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Automation and investigation of scandium separation from ionic contaminants using ion-exchange chromatography and electrochemical methods

Scandium radioisotopes can be used to perform diagnostics (positron emission tomography and single-photon emission computer tomography) and therapy on patients (theranostics) due to low toxicity, short half-lives, and stable decay products. 43, 44Sc, and 47Sc can be produced from elements such as Ca, V, and Ti by proton, neutron, and gamma irradiation.
The CERN-MEDICIS facility uses target materials irradiated at ISOLDE with the 1.4 GeV proton beam delivered by the CERN Proton Synchrotron Booster, and subsequently proceed to the offline mass-separation of the produced mixture of radionuclides. Mass-separated isotopes which are collected on Al or Zn coated Au foils (alternatively –NaCl or KNO3-coated Al) still contain isobaric contaminants that must be separated by chemical methods.
In this study, the update of methods and results of scandium (stable and radioactive) separation from contaminants are reported including a novel method of removing impurities by aqueous electrolysis of Sc/impurity mixtures. Sample investigation has been conducted with ICP-MS PLASMAQUANT, XRF ThermoScientific Niton XL3t, and SEM-FIB Zeiss XB 540. Current, voltage, and temperature registration was carried out using Keithly 2000 multimeters. Radiation measurements were conducted with Canberra Cryo-Pulse 5 plus GX4020 gamma spectroscope and radiameter ThermoScientific FH 40G-L10.
A proposed schematic for an automized system is shown as well as tests for a semi-automated system have been successfully completed. The electrochemical separation method shows application in contaminant removal (in aqueous media). 47Sc separation recoverability (from NaCl coated Al) using ion-exchange DGA resin shows 81.4 ± 13.2 % for the 3 mm Diba Omnifit Benchmark Microbore column and 75.9 ± 11.8 % for the 5 mm Diba Omnifit EZ adjustable end-piece column. The actual radiochemical recoverability is estimated to be upwards of ˜ 99.9 %.

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Poster

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