Detection of Illicit Uranium Masked by the Presence of Dissimilar Radioactive Material

Identification of unknown radioactive sources is a necessary process. With the heightened level of interest in the prevention of illicit trafficking of radioactive materials, new methods for the detection and characterization are being developed and evaluated. These methods are focused on detection of Uranium in the presence of more active radioisotopes to reduce the probability that an adversary could import fissile Uranium, an improvised nuclear device (IND) or a stolen nuclear weapon masked by a legitimate radioactive material shipment. An experiment was performed to detect the presence of Uranium by gamma spectroscopy utilizing a high purity Germanium (HPGe) radiation detector. A radioactive sample containing Uranium and an unknown radionuclide was placed in close proximity to a HPGe radiation detector with a Beryllium window end cap. An energy spectrum was collected for analysis. Analysis of the gamma peaks in the spectrum indicated that the sample was Ho-166m. None of the traditional photo peaks from Uranium were identified in the spectrum as the Ho-166m peaks overwhelmed the spectral results. By a non-traditional method of characteristic x-ray identification, the presence of Uranium was verified by identifying its characteristic x-ray peaks in the acquired spectrum. The energies of these characteristic x-rays, as listed in the nuclear decay tables, are

94.3 keV, 98.4 keV, 110.4 keV and 114.4 keV. The Uranium gamma peaks could not be seen in the acquired spectrum due to the large difference in specific activity on the order of 6 orders of magnitude between Uranium and Ho-166m, 1.922×10^{-6} Ci/g and 1.8 Ci/g respectively. The presence of Uranium, and other low specific activity radionuclides in the presence of high specific activity isotopes, can be verified through the non-traditional means of characteristic x-ray identification. This method is limited in the fact that the isotope can neither be qualified nor quantified through this method. To determine other artifacts such as enrichment or isotopic makeup more active means, such as sampling or active interrogation, would need to be employed.

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