DEVELOPMENT AND INTEGRATION OF AUTOMATED SYSTEMS FOR THE REMOTE PRODUCTION OF ASTATINE-211

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Astatine-211 (^{211}At) is a promising α-emitting isotope that is being evaluated for use in the treatment of blood-borne cancers, such as lymphoma, as well as micrometastatic disease. The combination of its short half-life (7.2 h), highly energetic α-emissions (5.87 MeV (^{211}At, 41.8%) and 7.45 MeV (^{211}Po, 58.2%)), and stable antibody labeling chemistries assure a promising future for this isotope.

The University of Washington (UW) is one of only a few U.S. institutions that are capable of routine accelerator-based production of ^{211}At. The UW Scanditronix MC-50 cyclotron utilizes an α-particle beam to bombard high-purity Bi metal (naturally monoisotopic) to form ^{211}At via the ^{209}Bi(α,*2n*)^{211}At reaction. The UW team has developed a multi-step wet chemical purification process [1] to supply ^{211}At for radiolabeling and oncological research. The process is based on the early solvent extraction studies of Neumann [2], wherein ^{211}At is efficiently extracted from 8 M HCl into diisopropyl ether (DIPE), washed with 8 M HCl, and finally back-extracted into NaOH. The UW ^{211}At isolation process, from target dissolution to final isotope purification, is performed manually in a glovebox.

PNNL is collaborating with UW to streamline the ^{211}At production process through the development of automated modules that can replicate the current manual isolation steps. This includes a flow-based Bi target dissolution cell, remotely controlled thermal system to distill away the HNO_3 used to dissolve the target and bring the Bi salts up in HCl acid, and a fluidic system to automate the liquid/liquid extraction process. The ultimate objective is to have a fully automated process replace the manual handling steps. This will ultimately facilitate the preparation of more numerous and higher activity targets, as the use of this isotope for oncological research and therapy is anticipated to grow in the coming years. Details of the existing method and current developments in the automated modules will be presented.

1. Balkin, E.R., D.K. Hamlin, et al., "Evaluation of a Wet Chemistry Method for Isolation of Cyclotron Produced [211At]Astatine". *Applied Sciences*, 2013. **3**(3): p. 636-655.
2. Neumann, H.M., "Solvent distribution studies of the chemistry of astatine". *Journal of Inorganic and Nuclear Chemistry*, 1957. **4**(5–6): p. 349-353.