E39 Gunshot Residue (GSR) Analysis by Single Particle Inductively Coupled Plasma Mass Spectrometry (spICP/MS)

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After attending this presentation, attendees will aware of a new method for analyzing GSR using spICP/MS.

This presentation will impact the forensic science community by demonstrating that spICP/MS is a fast, accurate, and promising method for GSR analysis that can identify and characterize hundreds of nanoparticles.

GSR contains micro and nanoparticles resulting from the rapid cooling of the discharge of gases and solid matter from firearms. GSR originates from the primer and propellant, as well as from the metallic components of the ammunition and firearm. The composition of GSR can vary mainly because of different primer compositions. The research presented is based on primers containing lead styphnate, barium nitrate, and antimony sulfide, which lead to a typical particle composition containing lead (Pb), barium (Ba), and antimony (Sb). The vast majority of modern ammunition uses this type of primer.[1]

After the discharge of a firearm, GSR particles can be deposited onto the shooter's hands, clothing, or other objects or people in the proximity. According to Locard's principle, GSR can also be transferred from one surface to another due to contact.[2] Thus, the analysis of GSR could provide some insight into the dynamics of a crime scene.

Scanning Electron Microscopy (SEM) with Energy-Dispersive X-ray (EDX) spectroscopy is the state of the art for GSR analysis; however, the setup and manual confirmation of results is tedious and time-consuming.[3, 4] The automated search of one blank stub can take two to six hours, depending on the instrument and chosen parameters. The duration of analysis could increase greatly if a sample contains a large number of detected particles.[5]

The research focus is on the use of spICP-MS to analyze GSR particles. With the availability of new analytical instruments with higher sensitivity and greater data processing capacity, it has been possible to identify and characterize GSR nanoparticles in a given sample in ten minutes. With the aid of an auto-sampler, the process can be fully automatized, allowing the analysis of more than 100 samples per day, independent of the number of particles in the sample. Another advantage of the technique is the possibility of fully automating post processing. The drawback of the method is that the use of quadrupole mass spectrometers only permits simultaneous analysis of two elements in each individual particle.

This presentation will discuss some of the results obtained with this new approach and open a new perspective for future research on GSR analysis. Swab samples collected from shooters' hands were sonicated in 10mL ofwater and analyzed with this technique, resulting in more than 600 particles per milliliter.

The low cost of analysis and less time-consuming sample preparation and analysis makes this new approach a promising procedure for GSR identification and characterization.

Reference(s):

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2. Kirk P.L. (1953). *Crime investigation: Physical Evidence and the Police Laboratory*. New York: Interscience Publishers.
3. ASTM1588-16 Standard Guide for Gunshot Residue Analysis by Scanning Electron Microscopy/ Energy Dispersive X-ray Spectrometry.
4. Charles S., Nys B. Examination of Firearms – Gun Shot Residue. In 17th Interpol International Forensic Science Managers Symposium, Lyon, October 2013. 46-66.
5. Trimpe M. *The Current Status of GSR Examinations*. FBI Law Enforcement Bulletin, May 2011.

GSR, Single Particle, ICP/MS