Performance Characteristics of hiRX - New XRF Instrument for sensitive and selective analyses

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Plutonium characterization is a critical aspect of safeguards operations of spent nuclear fuel reprocessing facilities. hiRX is a new XRF instrument based on monochromatic wavelength dispersive X-ray fluorescence which has the potential to provide accurate, rapid and direct quantification of plutonium in high salt matrices such as spent fuel reprocessing streams. Over the last several years we have presented the development of hiRX demonstrating excellent sensitivity with detection limits around 200 pg of plutonium in a synthetic spent fuel matrix. This sensitivity offers a new level of accuracy and precision for direct plutonium quantification in spent fuel matrices on as little as 1 microliter of sample. This presentation will highlight the preliminary results from a prototype hiRX instrument created for direct determination of Pu in nuclear spent fuel matrices. We will compare the performance of the prototype hiRX with conventional MXRF as well as confocal MXRF. The instrument achieves a linear calibration over 4 orders of magnitude with a correlation coefficient of 0.9999. Uranium is present in the calibration solutions at a concentration ratio with Pu of over 100 (U:Pu). Precision and accuracy are shown to be less than 5% for the calibration range from 0.05 to 10 g/L Pu. Unique sample cell design provides a convenient yet disposable sample cell with a total volume of less than 5 microliters. The performance comparisons with conventional micro X-ray fluorescence measurements will highlight the advantages of the hiRX approach to Pu characterization. This work was supported by the Next Generation Safeguards Initiative, Office of Nuclear Safeguards and Security, National Nuclear Security Administration.