OSAC RESEARCH NEEDS ASSESSMENT FORM

Title of research need: Assessment of the sources of variability for the analysis of small glass fragments

Keyword(s): Glass, variability, small fragments, databases

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)

Many studies have demonstrated the utility of LA-ICP-MS, μXRF, and LIBS for the forensic analysis of glass. However, relatively few studies have explored the sources of variability for the analysis of small glass fragments, particularly when using μXRF or LIBS. This research will provide further knowledge of the sources of variability and their improvement with the incorporation of advances in modern instrumentation. Moreover, this research can aid in the development of new standards for the analysis of glass using relatively novel instrumentation (e.g., LIBS).

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)?

No, we are not aware of any ongoing research that may address this research need that has not yet been published.

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)

1. ASTM Standard E2926-17 Standard Test Method for Forensic Comparison of Glass Using Micro X-ray Fluorescence (μ-XRF) Spectrometry, ASTM International
2. ASTM Standard E2927-16e1 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
3. T. Trejos and J. R. Almirall, Sampling strategies for the analysis of glass fragments by LA-ICP-MS Part I. Micro-homogeneity study of glass and its application to the interpretation of forensic evidence, Talanta 67 (2), 2005, 388-95.
4. T. Trejos and J. R. Almirall, Sampling strategies for the analysis of glass fragments by LA-ICP-MS Part II: Sample size and sample shape considerations, Talanta 67 (2), 2005, 396-401.
5. R. Corzo, T. Hoffman, T. Ernst, T. Trejos, T. Berman, S. Coulson, P. Weis, A. Stryjnik, H. Dorn, E. C. Pollock, M. S. Workman, P. Jones, B. Nytes, T. Scholz, H. Xie, K. Igowsky, R. Nelson, Kris Gates, h. Gonzalez, L.-M. Voss and J. Almirall, An Interlaboratory Study Evaluating the Interpretation of Forensic Glass Evi- dence Using Refractive Index Measurements and Elemental Composition, Forensic Chemistry 2021, 100307.
6. R. Corzo and E. Steel, Improving signal-to-noise ratio for the forensic analysis of glass using micro X-ray fluorescence spectrometry, X-Ray Spectrometry 49 2020, 679-689.

7. M. Czyzycki, M. Bielewski and M. Lankosz, Quantitative elemental analysis of individual particles with the use of micro-beam X-ray fluorescence method and Monte Carlo simulation, X-Ray Spectrometry 38 (6), 2009, 487-491.
8. A. Rindby, P. Voglis and A. Attaelmanan, Analysis of Inhomogeneous and Irregularly Shaped Samples by the Use of XRF Micro-beam Correlation Analysis, X-Ray Spectrometry 25 1996, 39-49.
9. T. C. Roedel, H. Bronk and M. Haschke, Investigation of the influence of particle size on the quantitative analysis of glasses by energy-dispersive micro x-ray fluorescence spectrometry, X-Ray Spectrometry 31 (1), 2002, 16-26.
10. A. Somogyi, L. Vincze, K. Janssens, B. Vekemans, A. Rindby and F. Adams, Interpretation and use of inter-element correlation graphs obtained by scanning X-ray fluorescence micro-beam spectrometry from individual particles. Part I - theory, Spectrochimica Acta Part B 55 2000, 75-89.
11. A. Somogyi, K. Janssens, L. Vincze, B. Vekemans, A. Rindby and F. Adams, Interpretation and use of inter-element correlation graphs obtained by scanning X-ray fluorescence micro-beam spectrometry from individual particles. Part II - application, Spectrochimica Acta Part B 55 2000, 1039-1049.
12. 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.
13. Almirall J, Trejos T. Advances in the Forensic Analysis of Glass Fragments with a Focus on Refractive Index and Elemental Analysis. Forensic Science Review 2006,18(2):73–96.
14. Dorn H, Ruddle DE, Heydon A, Burton B. Discrimination of float glass by LA-ICP-MS: assessment of exclusion criteria using casework samples. Can. Soc. Forensic Science, 2015, Vol 48, 2, 2015, 85-96.
15. Naes BE, Umpierrez S, Ryland S, Barnett C, Almirall JR. A comparison of laser ablation inductively coupled plasma mass spectrometry, micro X-ray fluorescence spectroscopy, and laser induced breakdown spectroscopy for the discrimination of automotive glass. Spectrochimica Acta Part B: Atomic Spectroscopy
16. Ryland SG. Discrimination of flat (sheet) glass specimens having similar refractive indices using micro X-ray fluorescence spectrometry. Journal of the American Society of Trace Evidence Examiners, Vol. 2, 2011, 2-12.
17. T Ernst, T Berman, J Buscaglia, T Eckert-Lumsdon, C Hanlon, K Olsson, C Palenick, S Ryland, T Trejos, M Valdez and JR Amirall. Signal-to-noise ratios in forensic glass analysis by micro X-ray fluorescence spectrometry, X-Ray Spectrometry, 2014, DOI: 10.1002/xrs.2437
18. Trejos T, Koons R, Becker S, et al. Cross-validation and evaluation of the performance of methods for the elemental analysis of forensic glass by µ-XRF, ICP-MS, and LA-ICP-MS. Anal. Bioanal. Chem. 405, 2013, 5393-5409.
19. Trejos T, Koons R, Weis P et al. Forensic analysis of glass by µ-XRF, SN-ICP-MS, LA-ICP-MS and LA-ICP-OES: evaluation of the performance of different criteria for comparing elemental composition. J. Anal. At. Spectrom., 28, 2013, 1270-1282.
20. Trejos T, Montero S, Almirall JR. Analysis and comparison of glass fragments by laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) and ICP-MS. Anal. Bioanal. Chem., 376 (8), 2003, 1255–64.
21. Walsh KA, Buckleton J, Triggs CM. A practical example of the interpretation of glass evidence. Science and Justice, Vol. 36, 1996, 213-218.
22. Weis P, Dücking M, Watzke P, Menges S, Becker S. Establishing a match criterion in forensic comparison analysis of float glass using laser ablation inductively coupled plasma mass spectrometry. J. Anal. At. Spectrom. 26, 2011, 1273-1284.
23. Zadora G, Ramos D. Evaluation of glass samples for forensic purposes — An application of likelihood ratios and an information–theoretical approach. Chemometrics and Intelligent Laboratory Systems 2010;102(2), 63–83.

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?

Yes, knowledge of the sources of variability for the analysis of small glass fragments is critical for the development of shared forensic glass databases, which relates to the NIJ research needs "Construction of new and updating of existing

databases with properties of manufactured materials" and "Identification and characterization of nanomaterials in evidentiary materials."

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

Identifying and addressing the sources of variation for the analysis of small glass fragments can lead to improved measurement precision and improved laboratory practices, both of which can provide support to the practitioner when defending their results in report writing and testimony.

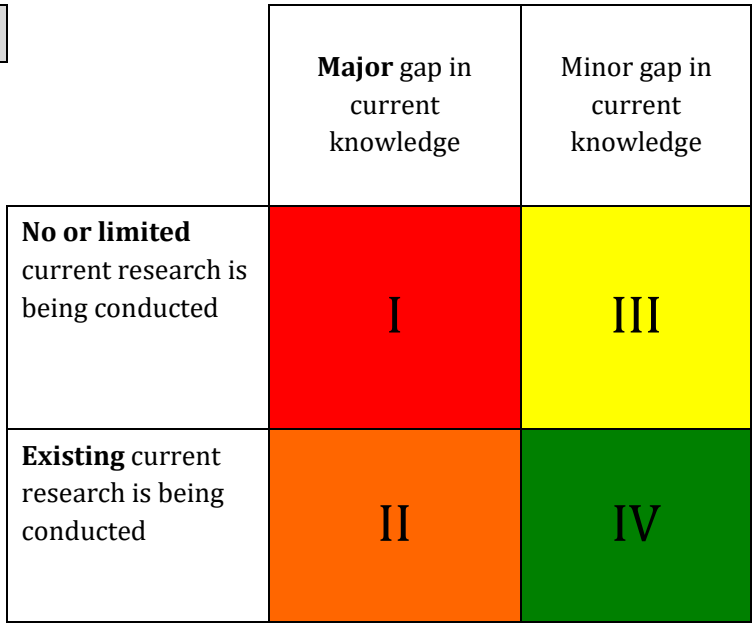
6. In what ways would the research results improve understanding of the scientific basis for the subcommittee(s)?

At the subcommittee level, this research would provide useful information for the glass training guide currently in development within the glass task group, and for current and potential future glass standards.

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

Improving the understanding of the sources of variation for the forensic analysis of small glass fragments is necessary for the development of shared databases, which can be used to assign a significance to forensic evidence to help support the practitioner's opinion in court.

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



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