$^{227}Th/^{223}Ra$ Generator

AN-1617-10

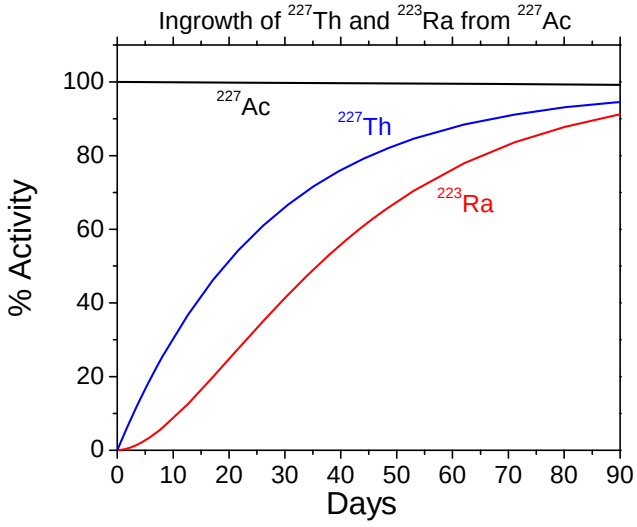
Summary of Method A method for the preparation of ^{227}Th ($t_{1/2}$ = 18.72 days) and ^{223}Ra ($t_{1/2}$ = 11.43 days) from ^{227}Ac ($t_{1/2}$ = 21.77 years) source material is presented. The method employs 2mL cartridges of UTEVA and DGA resins to obtain high purity ^{227}Th and ^{223}Ra in small volumes of eluate while preserving valuable ^{227}Ac source material. The source material, containing $^{227}Ac/^{227}Th/^{223}Ra$ in 4M HNO_3, is loaded onto stacked 2mL cartridges of UTEVA and DGA resins. ^{227}Th is retained on UTEVA Resin, while ^{227}Ac is retained on DGA Resin and ^{223}Ra is not retained. The ^{227}Ac source is recovered from DGA Resin with a small volume of 0.1M HCl. Following a suitable ingrowth period, the ^{227}Ac can be acidified to 4M HNO_3 and used to produce additional ^{227}Th and ^{223}Ra. The ^{227}Ac is preserved nearly indefinitely and continuously purified from chemical and radiologic impurities run to run. ^{227}Th is recovered from UTEVA resin with 0.5M HCl.

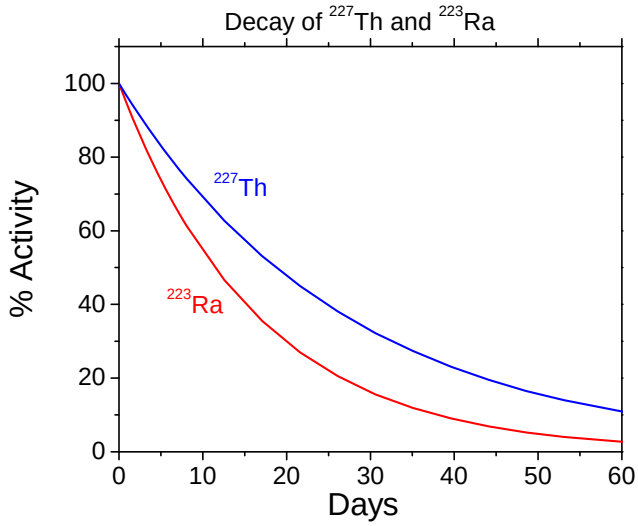
Reagents

UTEVA Cartridges (Eichrom UT-R50-S)
DGA, Normal Cartridges (Eichrom DN-R50-S)
^{227}Ac Source
Deionized Water
HCl
HNO_3

Equipment

Glass vials for storage of ^{227}Ac source.
Glass or plastic vials/bottles for collection of ^{223}Ra, ^{227}Th and waste.
10, 20 or 30mL plastic luer lock syringes
Gamma Spectrometry System for measurement of ^{227}Th and ^{223}Ra.





$^{223}Ra/^{227}Th/^{227}Ac$ Separation

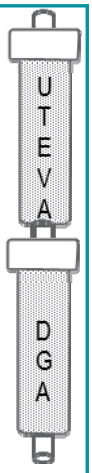
(1) Precondition stacked 2mL cartridges of UTEVA and DGA Resins with 10mL 4M HNO_3.

(2) Acidify ^{227}Ac eluate from previous separation with 5mL conc. HNO_3. (If new ^{227}Ac source, dilute to 20mL with 4M HNO_3.)

(3) Load $^{227}Ac/^{227}Th/^{223}Ra$ in 20mL 4M HNO_3. Collect ^{223}Ra.

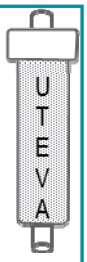
(4) Rinse UTEVA/DGA with 10mL 3M HNO_3. Collect ^{223}Ra.

(5) Separate UTEVA/DGA.

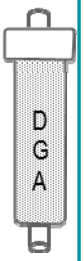


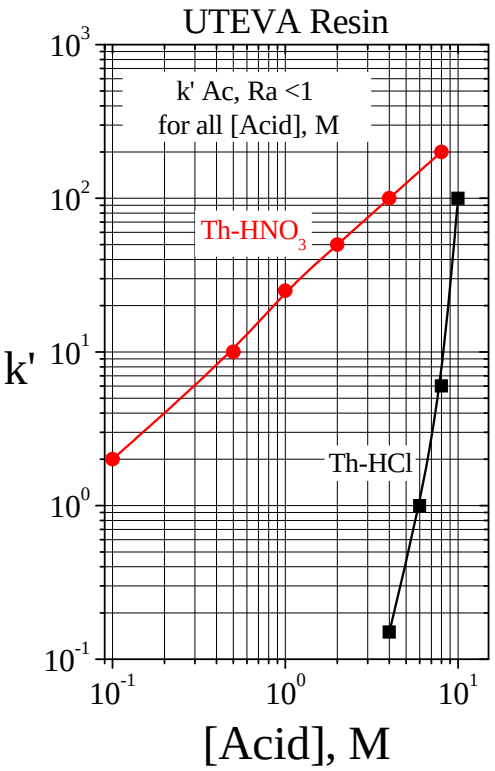
(6) Rinse UTEVA with 10mL 4M HNO_3. Discard as waste.

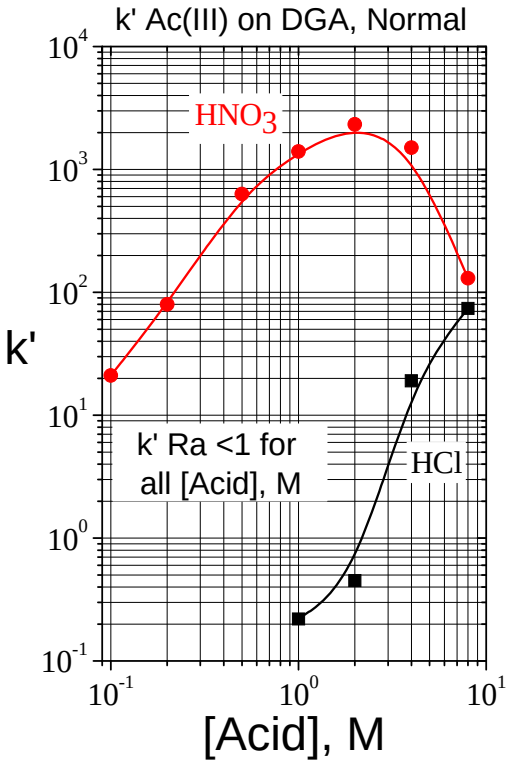
(7) Strip ^{227}Th from UTEVA with 10mL 0.5M HCl. ^{227}Th may be recovered in higher yield in less volume by stripping in opposite direction of load.



(8) Strip ^{227}Ac from DGA with 15mL 0.5M HCl. Save ^{227}Ac for future use.







References

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