Rapid, Non-Invasive Analysis of Radioactive Field Samples

(using XμPIXE: eXternal Microbeam Proton-Induced X-ray Emission)

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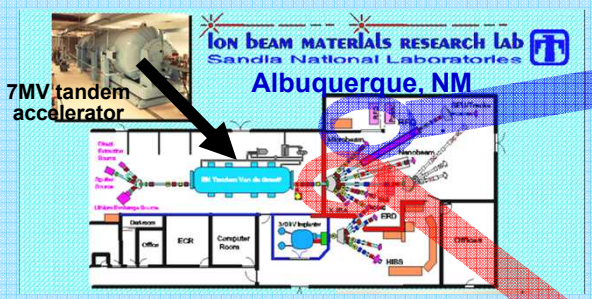
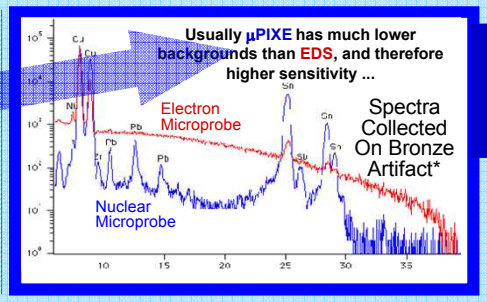
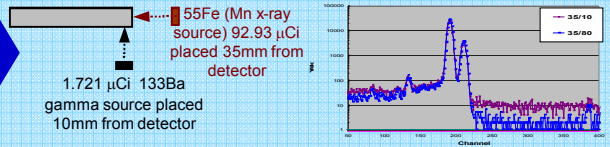




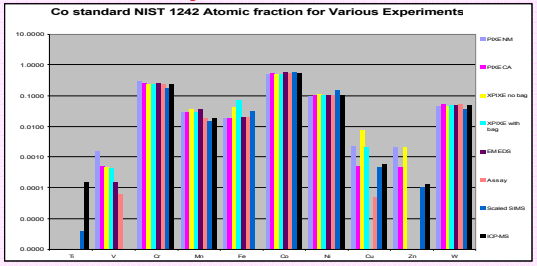
...but this advantage is partially lost if the sample is radioactive.

Si(Li) Detector Test using 55Fe and 133Ba sources

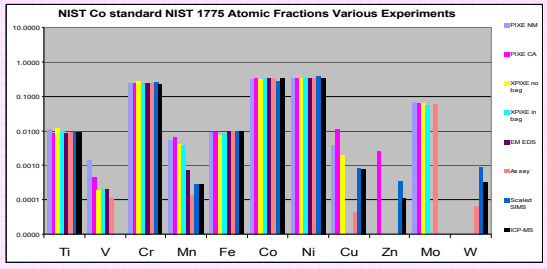


The data show that x-ray backgrounds will increase for the analysis of radioactive particulates, and this will lead to a loss of sensitivity. Even if XuPIXE can only be used for major elements, it will still be quite valuable to locate "particles of interest" on the collection media for examination by other techniques such as Mass Spectrometry.

Elemental Analyses of Bulk ^{59}Co Standards

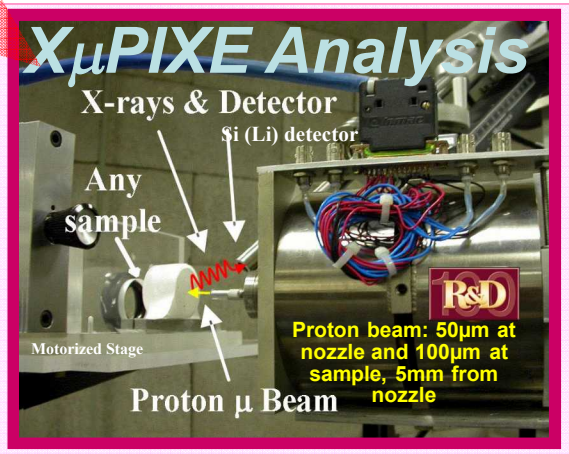


The elemental concentrations obtained from each technique (sans assay) were averaged; the standard deviation (stdev) was calculated to be 0.005. Both the average and XμPIXE elemental concentrations are within 1 stdev of the assay values. The XμPIXE. errors for Cr, Co, and Ni in this sample are 0.4, 10, and 4%, respectively, and are higher for Mn, Fe, and Cu.



For each element, the concentrations obtained from each technique (sans assay) were averaged; the standard deviation (stdev) was calculated to be 0.005. Both the average and XμPIXE elemental concentrations are within 1 stdev of the assay values. The XμPIXE. errors for Cr, Co, Ni, and Mo in this sample are 10, 5, 4, and 3%, respectively, and are higher for Mn and Cu.

XμPIXE results match the assay fairly well for the major elements, but poorly for the minor elements.



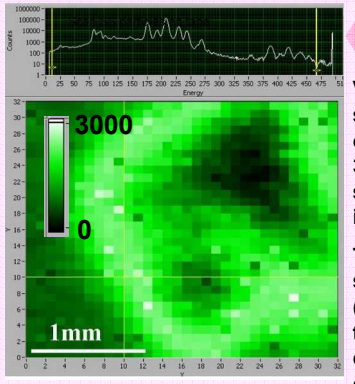
SUMMARY

XμPIXE uses a focused 3-MeV proton beam and x-y position sensitive spatial acquisition to rapidly detect and non-invasively characterize the composition of bulk samples or micron-scale particles on field samples. A ~100 micron, *ex vacuo* particle beam is quickly scanned over a collection sample, regions-of-interest are identified, and quantitative analysis performed. XμPIXE is well-suited for rapid, in situ analysis of samples for forensics investigations. This method could be used to characterize samples containing highly radioactive particulates, such as those collected by first-responders in interdicted RDDs or INDs.

XμPIXE Analyses of ^{59}Co Standard

XμPIXE spectra were collected on a bulk Co standard and on the same Co standard inside a 2 mil plastic bag. The green is the raw data and red is the fit by GeoPIXE*

XμPIXE Scan of Steel Particles



Very fine particles of stainless steel were dispersed on a piece of sticky tape. An area of about 3mm^2 was mechanically scanned and a region of interest (ROI) chosen.

The 1-5μm particles are much smaller than the 100μm beam (approximate pixel size), yet this fast scan was effective in choosing an ROI to analyze a cluster of particles.

*Fits to spectra and background were obtained with GeoPIXE, a code by C.G. Ryan and D.R. Cousens, CSIRO Exploration and Mining, Australia.