^{68}Ga Generator

AN-1613-10

Summary of Method ^{68}Ga is a positron emitting radionuclide which has garnered interest for use in positron emission tomography (PET). ^{68}Ga ($t_{1/2}$ = 68 min) can be readily isolated from its parent ^{68}Ge ($t_{1/2}$ = 271 days), which is produced by cyclotron irradiation of gallium or zinc target material. Classic ^{68}Ga generators consist of ^{68}Ge adsorbed onto an inorganic exchanger, such as Al_2O_3, SnO_2 or TiO_2. The ^{68}Ga is then periodically eluted with 0.1-1.0M HCl or dilute EDTA. These generators are simple and robust, yielding 60-80% of ^{68}Ga with minimal ^{68}Ge breakthrough over many elutions. However, the classic generator can be limited by the relatively large volume of solution needed to elute the ^{68}Ga and by metal ion impurities arising from the inorganic substrate. An alternative generator system has been developed, in which the ^{68}Ge source material is stored in dilute HCl. ^{68}Ga is then selectively retained on cation exchange resin, while the ^{68}Ge is remains in solution for future use. A small amount of rinsing of the cation exchange column, completes the ^{68}Ge source recovery. ^{68}Ga is then stripped from the cation exchange resin using a small volume of 4M HCl and adsorbed on a second cartridge of UTEVA resin. A small volume of rinse with 4M HCl provides additional decontamination from ^{68}Ge, and ^{68}Ga is recovered in a small volume of dilute HCl (0.05-0.5M HCl). The chemistry is robust and scalable. The separation has been demonstrated using 0.5 - 2mL columns/cartridges. Typical decay corrected yields of ^{68}Ga are 95 $\pm$ 1% in 2-5mL of 0.1M HCl, with <10^{-7}% ^{68}Ge impurity. Stable metal ion impurities are typically in the low parts per billion range. Operation of the generator has also been demonstrated with the Northstar Medical Radioistope automated generator system.

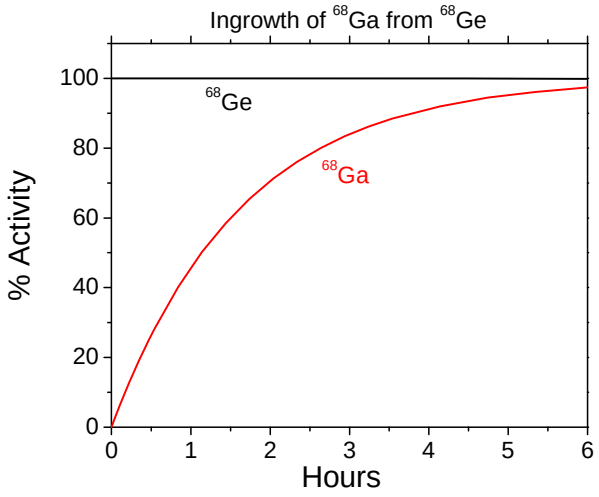
Reagents

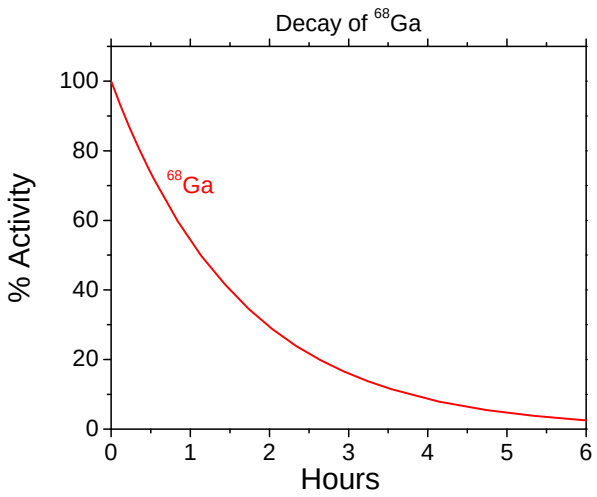
UTEVA Resin Cartridges (Eichrom UT-R50-S)
Cation Exchange 2mL Cartridges (Eichrom C8-R50-H)
^{68}Ge Source* Deionized Water
HCl

*Germanium chloride is relatively volatile and can be spread through the air. Care should be taken to minimize contamination of personnel and work spaces. Use of sealed systems for steps during separation is recommended.

Equipment

Glass vials for storage of ^{68}Ge source.
Glass or plastic vials/bottles for collection ^{68}Ga product and waste.
5, 10 or 20mL plastic luer lock syringes
Gamma spectroscopy system for measurement of ^{68}Ga. (The electron capture of ^{68}Ge can be measured by liquid scintillation or ^{68}Ge can be determined after decay/ ingrowth of ^{68}Ga using the 511keV emission following positron annihilation.)





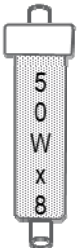
^{68}Ga/^{68}Ge Separation*

(1) Clean 2mL 50Wx8 cartridge with:

-20mL DI water

-20mL 4M HCl

-20mL 0.5M HCl



(2) Load ^{68}Ge/^{68}Ga source in 10-20mL 0.5M HCl. ^{68}Ga is retained.

(3) Rinse cartridge with 1mL 0.5M HCl. Collect in ^{68}Ge source vessel. Push remaining fluid to source vessel with air.

(4) Seal ^{68}Ge source vessel and set aside for future use.

(5) Rinse cartridge with 20mL 0.5M HCl. Dispose as waste.

(6) Precondition 2mL UTEVA cartridge with 5mL 4M HCl.

(7) Place 2mL UTEVA cartridge below 2mL 50Wx8 cartridge.

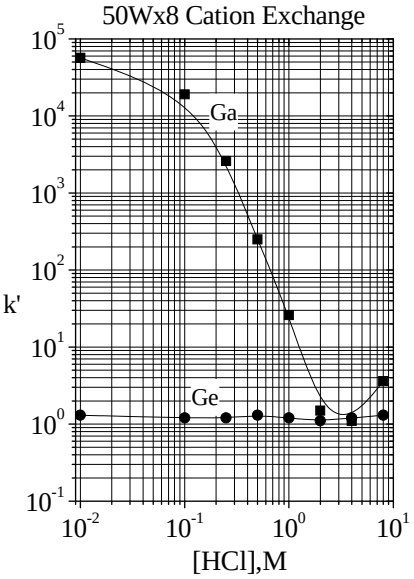
(8) Strip ^{68}Ga from 50Wx8 onto UTEVA with 20mL 4M HCl. Dispose of eluate as waste.

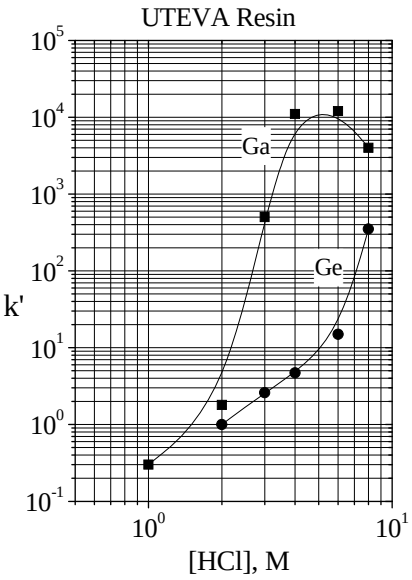
(9) Remove 50Wx8 cartridge.

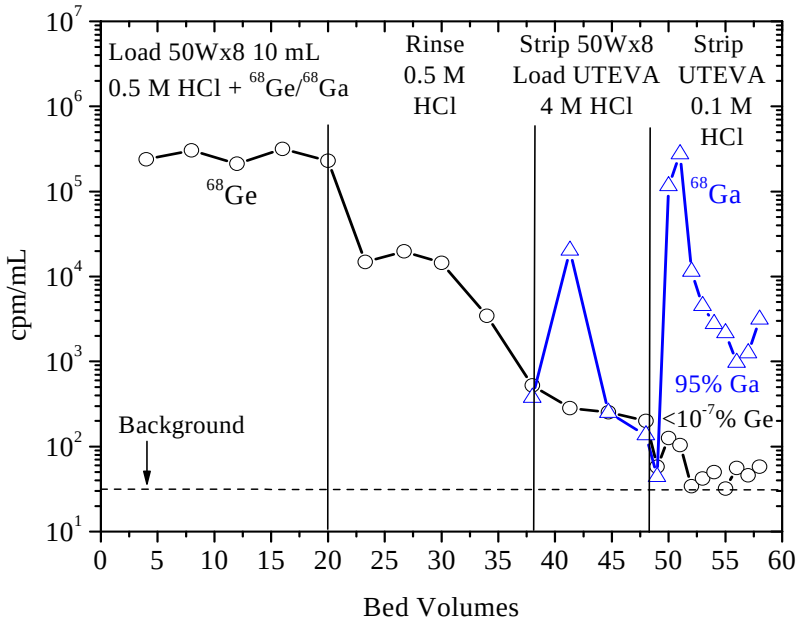
(10) Rinse UTEVA cartridge with 20mL 4M HCl.

(11) Strip ^{68}Ga with 5-10mL 0.1M HCl.

*The separation may also be performed using 0.5mL or 1mL columns/ cartridges and proportionally scaled eluate volumes to improve method speed and reduce losses from ^{68}Ga decay during separation.







References

1) McAlister and Horwitz, "Automated Two Column Generator Systems for Medical Radionuclides," *Applied Radiation and Isotopes*, 67:1985-1991 (2009).