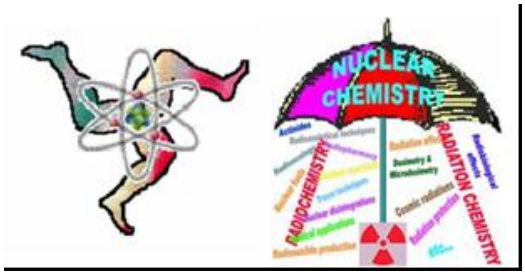

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Detection of ultratrace amounts of Np-237 with resonance ionization mass spectrometry (RIMS)

Thursday, 22 September 2011 11:50 (15 minutes)

Long-lived isotopes of the actinides are the major contributors to the radiotoxicity of spent nuclear fuel after a storage time of 1000 years. Especially Np-237 is considered as a potential hazard to the environment because of its long half-life of 2.14 million years and high mobility in aquatic systems. Since the concentration of Np-237 expected in case of a leakage of a nuclear waste repository is less than 0.1 nM, migration studies require very sensitive methods for the determination of Np-237. Resonance ionization mass spectrometry (RIMS) has proven to be a powerful method for ultratrace analysis of actinides. Therefore, a RIMS method for the detection of Np-237 has been developed by us and will be presented.
In RIMS, an atomic beam of Np-237 is evaporated from a heated filament, and the atoms are ionized with radiation from three tuneable lasers. The wavelengths of the lasers match subsequent optical transitions of the element. The laser ions are detected by a time-of-flight mass spectrometer. Since the involved optical transitions are unique for Np-237, this kind of ionization process is element specific. Thus, mass spectra free of isobaric interferences and with a very low background can be recorded.
Since only few high lying energy levels of Np-237 suitable for excitation and ionization were known, extensive spectroscopic studies were carried out [1]. With the identified energy levels, several three-step excitations schemes have been developed. Currently, an overall detection efficiency for Np-237 of 2E-6 has be obtained by RIMS.

[1] S. Raeder, N. Stöbener, T. Gottwald, G. Passler, T. Reich, N. Trautmann, K. Wendt: Determination of a three-step excitation and ionization scheme for resonance ionization and ultratrace analysis of Np-237, Spectrochim. Acta B, in press,
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