Contribution ID: **1745** Type: **Oral**

The application of the chromatographic model for the isolation of heavy actinides, produced in reactions with heavy ions

Monday 28 October 2024 15:20 (15 minutes)

The only way to produce transfermium elements for their study is the accelerator production method in particular multinucleon transfer nuclear reactions with heavy ions1. Neutron-rich isotopes of these elements can be synthesized as a mix of reaction products with predicted half-lives from 1 min to 1 day. Such nuclear physical properties and very similar chemical properties of heavy actinides limit a number of separation methods. A method that meets all the requirements is cation exchange chromatography in α-hydroxyisobutyrate ammonia (α-HIB)2.
We developed the semi-empirical model of predicting the chromatographic parameters, elution and position of actinides peaks on the chromatogram. The validation of the model was performed in application of high-pressure liquid chromatography to separation of Cf and Fm from irradiated uranium target. In this work we irradiated thin 238U target with 1150 MeV Xe ions with an aver-age intensity of 20 nA for 48-72 hours at the U-400 accelerator (FLNR). After cooling for 1 hour, we dissolved U target to make a separation. Radiochemical separation procedure was performed in two steps. Separation of target material, neptunium and plutonium using UTEVA resin followed by cation exchange separation of Cf and Fm fractions with α-HIB. The later followed by prepara-tion of spectrometric sources by LaF3 co-precipitation method. The optimal amount of carrier and the thickness of the spectrometric sources were calculated with the SRIM program taking into account energy losses. Using this approach an energy resolution of 70 keV was achieved. Final samples were analyzed with gamma- and alpha-spectrometry to search isotopes of Cf and Fm, estimate the yield and the cross section.

References
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Primary author: БОДРОВ, Александр (ОИЯИ)

Co-authors: Mr SHAHOV, Aleksei (FLNR JINR); Mr GOLTSMAN, Andrei (JINR); BOZHIKOV, Gospodin (FLNR, JINR); AKSENOV, Nikolay (FLNR, JINR); Dr LUKYANOV, Sergey (FLNR JINR)

Presenter: БОДРОВ, Александр (ОИЯИ)

Session Classification: Applied Research

Track Classification: Applied Research