participating PRISMAP facilities shall be acknowledged in the publication. Acknowledgement and co-authorship of PRISMAP staff members who participated in the experiment shall be considered according to the research field best practices and verified with the PRISMAP Technical Manager before any publication.

The user group shall contact the PRISMAP Technical Manager 30 days prior to submission of publications or other communications of results that were obtained by making use of services provided by PRISMAP (radionuclides delivered or medical services provided). The Technical Manager will communicate to the user group the list of PRISMAP facilities and persons that have contributed to each specific project and the way this contribution must be acknowledged in the publication/communication or where co-authorship is required to reflect specific scientific contributions.

Users must comply with Horizon 2020 dissemination rules (i.e. acknowledge that their work was financially supported by the European Union's Horizon 2020 Research and Innovation Programme by including the following acknowledgement: "This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101008571 (PRISMAP)"), and grant open access to resulting publications and related data.

Dissemination shall take place only once legitimate interests regarding intellectual property have been safeguarded. A maximum publication delay of 90 days may be granted for this purpose.

Acknowledgements

The list of name(s) to be mentioned in the acknowledgment section is sent to the technical manager by the main contact of the involved facilities.

A general sentence will be added by the corresponding author of the article (user side):

“The authors would like to thank the members of the PRISMAP consortium and of the PRISMAP user selection panel, coordination and management team for their advice and support.”

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