Contribution ID: **52** Type: **Oral**

APPLICATION OF ALPHA-AUTORADIOGRAPHY FOR DETECTION AND IDENTIFICATION OF ALPHA-EMITTING CONTAMINATION IN NUCLEAR FORENSICS EXAMINATION

Introduction

The objects of investigation in nuclear forensics may be represented as soil samples, vegetation, tissue fragments, filter materials, biological samples, everyday objects contaminated with particles of nuclear and other radioactive materials (NRM). The analysis of such objects, during the investigation, first of all, requires the use of non-destructive methods of analysis. Sources of α-radiation located at these objects can have low radioactivity, and it is practically impossible to register them using radiometric equipment. Usually, the carriers of these particles are materials and objects that have a developed relief and low electrical conductivity or have an extended geometry. Because of these features, as well as because of the strong gas release, their microanalysis using devices based on the use of focused electron and ion beams is difficult.

In this regard, for the detection of point sources of α-radiation, an alpha-autoradiographic study may be effective. This method allows not only to localize the sources of alpha radiation but also to draw a preliminary conclusion about their isotopic composition, without affecting the integrity of the research object. This study estimates the informativity of alpha-autoradiography method for analysis of biological samples, tissue fragments, filter materials and soil samples contaminated with NRM particles.

Experimental part

A study had started with a model experiment to obtain the dependence of the geometric parameters of the tracks on the energy of the alpha radiation source. This work describes the process of preparing samples and instruments required before exposure, as well as the process of transferring localized particles to a substrate suitable for instrumental analysis by probe methods.

After 70 days of a track detector exposure over a biological sample, tracks from six point sources of alpha radiation were found (Fig. 1). Geometric parameters of these tracks correspond to alpha-emitting energy of uranium. The presence of uranium was confirmed by Scanning Electron Microscopy with Energy Dispersive X-Ray Analysis (SEM-EDX).

In the soil samples found track clusters correspond to plutonium particles. In this case, the exposure time required to localize plutonium particles is significantly less than that for uranium particles. It is possible to localize a particle of a hundred nanometers within 96 hours and 2 hours will be enough for micron-sized particles (Fig. 2). The image of a plutonium particle (1 μm) is shown in Fig. 3.

Conclusions

As a result of the study of biological samples, tissue fragments, filter materials and soil samples contaminated with NRM particles, a preliminary conclusion about the presence of uranium and plutonium in these particles was made. Moreover, alpha-emitting particles were localized on objects that were not suitable for analysis by probe methods. The high sensitivity of the method allows localizing uranium microparticles of hundreds of nanometers.

Authors: RIABOCHENKO, Mariia (Laboratory for Microparticle Analysis); ZHIZHIN, Kirill (Laboratory for Microparticle Analysis)

Co-author: STEBELKOV, Vladimir (Laboratory for Microparticle Analysis)

Presenter: RIABOCHENKO, Mariia (Laboratory for Microparticle Analysis)

Session Classification: Oral Session #6 –Novel Techniques Applied to Nuclear Forensic Examinations

Track Classification: 1. Nuclear Forensics Capability Building: Initiation and Sustainability: 1.2 New Technologies, R&D and Signature Research in Nuclear Forensics