A119 Comparison Study of Laser - Induced Breakdown Spectroscopy Using Glass Standards for Trace Elemental Analysis

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After attending this presentation, attendess will become familiar with the applications of LIBS and the conditions for obtaining and the analysis of LIBS spectra.

The impact of this presentation on the forensic community will include corroboration that data collection from one lab can be duplicated by another lab using a similar LIBS configuration (Rodriguez-Celis 08) and an investigation into utilizing trace elements for finer distinction between similar glasses such as automotive glasses.

The objective of this project is to investigate the sensitivity of the LIBS instrument using NIST standards 612 and 610. This is achieved by determining the number of trace elements that can be identified in NIST standards 612 and 610. Once the sensitivity is determined, 31 automobile glass samples will be analyzed for trace elements to determine individuality/uniqueness of these samples. The educational objectives of this presentation are to familiarize the attendee with the applications of LIBS and the conditions for obtaining and the analysis of LIBS spectra.

Modern LIBS instruments use a high power laser pulse to generate a plasma from the sample. Light is given off from the excited species in the plasma as they drop back to their ground state. The light from the different species is collected after an initial delay of approximately 1 µsec. The delay helps reduce the noise detected by the instrument. The collected light is dispersed by a spectrometer or monochromator, and then collected by a detector that sends the data to a computer to be analyzed (Miziolek 06).

Glass analysis was one of the first forensic applications of LIBS to be studied. Currently, density and refractive index are most often used to classify glass for forensic purposes (Saferstein 07). However, as glass manufacture becomes more standardized, the refractive indices and densities can overlap leaving no discernable difference among fragments of glass (Koons 01). Elemental analysis can supplement the analysis of physical properties of glass for greater discrimination among glass types and LIBS provides a quick and non-destructive elemental analysis of glass.

The first objective of this study is to investigate the reproducibility of glass comparisons reported in the literature. In their 2008 report published in Analytical and Bioanalytical Chemistry, Rodriguez-Celis et al. described the methodology for identifying glass from a common automotive source. The analysis consists of 3 important steps:

1. Optimization of the experimental setup to a statistical variation of less than 15%
    a. All data is collected at a constant detector delay of 1 µsec. and integration time of 2.1 msec.
2. Recording 100 spectra each from 15 locations on the glass sample
3. Correlating the linear and rank correlation coefficients to a library spectra (Generated in the lab)

The second objective of this study is to investigate the analysis of trace elements as a way to differentiate between similar types of glasses. As stated previously, the manufacture of glasses is becoming more standardized and there is less variation in glass compositions from manufacturer or even from plant to plant. However, there may be variations in the composition of trace elements from batch to batch within a manufacturer's products. One way to detect trace elements is to vary the detector delay to optimize the signal for certain elements. For example, under standard conditions, the line at 309.3 for Al was very week. When the detector delay was lengthened to 1.5 µsec., the line at 309.3 was enhanced relative to other lines in the spectra.

In conclusion, in this presentation we will report on the ability to apply the experimental conditions from one LIBS system to another lab as well as expanding into identification of trace elements as a means of further discriminating between glasses.

LIBS, Glass, Elemental Analysis

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