1) Ion exchange separations for the preparation of medical isotopes

Project 1 is part of a collaboration with the Idaho Accelerator Center to develop electron linear accelerator sources of medical isotopes. Medical imaging frequently uses technetium-99m which is produced by the decay of molybdenum-99:

\[ ^{99}\text{Mo} \rightarrow ^{99\text{m}}\text{Tc} + \gamma \]

Molybdenum-99 is currently produced by separation from a mixture of nuclear fission products. The reactors which are used for this process are aging which puts future supply in jeopardy. New methods of producing molybdenum-99 or alternative radionuclides are therefore needed.

The current focus of the product is the production of copper-67 via a photonuclear reaction in zinc:

\[ ^{68}\text{Zn} + \gamma \rightarrow ^{67}\text{Cu} + 1p \]

This isotope decays by β emission with an average particle energy of 141 keV and also emits γ photons of energies 93 keV and 184 keV. These two characteristics make copper-67 suitable for simultaneous imaging and radioimmunotherapy which is a very desirable combination.

Our part of this project is the chemical separation of the copper-67 from the zinc target material. This is accomplished using an anion exchange resin under hydrochloric acid conditions where it is very selective for zinc and a chelating ion exchange resin under conditions where it is selective for copper.

The key criteria for a successful separation are specific activity, purity, and total yield. Specific activity is the ratio of the activity of the target isotope to the total mass of all isotopes of that element, usually in kCi/g. The purity refers to the absence of other elements, in this case primarily zinc. Total yield is the amount of the target isotope produced.

Future work will include developing other separations for radionuclides which are suitable for medical imaging, radioimmunotherapy, or both.