

# **QUANTIFICATION OF GALLIUM IN DRIED RESIDUE SAMPLES BY XRF: AN IMPROVED SAMPLE PREPARATION METHOD FOR ANALYZING PLUTONIUM METAL**

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Determining the concentration of gallium and other key elements in plutonium metal is vital for manufacturing nuclear weapons. A novel sample preparation method was developed to accurately quantify the concentration of gallium and ultimately other elements in plutonium metal using wavelength-dispersive X-ray fluorescence (XRF).

The established method currently used to prepare plutonium for gallium analysis entails dissolving the sample in acid and removing the plutonium with ion exchange chromatography for safety purposes. The gallium remaining in solution is then analyzed by XRF. Due to the chromatography step, however, this process is time consuming, and the specimen solution is still radioactive due to the presence of residual plutonium and trace americium. Hence, an alternative process was developed to avoid these issues in which the plutonium solution is cast in multiple spots on a Mylar XRF film, dried, and sealed inside a sample cell for analysis. This sample preparation method is considerably faster and safer than using the solution process.

A series of aqueous gallium standards were prepared in a preliminary study and cast as dried residues. The resulting calibration curve for these standards was very linear with an RMS of 0.3% of the standards concentration range. A solution was then prepared containing gallium, zinc (internal standard), and lanthanum (plutonium surrogate), and multiple dried residue specimens were cast from this solution. Quantification of the gallium in these specimens demonstrated excellent precision (2.8% RSD), but the average gallium concentration value was 18.8% higher than the expected value. Dried residue standards containing lanthanum were then prepared and calibrated. The calibration results will be presented as well as gallium quantification data using this new calibration.