

Gold Star Mothers Stamp

Analysis Using Scanning Electron Microscopy and Mass Spectrometry

Introduction:

In 1948, the U.S. Post Office issued the Gold Star Mothers stamp to honor mothers whose sons had been killed in war. We obtained a vintage Gold Star Mothers Stamp to analyze using SEM and Mass Spectrometry, combining techniques to obtain different kinds of details about the stamp and correlate analyses from various analytical techniques on the same sample.

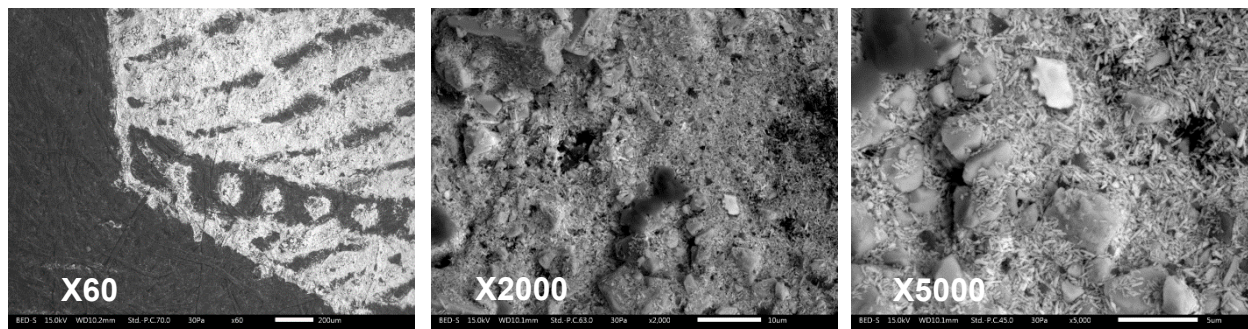
We used an analytical low vacuum Scanning Electron Microscope with Energy Dispersive X-ray Spectroscopy (EDS), the AccuTOF™- DART®, the first commercially available ambient ionization mass spectrometer, and the SpiralTOF™ which has highest mass-resolution and mass accuracy of all commercially available MALDI-TOFMS systems.



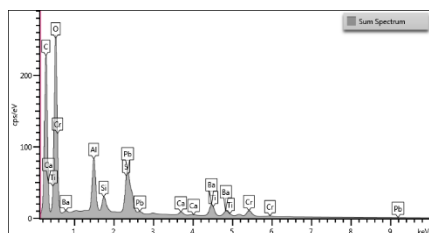
Figure 1. A Gold Star Mothers Stamp from 1948.

Scanning Electron Microscopy Data:

Backscattered Electron Images at 15kV in low vacuum mode, with no destructive sample prep required. In BSE the contrast is created from a difference in mean atomic number, with high Z number materials bright and low atomic number materials dark.



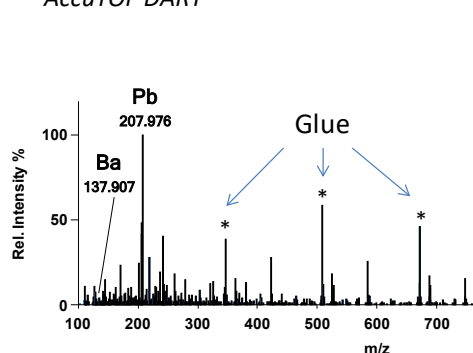
Energy Dispersive X-ray Spectrum at 15kV in low vacuum mode showing all elements present and elemental X-ray Maps showing the “positions” of each element.



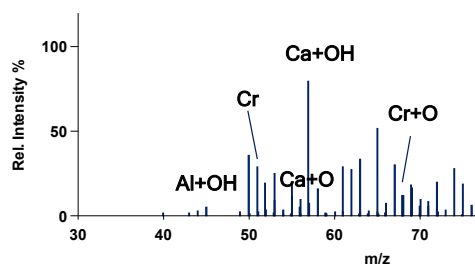
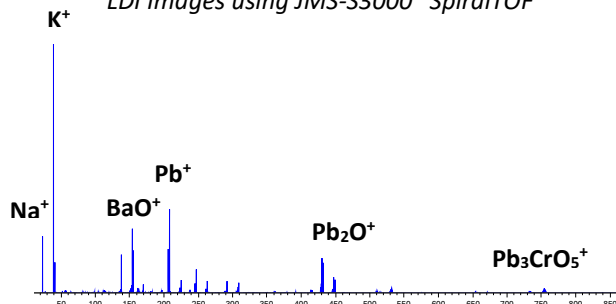
Mass Spectrometry Data:

A paper triangle cut from the stamp was wetted with dilute HNO_3 and biased to 3000 V to induce paper spray¹ for detection of isotopes for lead, chromium, calcium, barium, and aluminum. LDI imaging with the SpiralTOF showed the distribution of both elemental species and characteristic cluster ions.

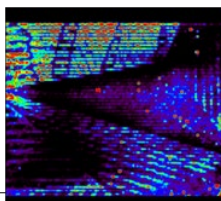
PaperSpray® Ionization [1] mass spectrum using AccuTOF DART



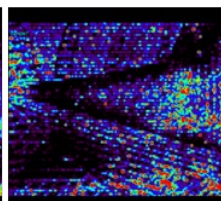
Laser Desorption Ionization (LDI) mass spectrum and LDI Images using JMS-S3000 "SpiralTOF"



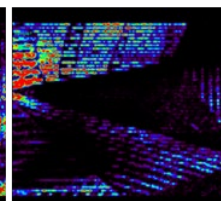
Na Distribution



Ba Distribution



Pb₃CrO₅ Distribution



¹Cody, R. B.; Dane, A. J. Paper spray ionization for ambient inorganic analysis; *Rapid Communications in Mass Spectrometry* **2014**, 28, 893-898.