A187 A Comparison of Lead, Barium, and Antimony Isotope Concentrations in Gunshot Residue Using ICP-MS and SEM

Holly Bennett, 714 Duncan Avenue, Apartment #1215, Pittsburgh, PA 15237; and Stephanie J. Wetzel, PhD, Duquesne University, Department of Chemistry and Biochemistry, 600 Forbes Avenue, Pittsburgh, PA 15282*

After attending this presentation, attendees will understand the necessary elements that make up the unique composition of gunshot residue and the the most advantageous combination of analytical techniques used for the detection of gunshot residue on different materials.

This presentation will impact the forensic science community by serving as a quick alternate method of detection for gunshot residue on a particular sample of interest.

Gunshot residue (GSR) evidence is of utmost importance in the investigation of violent crimes involving firearms as it may directly link an otherwise unknown subject to an environment of weapon discharge. A unique GSR particulate of interest is composed of heavy metals in varying proportions that include lead, barium, and antimony. Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) is an analytical technique that will yield the overall concentration of lead, barium, and antimony present in a sample suggested to contain GSR. Some environmental sources, including vehicle brakes and fireworks, have been shown to resemble GSR, which could yield false positive confirmations of the presence of GSR on the particular sample of interest. Therefore, a need exists for an analytical technique that will thoroughly and quickly analyze a piece of fabric or carbon-coated adhesive stub suspected to contain GSR. Manual Variable Pressure Scanning Electron Microscopy (VP-SEM) allows the specific identification of a unique GSR particulate that contains lead, barium, and antimony embedded within a charging piece of fabric or on the surface of the carbon-coated adhesive stub. It was hypothesized that the advantage of SEM over ICP-MS is the ability to distinguish Pb, Ba, Sb, Pb-Ba , Pb-Sb, and Ba-Sb particles from a Pb-Ba-Sb particulate, thus yielding a more accurate representation of whether or not GSR is present in the sample or not. Acetate, cotton, nylon, polyester, and rayon fabrics were wrapped around the wrist of the shooter that fired a 9mm handgun. Carbon-coated adhesive stubs were then dabbed against the back of the hand and fingers and the palm of the shooter. A bulk analysis of Pb-208, Ba-137, and Sb-121 concentrations in acetate, cotton, nylon, polyester, and rayon fabrics containing GSR was done by ICP-MS. Then a total evaluation of all the particulate present in the fabrics was done by manual SEM to determine if the potential particles were consistent with GSR. ICP-MS results showed that acetate and nylon retained the lowest amount of GSR, while rayon, cotton, and polyester retained the most GSR. Contrastingly, SEM results indicated that acetate had a multitude of GSR particles embedded within the fibers, whereas polyester had numerous Pb-Ba particulates, but only a single unique GSR particulate. The Pb-Ba particulates found in polyester using SEM could have contributed to the higher intensity of Pb-208 and Ba-137 isotopes found in ICP-MS, leading to a false indication that a high amount of GSR was retained. ICP-MS was a valuable tool used to search for GSR on fabrics, but SEM was able to indicate the elemental composition of each particulate, whether it be GSR or not, on the fabric for a more accurate representation of the amount of GSR present. A quick backscatter method for the detection of GSR on fabrics using SEM was also developed during analysis of the different types of fabrics, and easily applied to the analysis of the carbon-coated adhesive stubs. The methodology has been used in other scientific applications, but it has not been applied in the forensic science field to the detection of GSR. This method could be a valuable tool to the forensic science field as it can quickly detect the presence of GSR on fabrics to directly link someone to a firearms crime scene.

Gunshot Residue, Inductively Coupled Plasma-Mass Spectrometry, Scanning Electron Microscope