B79 Morphology and Microanalysis of Aluminum (Al) Powders From Amateur Improvised Explosive Device (IED) Methods

JenaMarie Baldaino, MS, 14701 River Walk Way, Apt 389, Woodbridge, VA 22191; Jack Hietpas, PhD, Penn State University, 329 Whitmore Lab, University Park, PA 16802; and JoAnn Buscaglia, PhD, FBI Laboratory, CFSRU, 2501 Investigation Parkway, Quantico, VA 22135*

After attending this presentation, attendees will better understand the forensic potential of combining elemental microanalysis and micromorphology to provide insight into the method of Al powder production.

This presentation will impact the forensic science community by discussing the differences in surface characteristics, elemental composition, and particle micromorphology of Al powders manufactured using various amateur methods and extracted from commercially available products. These results may provide valuable lead identification for forensic investigations.

Starting materials for an IED are readily obtainable from local commercial sources. Al powder, a common metallic fuel, has a wide variety of legitimate uses and is widely available without significant regulatory constraints.[1] Al powders can be obtained from industrial manufacturers or can be produced inexpensively using basic instructional manuals and videos. Due to the online sharing of instructional manuals and published books on how to construct IEDs, bomb-makers are now informed on the easily accessible household materials that can be used to make explosive chemical mixtures.[2]

For this project, Al powders from Al foil, spray paint, pyrotechnics, and Al cans were obtained and produced. Al powder was extracted from Al flake-containing spray paint and pyrotechnics, and was manufactured from Al foil and Al cans using ball-milling, grinding, and blending techniques. For Al flake-containing spray paints, acetone was added to solubilize the binders and additives, followed by centrifugation to form an Al powder pellet; the supernatant was removed to isolate the Al powder pellet, which was then dried by solvent evaporation. For the pyrotechnics, several separation techniques were used to remove the explosives and additives. Density separation techniques were used to separate the charcoal and elemental Silicon (Si) from the Al powder. A hand magnet was used to remove iron filings from "gold" sparklers. Lastly, a ball-milling technique, which used a small 6 lb. rotary dual drum ball mill and ball bearings, and a grinding technique (using a coffee grinder) were used to manufacture Al powder from Al foil and Al cans.

Preliminary results obtained from Scanning Electron Microscopy (SEM) micrographs demonstrate that Al powder manufactured by ball milling could be confidently differentiated from those extracted from an Al flake-containing spray paint. Furthermore, SEM with Energy-Dispersive X-ray Spectroscopy (EDS) analysis of the Al flake-containing spray paints provided additional information that could differentiate between brands and among products within brands. Four different manufacturers of Al flake-containing spray paints were studied: (1) Manufacture A's product contained Al and iron; (2) one of the products from Manufacturer B contained Al, potassium, copper, Si, sodium, and titanium (the other product contained only Al); (3) Manufacturer C's products contained Al and Si; and, (4) Manufacturer D's product contained only Al. All of these elements were present in the Al powder after an acetone wash, which is how amateur bomb-makers are extracting Al powder from spray paints, so these differences are also expected to be present in case samples.

Reference(s):

1. Kosanke K.L, Kosanke B.J. 2007. A Study Evaluating Potential for Various Aluminum Metal Powders to Make Exploding Fireworks. *Pyrotechnics Guild International Bulletin*, No. 154.
2. Larabee A. 2015. *The Wrong Hands: Popular Weapons Manuals and Their Historic Challenges to a Democratic Society*. Oxford University Press, New York, NY.

Aluminum Powder, SEM/EDS, Microanalysis