C13 The Analysis of Gun Shot Residue Using Transmission Electron Microscopy

Whitney B. Hill, MS, MVA Scientific Consultants, 3300 Breckinridge Boulevard, Suite 400, Duluth, GA 30096*

The goal of this presentation is to present to the forensic community information about how Transmission Electron Microscopy (TEM) coupled with Energy Dispersive X-ray Spectroscopy (EDS) can be instrumental in the analysis of nano-sized gun-shot residue (GSR).

This presentation will impact the forensic science community by showing the advantages of using TEM-EDS to identify nano-sized GSR particles released during the discharge of a firearm.

Routine GSR analysis is normally performed by Scanning Electron Microscopy (SEM). Classic GSR particles are usually defined as spherical particles, 1um in size and larger, containing three main components, which are Pb, Ba, and Sb. Therefore, particles less than 1um in size are usually overlooked during routine analysis for GSR by SEM.

For this presentation, an experiment was done using TEM-EDS to characterize the particles released during the discharge of a firearm. Samples of GSR were generated by firing five rounds of Browning High Powered Sellier and Bellot ammunition from a 9mm handgun in an enclosed facility. Air samples were collected simultaneously with the firing of each round of ammunition. The air pumps were set up adjacent to the muzzle and ejection port of the handgun. An ambient air sample was collected 12 hours after firing the initial five rounds of ammunition. A second set of GSR samples was generated by firing three rounds of Winclean ammunition also from a 9mm handgun in an enclosed facility. Air samples were also collected simultaneously with the firing of each round of the Winclean ammunition. The GSR samples were collected on 0.45 µm pore sized, 25mm diameter, Mixed Cellulose Ester (MCE) filters and prepared according to procedures described in the NIOSH 7402 method for TEM. TEM-EDS analysis of the filters showed that particles, both spherical and non-spherical, of varying sizes and elemental compositions, were released into the atmosphere during the discharge of each round of ammunition. A significant amount of the particles observed by TEM-EDS were less than 1µm in size. However, the spherical GSR particles containing Pb, Ba, and Sb, analyzed by TEM-EDS, ranged in size from greater than 1µm to less than 100nm. Analysis of the ambient air sample showed that nano-sized, spherical GSR particles containing Pb, Ba, and Sb were still suspended in the air 12 hours after the initial rounds of ammunition were discharged.

This study confirmed that many GSR particles less than 1µm in size are released into the atmosphere during the discharge of a firearm and these particles tend to remain suspended in the air for longer periods of time than the larger particles. Therefore, TEM-EDS can be instrumental in the analysis of nano-sized GSR particles especially in the absence of those greater than 1µm in size. Future research involves determining how long and under what conditions, nano-sized GSR particles can remain suspended in the air.

GSR, TEM, Nanoparticles

 ** Presenting Author*