

## ***Recent achievements at the Insitute of Isotopes***

### **1. Analysis for safeguards purposes using inductively coupled plasma mass spectrometry**

#### **1.1. Bulk analysis of U and Pu content and isotope ration in safeguards swipe samples**

The most effective sampling type of the International Safeguards System of the International Atomic Energy Agency (IAEA) is the so-called swipe sample. The Agency regularly takes such samples in the field and sends them to laboratories for detection of any traces of nuclear material. Much information can be obtained from the small amount of material collected in one sample that inspectors swipe on a 10 x 10 cm piece of cotton cloth to detect nuclear signatures which might reveal undeclared activities.

Sample preparation and analytical method have been developed for the determination of plutonium and uranium in ultra-trace amount (pg/g) and precise isotope ratios in environmental safeguards swipe samples using inductively coupled plasma mass spectrometry.

The aim of this study was to develop a more simple, faster, more effective and cheaper sample preparation and analysis method for bulk analysis of environmental swipe samples than the methods used commonly by the IAEA. Using this method the inspection of the Hungarian nuclear facilities is effectively available.

Another aim of the study was to join the Network of Analytical Laboratories of IAEA under the auspices of the Hungarian Atomic Energy Authority. This procedure is in progress.

#### **1.2. Analysis of single particles in safeguards swipe samples**

Beside the bulk analysis of swipe samples the analysis of single particles is a more effective measurement type. The isotopic measurement of single actinide particles was recognized as an indispensable tool to control non-proliferation in nuclear safeguards. As individual particles can be transported outside the nuclear facilities, their isotopic composition is characteristic for the activities and materials used in the facility. Therefore, collection of environmental samples (e.g. swipe samples) and the characterization of radioactive particles are of primary importance to reveal undeclared clandestine nuclear activities.

Particle analysis is more sensitive than bulk analysis because individual particle analysis can yield information on the precise formation of the particle, while bulk analysis averages the particles together. The particle analysis is not often performed at IAEA laboratories because the various analytical techniques available for the isotope ratio analysis of single particles are significantly more difficult, expensive and time consuming.

At the Institute of Isotopes the development of a new analytical method, using inductively coupled plasma mass spectrometry has been started for the determination of single particles originating from environmental safeguards swipe samples using. The method is more effective, faster, and cheaper than the analytical methods used commonly by the IAEA.

During the method development a localization and relocalization step has been developed using optical microscopy, scanning electron microscopy and so-called micromanipulation techniques.

An analytical technique has been developed for precise isotope ratio measurement of 5-10  $\mu\text{m}$  size single particles. Adaptation of the method for analysis of single particles on swipe samples is in progress.