## A156 The Characterization of Bullet Wipe From Non-Lead Bullets Using Laser Induced Breakdown Spectroscopy

*Elizabeth A. Gardner, PhD*, UAB, Dept of Justice, UBOB 210, 1530 3rd Ave S, Birmingham, AL 35294-4562; and Brittany Phillips, MSFS, 5709 5th Ct S, Birmingham, AL 35212*

After attending this presentation, attendees will have understanding of how laser-induced breakdown spectroscopy (LIBS) can be used for the presumptive identification of trace evidence, learning how this technology also can be used to detect bullet wipe from non-lead bullets.

This presentation will impact the forensic science community by presenting a new method for the presumptive identification of bullet wipe in bullet holes shot from a distance of over six feet; a distance that gun powder residue is unlikely to travel. Over the years, scientists have developed methods for detecting GSR on a shooter's hands, a victim, or any object that may have been within six feet of the firearm. However, when the weapon is more than six feet from the target, gun powder residue is generally not present. The only residue available for analysis is bullet wipe, material that is transferred from the surface of the bullet as it penetrates the target.

Laser Induced Breakdown Spectroscopy (LIBS) is used to identify the elemental composition of an unknown material. Areas as small as $2mm^2$ can be analyzed, making it an ideal method for the analysis of the minute residues left by a bullet. The advantages of LIBS include minimal sample preparation and short time for analysis. This technique is also relatively non-destructive to most surfaces being tested. Unlike atomic absorption, the composition can be unknown. The primary disadvantage of LIBS is that quantification is not currently possible.

The focus of this project is to apply LIBS as a presumptive test where identifying the composition of the sample is sufficient and quantification can be done as part of the confirmatory analysis, if required. The ease of analysis with LIBS lends itself very well to fast screening of inorganic trace evidence.

Four materials, cotton, wood, drywall, and cement, were shot with three different brands of lead-free cartridges: Extreme Shock: 357 Mag 90 CT2 (ES), Dynamic Research Technologies 9mm (DRT), and Winchester Super Clean NT (WIN). Each material was shot from distances of one, three, six, and twelve-feet. To detect the bullet wipe, the samples were analyzed for copper, lead, and barium. The analysis was performed using addLIBS software and the NIST Atomic Spectra Database.

The manufacturers' information stated that the ES bullets were made of copper-clad tungsten, the DRT bullets had a copper-clad compressed core made from three undisclosed metals, and the WIN had a copper clad tin core. Due to the jacket, copper was the only metal detected in the bullet wipe that could be attributed to the cartridges. Some lead and barium was detected in the bullet wipe, most likely from the barrel of the guns, as these metals were not detected in the casing, bullet, or powder from any of the unfired ammunition used for the controls. Lead and barium were found on the swabs used to clean the barrel of the gun between firing.

Bullet wipe was successfully detected in the cotton, wood, and drywall. Bullet wipe could not be detected in the cement block. Not only did the bullets knock chips off the surface of the block, but cement is a complicated mixture of minerals, including barium oxide.

**Gun Powder Residue, LIBS, Bullet Wipe**

 ** Presenting Author*