B41 Forensic Analysis of Glass by LIBS — A Comparison to XRF and LA-ICP-MS for Elemental Profiling

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After attending this presentation, attendees will understand the role of LIBS and its impact on forensic elemental analyses.

This presentation will impact the forensic community and/or humanity by observing that LIBS is great complimentary elemental technique to aid in solving trace evidence related crimes.

Materials analysis and characterization can provide important information as evidence in legal proceedings. Although the utility of trace elemental analyses for comparisons for glass, paint fragments, bullet lead and metal fragments has been shown to offer a high degree of discrimination between different sources of these materials, the instrumentation required for the generation of good analytical data in forensic comparisons can be beyond the reach of many forensic laboratories. Scanning Electron Microscopy with an Energy Dispersive Spectrometer (SEM-EDX), X-Ray Fluorescence (XRF), Laser Ablation Inductively Coupled Plasma Atomic Emission Spectroscopy (LA-ICP- AES) and, more recently, LA-Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) have all been used in forensic laboratories for such elemental analysis determinations. Two different and recently developed Laser Induced Breakdown Spectroscopy (LIBS) instruments have been evaluated as tools for the forensic elemental analysis of glass and compared in performance to other elemental methods in order to determine the utility of comparing casework sized glass samples. The first of the two LIBS instruments utilized in this study is a Foster and Freeman (ECCO) Laser Induced Breakdown Spectrometer (*Worcestershire*, UK) which is a self-contained device that is operated at 1064 nm, delivering a single laser pulse; the spectral range for this instrument is 200-600nm. The second LIBS instrument is a newly developed laser delivery module, custom manufactured by Photon Machines (San Diego, CA USA), coupled to an Andor Mechelle spectrometer (South Windsor, CT USA) operating in the spectral range of 200-900 nm. The new LIBS contains a New Wave Research Solo III dual cavity laser (Fremont, CA USA) capable of delivering 2 laser shots within less than a microseond apart (two independent laser heads operating at 1064 nm) and a New Wave Research Tempest laser (Fremont, CA USA) operating at 266 nm. The laser delivery module has the capability to deliver a single pulse (@ 1064 nm or @ 266 nm), a double pulse (1064 nm followed by 266 nm and vice-versa), and a triple pulse (i.e., 1064 nm-266 nm-1064 nm). All laser combinations will be studied to enhance signal in order to improve the elemental characterization of glass samples for forensic comparisons. Such developments in the instrumental design of these LIBS systems, designed to specifically address the analytical requirements of the forensic laboratory, are also presented. The power of LIBS-based elemental analysis to discriminate between different glass samples is also compared to the discrimination power of XRF and LA-ICP-MS. The relatively low cost, ease and speed of operation, and non-destructive nature of the LIBS analysis makes the technique a potentially viable forensic elemental analysis tool.

LIBS, Glass, LA-ICP-MS

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