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Laser Spectroscopy, Instrumental Neutron Activation, and Mass Spectrometry Trace Analysis

Among the modern analytical methods, laser spectroscopy, Instrumental Neutron Activation (INAA), and mass spectrometry analysis are the leading techniques for the detection of trace amounts of different isotopes in complex matrices providing the breadth of information about the elemental and isotope composition [1-10]. We report on chemiluminescence of plutonium, uranium, and samarium in solutions excited by laser radiation. The details of multi-step excitation of species and time-resolved detection [1-4,8] of resulting luminescence (Time Resolved Laser Induced Fluorescence –TRLIF) and chemiluminescence (Time Resolved Laser Induced Chemiluminescence –TRLIC) are considered. In the next step, we combine the atomic laser spectroscopy with mass spectrometry detection (Resonance Ionization Mass Spectrometry –RIMS). The high sensitivity has been demonstrated for krypton isotopes (including ^{81}Kr) of radiogenic (nuclear power plants) and cosmogenic (meteorites and other extraterrestrial material) origin [5,6]. Several multi-step RIMS approaches have been extended to uranium and other radioisotopes from solid and liquid samples [7,8]. The development of a suitable excitation/ionisation schemes for both TRLIF/TRLIC and RIMS is of a high priority allowing more complex sample characterisation. We have applied both INAA and Inductively Coupled Plasma Mass Spectrometry (ICP-MS) methods and analysed the elemental composition (64 elements) of bones of dinosaurs, South mammoths, prehistoric bear and archanthropus as well as the samples of surrounding soils; everything collected in different parts of Uzbekistan [9,10]. A high concentration of uranium we detected in the bones of dinosaurs (122 mg/kg), South mammoth (220 mg/kg), prehistoric bear (24 mg/kg) and archanthropus (1.5 mg/kg) compared to surrounding soils (3.7-7.8 mg/kg) and standard bones (<0.01 mg/kg) is a bit of a puzzle [10].

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