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Selective Separation of Radium and Actinium from Bulk Thorium Target Material

A complete scheme for the selective separation of actinium and radium isotopes from bulk 232Th target material will be presented. The process may be applicable to the production of 225Ac and 227Ac via proton spallation on thorium targets. Thorium metal is dissolved in sulfuric acid with small amounts of HF. Actinium and radium are retained on cation exchange resin from the sulfate medium, while neutral and anionic thorium sulfate complexes are rejected. Targeting the minor components (Ac,Ra) allows use of much smaller chromatographic columns than traditional nitrate based systems which target the bulk thorium. Additionally, the primary separation is performed from 0.1M Th, 0.6M sulfate, pH 1-2 instead of the more corrosive 3-8M HNO3 typically employed in solvent extraction or anion exchange based thorium separations.
Actinium and radium are recovered from the cation exchange resin in a small volume of 5M HNO3 and directly purified via extraction chromatography with UTEVA and DGA resins without feed adjustment or evaporation. The radium fraction can be further processed following ingrowth of 225Ac from 225Ra to produce additional 225Ac free from any potential 227Ac impurity. The flowsheet has been tested at the Canadian Nuclear Laboratory (CNL) on 25 gram solid thorium targets irradiated at Fermi Lab.

Bond, A.H., Horwitz, E.P., McAlister, D.R., 2006. A Multicolumn Selectivity Inversion Generator for the Production of High Purity Actinium-225 for Use in Therapeutic Nuclear Medicine, United States patent number 7,087,206. (Licensed to NorthStar Medical Radioisotopes)
D.R. McAlister, E.P. Horwitz, "Selective Separation of Radium and Actinium from Bulk Thorium Target Material on Strong Acid Cation Exchange Resin from Sulfate Media,"Applied Radiation and Isotopes, 140, 18-23 (2018).

Email Address

dmcalister@eichrom.com

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Primary author: MCALISTER, Daniel (Eichrom TEchnologies, LLC/PG Research Foundation, Inc.)

Co-authors: GENDRON, Denise (Canadian Nuclear Laboratory); HORWITZ, E. Philip (Eichrom Technologies, LLC/PG Research Foundation, Inc.); HARVEY, James T. (NorthStar Medical Radioisotopes); CAUSEY, Patrick (Canadian Nuclear Laboratory); PERRON, Randy (Canadian Nuclear Laboratory)

Presenter: MCALISTER, Daniel (Eichrom TEchnologies, LLC/PG Research Foundation, Inc.)