

OSAC RESEARCH NEEDS ASSESSMENT FORM



Title of research need:

Cross-validation of current and new micro-XRF technology for the forensic analysis of modern glass

Keyword(s):

Glass, X-ray Fluorescence, validation, databases, elemental analysis

Submitting subcommittee(s):

Trace Materials

Date Approved:

02/24/2021

(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)

The elemental analysis of glass provides valuable information in the comparison of glass evidence. Micro X-ray Fluorescence has shown to be a valid analytical technique for the comparison of the elemental composition of glass, and a standard test method is now available to forensic examiners. LA-ICP-MS and micro- XRF are recognized as the most informative tools for forensic glass comparisons. Nonetheless, the most extensive existing glass databases have been built primarily with ICP data (ICP-MS, ICP-OES, and LA-ICP-MS). It will be useful for the XRF-users to generate larger collection datasets that include modern glass compositions to expand the current knowledge on XRF-elemental profiles of glass, evaluate the potential of sharing databases among laboratories, and use alternative probabilistic interpretation approaches. Moreover, in recent years modern micro-XRF systems are employing SDD detectors instead of the traditional SiLi detectors as they are anticipated to be more sensitive and precise. The comparison among systems currently available at crime laboratories will provide an essential body of knowledge to evaluate the performance of SiLi and SDD detectors under the current ASTM standard method E2926-17.

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)?

The glass task group is currently involved in an interlaboratory study to address this research need.

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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2. Almirall J, Trejos T. Analysis of Glass Evidence. In: Siegel JA, editor. Forensic Chemistry Fundamentals and Applications. Chichester, UK: John Wiley & Sons, Ltd, 2015; 228–72.
3. ASTM E2330-12. Standard Test Method for Determination of Concentrations of Elements in Glass Samples Using Inductively Coupled Plasma Mass Spectrometry (ICP-MS) for Forensic Comparisons, ASTM International, Vol 14.02
4. ASTM E2926-17. Standard Test Method for Forensic Comparison of Glass Using Micro X-ray Fluorescence (μ -XRF) Spectrometry, ASTM International, Vol 14.02
5. ASTM E2927-16. Standard Test Method for Determination of Trace Elements in Soda-Lime Glass Samples Using Laser Ablation Inductively Coupled Plasma Mass Spectrometry for Forensic Comparisons, ASTM International, Vol 14.02

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7. Corzo, R, Hoffman, T, Weis, P, Franco-Pedroso, J, Ramos D, Almirall J. The use of LA-ICP-MS databases to calculate likelihood ratios for the forensic analysis of glass evidence. *Talanta*, 186, 2018, 655-661.
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9. Curran JM, Triggs CM, Buckleton JS, Walsh KAJ, Hicks T. Assessing transfer probabilities in a Bayesian interpretation of forensic glass evidence. *Science & Justice* 38(1), 1998, 15–21.
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16. Hicks T, Monard Sermier F, Goldmann T, Brunelle A, Champo C, Margot P. The classification and discrimination of glass fragments using non-destructive energy dispersive X-ray μ fluorescence. *Forensic Science International*, Vol. 137, 2003, 107-118.
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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, this research need is not identified by NIJ.

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

LA-ICP-MS and micro- XRF are recognized as the most informative tools for forensic glass comparisons. Although LA-ICP-MS is considered the “gold standard” due to its superior performance, relatively more crime laboratories have access to XRF instrumentation compared to LA-ICP-MS systems due to lower costs of acquisition, ease of use, and straightforward data processing, while still providing high discrimination among glass sources. Expanding current research on micro- XRF will provide greater support to forensic examiners to defend their results in court. In particular, a useful body of knowledge can be provided by 1) expanding current studies on the variation of XRF elemental composition of glass in modern formulations (within-sources, between-sources, and instrumental variation) and 2) extending studies to evaluate the analytical performance of novel XRF detection technology.

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

At the subcommittee level, these types of research would provide additional support to the interpretation and report writing guidelines that are being developed for glass evidence and trace materials in general.

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

Increasing the existing body of knowledge on micro-XRF technology for the forensic analysis of glass would allow more efficient use of resources at crime laboratories, and the future application of probabilistic interpretation approaches to support the examiner's opinion in reports and testimony.

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

IV

	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.