^{225}Ac/^{225}Ra Generator

AN-1614-11

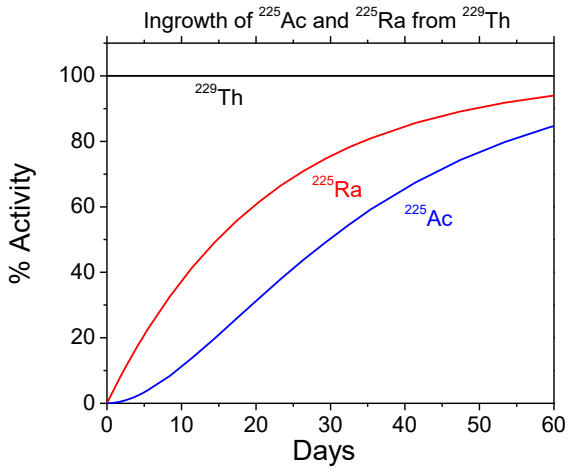
Summary of Method A method for the preparation of ^{225}Ac ($t_{1/2}$ = 10 days) and ^{225}Ra ($t_{1/2}$ = 14.8 days) from ^{229}Th ($t_{1/2}$ = 7340 years) source material is presented. The method employs 2mL cartridges of UTEVA and DGA resins to obtain high purity ^{225}Ac in small volumes of eluate while preserving valuable ^{229}Th source material. The method is meant for ^{225}Ac tracer production from ^{229}Th containing 5-10mg or less of total Th. For separations from larger masses of Th see the Eichrom website bibliography for other options (Recent Advances in the Recovery and Purification of Actinium Isotopes, Horwitz and McAlister, National Meeting of the American Chemical Society, 2009). The source material, containing ^{229}Th, ^{225}Ac, ^{225}Ra and other daughter nuclides in 4M HNO_3, is loaded onto stacked 2mL cartridges of UTEVA and DGA resins. ^{229}Th is retained on UTEVA, while ^{225}Ac is retained on DGA and ^{225}Ra passes through both cartridges. ^{225}Ra can be saved for use as a radiotracer or as an additional source of ^{225}Ac, following a suitable ingrowth period. ^{225}Ac is recovered from DGA with a small volume of 2.0M HCl. The ^{229}Th source is recovered from UTEVA with a small volume of 0.5M HCl. Following a suitable ingrowth period, the ^{229}Th can be acidified to 4M HNO_3 and used to produce additional ^{225}Ac and ^{225}Ra. The ^{229}Th is preserved nearly indefinitely and continuously purified from chemical and radiologic impurities run to run.

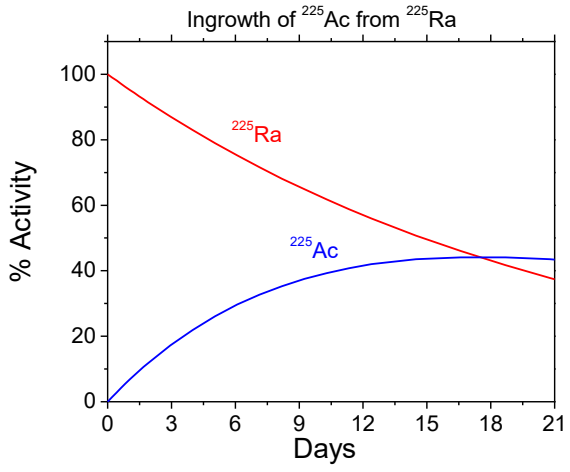
Reagents

UTEVA Resin Cartridges (Eichrom UT-R50-S)
DGA Resin Cartridges (Eichrom DN-R50-S)
^{229}Th Source
Deionized Water
HCl
HNO_3

Equipment

Glass vials for storage of ^{229}Th source.
Glass or plastic vials/bottles for collection of ^{225}Ac. ^{225}Ra and waste.
5, 10 or 20mL plastic luer lock syringes
Gamma spectrometry system and/or alpha spectrometry for measurement of ^{225}Ac(^{221}Fr), ^{225}Ra and ^{229}Th.





$^{225}Ac/^{225}Ra/^{229}Th$ Separation

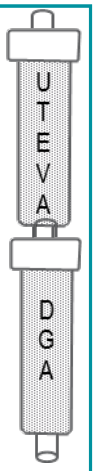
(1) Precondition stacked 2mL cartridges of UTEVA and DGA with 10mL 4M HNO_3.

(2) Acidify ^{229}Th eluate from previous separation with 5mL HNO_3. (If new ^{229}Th source, dilute to 20mL with 4M HNO_3.)

(3) Load ^{229}Th and daughters in 20mL 4M HNO_3. Collect and save eluate containing ^{225}Ra.*

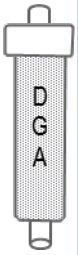
(4) Rinse UTEVA/DGA with 10mL 4M HNO_3. Collect ^{225}Ra.*

(5) Separate UTEVA and DGA cartridges.



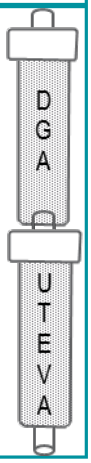
(6) Rinse DGA with 10mL 8M HCl.

(7) Strip ^{225}Ac with 10mL 2M HCl. (Traces of ^{229}Th that may have broken through UTEVA will be retained on DGA.)

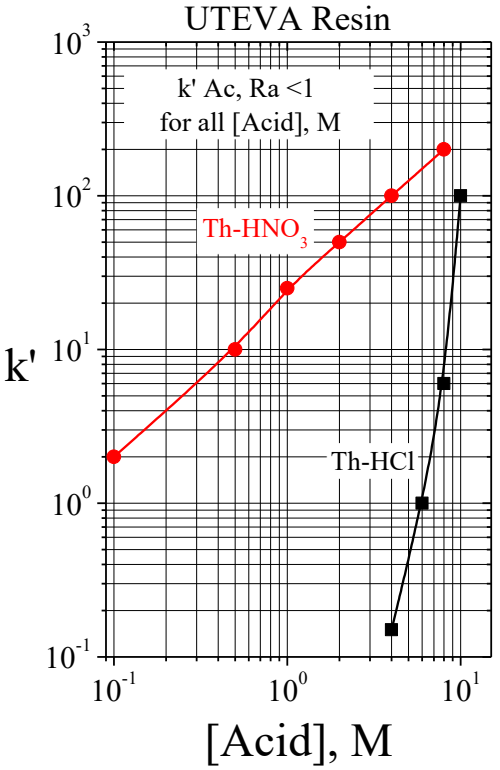


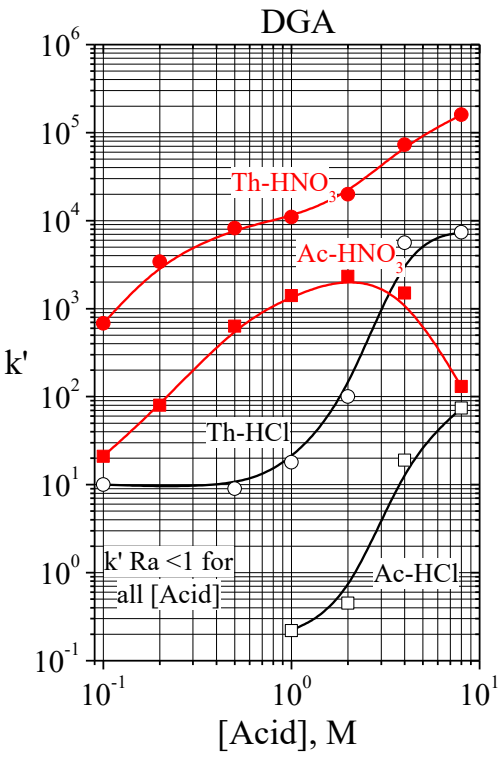
(8) Place DGA (from which ^{225}Ac has been stripped) above the UTEVA cartridge.

(9) Strip ^{229}Th from DGA-UTEVA cartridges with 15mL 0.5M HCl. Save ^{229}Th for future use.



*^{225}Ra can used directly as a tracer or as a source of additional ^{225}Ra.





References

1) McAlister and Horwitz, "Chromatographic Generator Systems for the actinides and natural decay series elements," *Radiochimica Acta*, 99:1-9 (2011).