

ANALYSIS OF BIOLOGICAL SAMPLES CONTAMINATED BY NRM FOR NUCLEAR FORENSICS EXAMINATION

Introduction

Objects of nuclear forensics investigation usually are sources of ionizing radiation (IR), environmental samples from the crime scene and other objects contaminated with nuclear and other radioactive materials (NRM). Nevertheless, people and other living organisms may become witnesses or victims of an incident associated with NRM. In this case, biological samples contaminated with NRM become another type of object for investigation.

Studies related to the analysis of such samples, due to their uniqueness, are rare and not widespread. This paper describes the study of biological samples of various types and origins, contaminated with NRM and their imitators, using a wide range of analytical methods: Image Plate, alpha autoradiography, scanning electron microscopy (SEM).

Experiment

For the analysis of biological samples, first of all, non-destructive and low-destructive methods of analysis are used, since the objects of study contain small amounts of material, often just several microparticles. Probe methods of analysis usually give a large amount of information about the material (morphology, elemental composition, isotopic composition). In most cases, this information is sufficient to answer the questions of the investigation about the nature and origin of the material.

In this work, the objects of study were samples of the internal organs of mice, as well as the lungs of humans and mice. Lungs samples are thin waxed sections transferred on a glass slide or carbon disk. The research has shown that the Image Plate is a fast and non-destructive method for detecting distributed sources (Fig. 1). At the same time, the most effective method for detecting point sources of alpha radiation is alpha autoradiography. Using this method, with a long exposure time, six sources of alpha radiation in the sample were found (Fig. 2). Further, these point sources were investigated by probe methods. A preliminary conclusion about uranium content in the particles was made based on the results obtained by alpha-autoradiography.

Unlike alpha autoradiography, probe methods require preliminary preparation of the sample for analysis. One way to prepare a waxed section of a biological sample is by sputtering a thin gold layer (20-30 nm) on it. After this preparation, particles detected by alpha autoradiography were found and analyzed by probe method. These particles included uranium and oxygen. The particles have a size of about hundreds of nanometers, and they have undefined shapes.

Conclusion

The study of biological samples contaminated with NRM requires an integrated approach using various methods of analysis and sample preparation techniques. The results obtained during the study of biological objects are highly informative for nuclear forensics. Therefore, its study is important not only for answering investigative questions related to the origin of NRM but also for answering questions related to the effect of the discovered material on humans and other living organisms exposed to it.

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Session Classification: Poster Session 4

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