A197 Glass Analysis by Laser Ablation Inductively Coupled Plasma Mass Spectrometry: Casework Experience

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After attending this presentation, attendees will have a better appreciation of how elemental analysis works in real cases. They will also be able to acquire software that will assist in reporting of results and in research.

This presentation will have an impact on the forensic science community by demonstrating the utility of Laser Ablation Inductively Coupled Plasma Mass Spectrometry in forensic casework.

The use of Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) for the analysis of glass has been the subject of a great deal of research; however, reports of the use of this technique in casework are lacking. This presentation will examine the use of elemental analysis of glass from samples collected since 2009. In that time, of the cases where elemental analysis had potential to be useful (i.e., excluding cases with no questioned glass recovered, or where the questioned glass was different in refractive index or thickness), 64% had sufficiently large questioned samples to perform LA-ICP-MS analysis.

A total of 82 glass samples from cases submitted to the CFS have been analyzed with LA-ICP-MS, with the following trace elements used for discrimination: 49Ti, 55Mn, 85Rb, 88Sr, 90Zr, 137Ba, 139La, 140Ce, 146Nd, and 208Pb. Using pairwise comparison analysis (3321 pairs) with a modified ± four standard deviation match criterion, three Type II errors were found, giving a false inclusion rate of approximately one in 1000. Further analysis of the casework samples has shown little correlation between refractive index and the concentration of any of the ten trace elements that are used for comparison (the largest R2 value among the ten elements is for 49Ti, at 0.19). Given this, it is not unreasonable to assume that the trace element concentration and refractive index are independent. Using this assumption, along with the observation that in typical cases, the refractive index range for a known sample will match 1-4% of the samples in the CFS database, the coincidental match probability can be estimated. For two unrelated pieces of glass, when refractive index, thermal history, and elemental concentration have been determined, this is approximately one in 25,000-100,000.

In order to present the results of the elemental analysis in a more readily understandable form, a spreadsheet has been developed that not only determines if samples are indistinguishable from one another, it also presents the information in a clear manner, suitable for reviewers or presentation in court. A related spreadsheet has also been developed that can perform pairwise comparisons for up to 500 samples (124,750 comparisons). This has great utility in determining Type I and Type II error rates. Both spreadsheets are freely available to interested parties.

Two interesting cases will be discussed. The first had questioned and known sources that were indistinguishable in refractive index, but differed in elemental concentration. This is the first case seen at the CFS where samples indistinguishable in refractive index were distinguished by elemental analysis. The second case, a "smash and grab" at a jewelry store, had four known samples from one location. Questioned glass was indistinguishable from all four known samples in refractive index, and indistinguishable from three of the known samples in elemental concentration. One known sample was different in just one element.

Glass, Elemental Analysis, ICP-MS

