OSAC RESEARCH NEEDS ASSESSMENT FORM

Title of research need: Quantitative Metrics for GSR Analysis

Keyword(s): Gunshot Residue, GSR, Quantitative Metrics, K-ratios

Submitting subcommittee(s): Ignitable Liquids, Explosives, & Gunshot Residue

Date Approved: 3/02/2021

(If SAC review identifies additional subcommittees, add them to the box above.)

Background Information:

1. Does this research need address a gap(s) in a current or planned standard? (ex.: Field identification system for on scene opioid detection and confirmation)

Yes, this research need addresses the establishment of a quantitative metric by which GSR data can be evaluated to determine the class in which each particle is placed. The current standard for gunshot residue classification of particles depends upon the manual review of energy dispersive X-ray spectra to determine the list of elements present. Relying on the experience and judgement of an analyst is subjective. Not all analysts will identify the same elements present and may therefore possibly assign the particles to a different particle class. Classification can be made objective by interpreting the spectra relative to the spectra from pure elements. A long-established mechanism to evaluate spectra objectively is by using the k-ratio, the ratio of intensity in the unknown spectrum relative to the intensity in a pure element spectrum. The k-ratio can be used to develop quantitative rules to assign particles to classes based on the quantitative measures of their elemental constituents. k-ratios are an objective metric which could eliminate much of the subjectivity in assigning particles to classes. There is currently insufficient data in the literature to construct quantitative rules for mapping k-ratio data into gunshot residue relevant particle class assignments. The research would involve collecting large quantities of gunshot residue data, quantifying it using k-ratios and developing quantitative rules to assign particles to descriptive classes including the currently used classes (characteristic, consistent with and associated with). Subsequent research could be useful for identifying particles from lead-free and other challenging primer types, as well as, developing rules for materials like fireworks with similar k-ratio signatures. The accuracy of the method created to determine the quantitative metric, and this will need to be demonstrated. The quantitative metric will need to be usable by existing automated GSR software users and platforms or be able to be incorporated in the existing software.

2. Are you aware of any ongoing research that may address this research need that has not yet been published (e.g., research presented in conference proceedings, studies that you or a colleague have participated in but have yet to be published)?

Yes, small scale studies have been performed but have not yet been published due to more data needed for a full quantitative metric to be determined.

3. Key bibliographic references relating to this research need: (ex.: Toll, L., Standifer, K. M., Massotte, D., eds. (2019). Current Topics in Opioid Research. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-88963-180-3)

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[10] F. Schamber. A Modification of the Linear Least-Squares Fitting Method which Provides Continuum Suppression. Ann Arbor Science Publishers. 1977, 241.

[11] L. Currie. Nomenclature in Evaluation of Analytical Methods Including Detection and Quantification Capabilities. Analytica Chimica Acta. 1999, 391, 105.

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[13] N. Ritchie. Using DTSA-II to Simulate and Interpret Energy Dispersive Spectra from Particles. Microscopy and Microanalysis. 2010, 16, 248.

4. Review the annual operational/research needs published by the National Institute of Justice (NIJ) at https://nij.ojp.gov/topics/articles/forensic-science-research-and-development-technology-working-group-operational#latest? Is your research need identified by NIJ?

No.

5. In what ways would the research results improve current laboratory capabilities?

The research result will improve the procedure by which a GSR analyst categorizes a particle based on the quantitative metric.

6. In what ways would the research results improve understanding of the scientific basis for the subcommittee(s)?

The research result will improve the understanding of the quantitative analysis of the data produced from a GSR test result. The established quantitative metric could be incorporated into a future revision of ASTM 1588.

7. In what ways would the research results improve services to the criminal justice system?

The research results would allow for a more precise and reproducible interpretation of gunshot residue test results in reports and in courts of law.

8. Status assessment (I, II, III, or IV): **II**

	Major gap in current knowledge	Minor gap in current knowledge
No or limited current research is being conducted	I	III
Existing current research is being conducted	II	IV

This research need has been identified by one or more subcommittees of OSAC and is being provided as an informational resource to the community.