



A113 Size Limitations for the Analyses of Float Glass Fragments by LA-ICP-MS: Influence of Fragment Size on Measurement Accuracy and Discrimination Potential for Glass Analysis

Stefan Becker, PhD, Marc Duecking, MS, Peter Watzke, MS, and Peter Weis, PhD, Bundeskriminalamt, Forensic Science Institute, KT 13, Wiesbaden, 65173, GERMANY*

After attending this presentation, attendees will understand principles concerning size limitations for the analyses of float glass fragments by Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS), also addressing such issues as criteria to determine the minimum sample requirements, and effects of deviating from the standard protocol.

This presentation will impact the forensic science community by serving as a key aspect to raise awareness on the limitations of applying LA-ICP-MS in forensic glass analysis.

Over the last two decades, LA-ICP-MS has been proven to be a reliable and powerful technique in forensic glass analysis, especially for the comparative analyses of questioned and control glass samples. Harmonized measurement parameters have been established over time, leading to methods commonly used by the majority of forensic laboratories employing LA-ICP-MS. These methods are using single spot analyzes, multiple sampling positions on a single fragment, 10 Hz repetition rate, a crater diameter 50-80 micrometer, and an ablation time of 50 seconds or more. These methods commonly applied require a material amount for each analysis in the range of 500-1400ng assuming a crater depth of approximately 100 micrometer and crater diameter ranging from 50 to 80 micrometers. Applying six analyses on each glass fragment, the minimum sample requirement for a glass fragment to be suitable for analysis is approximately given by a minimum sample size of 0.4-0.5mm and a minimum thickness of 0.1mm.

In casework, a fair amount of recovered glass fragments might have a maximum-size length smaller than 0.5mm and many glasses exhibit a very small thickness (<0.1mm). Measurement of these fragments can be done with a reduced number of readings (ablation spots) or a shortened transient signal caused by thin fragments leading to depleted/reduced sample information. Based on the significantly smaller sample amount to be transported into the ICP-MS and on shorter integration intervals, a larger standard deviation that has an impact on the match criteria and a reduced discrimination power can be expected.

This presentation will evaluate the effect of smaller sample sizes on the analytical results (i.e., accuracy), and hence the discrimination potential of the method.

In this presentation, results from the investigation on over 70 fragments from three different float glasses will be presented. The selection of the glass samples was based on their different color and thermal history: a green non-tempered float glass (Vegla, Herzogenrath/ Germany), a clear non-tempered float glass (Flachglas, Weiherhammer 1/ Germany), and a green tempered float glass (Libbey Owens Ford, Lathrop CA/ U.S.A) were investigated. Glass fragments of different sizes were selected from each of these glasses and physical properties (size, mass) were documented. Samples were analyzed using a standard LA-ICP-MS method using helium as a transport gas.¹ The effect of the limited sample size on the analytical results and the impact of reduced analytical information on the discrimination power using a standard LA-ICP-MS method were investigated.

The evaluation was done applying pairwise comparisons of the data sets using a modified four sigma match criterion already described in literature.² Results of a particular fragment size were compared with the results from different fragments of the same glass and were also compared with the results of glasses of different origin in order to evaluate type one and type two errors. Also, the application of modified ablation parameters with reduced repetition rate and smaller spot size is described and evaluated.

References:

- ¹ Latkoczy C., *et al.* Development and evaluation of a standard method for the quantitative determination of elements in float glass samples by LA-ICP-MS. *J Forensic Sci* 2005;50(6):1327-41.
- ² Weis P, Duecking 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* 2011;26:1273-84.

LA-ICP-MS, Float Glass, Sample Size