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Solvent extraction studies for the separation of radioarsenic, radiogermanium and radiogallium

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Solvent extraction techniques were developed to separate As-72 from bulk amounts of proton-irradiated germanium dioxide targets, Ge-68 from proton-irradiated gallium(III) oxide targets and Ga-68 from parent Ge-68. Several methods have been reported to isolate arsenic radionuclides from irradiated Ge and germanium dioxide targets [1,2]. In this work the germanium dioxide target, irradiated with 17 MeV protons, was dissolved in either HCl or KOH. Then the ratio of As(III) to As(V) was determined via thin layer chromatography using Si-60 phase plate as a stationary phase and a mixture of sodium bitartrate/methanol in the ratio of 3:1 as the mobile phase. Our separation method utilizes the observation that arsenic (III) can be extracted selectively and quantitatively by cyclohexane from hydrochloric acid solution containing alkali iodide [1]. The influence of concentrations of different acids and of KI as well as the effect of various organic solvents was investigated. Optimally, the extraction of As(III) into cyclohexane occurred with 4.75 M HCl and 0.5 M KI, and its back-extraction into the aqueous phase with water containing 0.1 % hydrogen peroxide. The overall radiochemical yield of the radioarsenic separation was about 95±2 %. The method was used in the separation of high purity As-72, a potentially useful positron emitter, formed via the Ge-72 (p,n)-reaction.
An optimised method of separation of the radionuclide Ge-69, used as a tracer in gallium /germanium separation studies, was worked out. The gallium (III) oxide target, irradiated with 17 MeV protons, was dissolved in 8 M sulphuric acid and used as a stock solution. To an aliquot HCl was added and its concentration adjusted to 0.4 M in order to transfer germanium to the chloride form. With this the extraction of radiogermanium using toluene was then studied at varying concentrations of H2SO4. From a solution of 8 M sulphuric acid and 0.4 M HCl the extraction was maximum. Using the optimised separation, the radionuclide Ge-68, formed via the Ga-69 (p,2n)-reaction, was separated from a gallium (III) oxide target irradiated with 45 MeV protons. Further on, the separation of Ga-68 from the parent Ge-68 was investigated. The method is based on anion exchange solvent extraction using Aliquat 336 in xylene from hydrochloric acid [3]. Aliquat 336 in xylene has been used for the first time for separations involving radiogallium and radiogermanium. Optimisation studies were related to the influence of HCl concentration and different solvents. The solvent extraction using Aliquat 336 in xylene led to a high separation yield of 68Ga from its parent Ge-68. The time of separation was short with about 20 min, the contamination from Ge-68 was less than 0.1 % and the final product was obtained in 0.5 M KOH.

References

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