RADIOACTIVE SAMPLE EFFECTS ON EDXRF SPECTRA

Christopher G. Worley
Los Alamos National Laboratory, MS G740, Los Alamos, NM 87545

Energy dispersive X-ray fluorescence (EDXRF) is a rapid and often straightforward method to determine sample elemental composition. Spectra covering most of the periodic table can be collected in a few minutes or less, and elemental content can be easily determined if there is adequate energy resolution. Pulse pile-up, escape peaks, and sample diffraction effects can complicate spectra when using a Si(Li) detector, but these artifacts can be deciphered by an experienced analyst.

Radioactive samples, however, can introduce artifacts that further complicate spectral interpretation, particularly when using portable instruments where the detector is located in close proximity to the instrument analysis window held against the sample. Gamma rays emitted by a sample are indistinguishable to the detector from X-rays of the same energy, but radioactive sample gamma energies are normally too high to be of concern in EDXRF. However, spectra collected from alpha particle emitters can contain X-ray emission peaks. For example, plutonium-239 EDXRF spectra exhibit a prominent uranium L X-ray emission peak series. When a plutonium-239 atom alpha decays, there is some probability that the uranium-235 daughter nucleus will be left in an excited state that can then transfer its excess energy to an electron through internal conversion.[1] If the electron is then ejected upon absorption of this energy, an X-ray photon or Auger electron will be emitted. Hence, the uranium L X-ray series is emitted due to sample radioactive decay rather than source-induced X-ray fluorescence, and quantifying the uranium based on observed peak intensities can lead to erroneous results.

A portable EDXRF instrument was used to collect spectra from plutonium and other radioactive samples. Examples will be presented and compared with data collected with a WDXRF instrument to demonstrate the differences to which sample radiation-induced X-ray emission affects the detectors on these two types of instruments.

1. D. Reilly, N. Ensslin, and H. Smith, Jr. *Passive Nondestructive Assay of Nuclear Materials*, U.S. Government Printing Office: Washington, D.C., 1991.