B174 Characterization of Automobile Float Glass With Laser Induced Breakdown Spectroscopy (LIBS) and Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS)

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The goal of this presentation is to present the results of a pilot study of Laser Induced Breakdown Spectroscopy (LIBS) and Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) for the discrimination of automobile glass.

This presentation will impact the forensic community and/or humanity by demonstrating how LIBS provides an alternative method to LA-ICP-MS that is more economical and allows more rapid data collection.

Forensic glass analysis provides direct comparison of questioned and known glass samples. For each of the 23 automobile float glass samples studied, shards from the same glass were analyzed using both LIBS and LA-ICP-MS. Refractive index measurements were also made on all 23 glass samples by the GRIM3 method. All LIBS measurements were made at the National Center for Forensic Science at UCF. All LA-ICP-MS and refractive index (RI) measurements were made at the South Carolina Law Enforcement Department (SLED) Columbia, SC. Pair wise comparisons were made of the data for all samples to determine discrimination factors for each technique.

The Ocean Optics LIBS2000+ system was used for data acquisition; it utilizes a Nd-YAG laser that emits at a fundamental wavelength of 1064 nm (Big Sky, model CFR200, 98 mJ/pulse, pulse width 7 ns). For the LIBS measurements, glass samples (float side) were analyzed by comparing 5 spectra each comprised of an average of 10 single-shot spectra (detector delay of 15 microseconds) in one spot. The LIBS sample chamber was purged with Argon gas for 45 seconds prior to initiation of the laser ablation, followed by a 30 second Argon purge after every 50 laser shots. This data was used to select 29 emission wavelengths that were shown to have reproducible intensities for repetitive scans. These emission lines were in turn used to calculate 13 ratios of intensities, a method that eliminates errors in data analysis that can be caused by laser shot-to-shot fluctuations. Of the 13 intensity ratios, 10 of these were selected based on their ability to discriminate between glass samples.

Previous research has shown that it is possible to discriminate auto- mobile samples based on their isotopic abundance using LA-ICP-MS plus the refractive index. The Agilent 7500s ICP-MS instrument used in this research utilizes a New Wave Research/Merchantek LUV 213 nm laser system for data sampling. In this work, 16 isotopes were selected for glass sample discrimination purposes. In order to determine sample discrimi- nation ability, ratios of these isotopes were used in order to minimize the effect of laser shot-to-shot fluctuations. Four (4) layers of glass are sequen- tially ablated by rastering across the surface of the glass. The first layer of the glass is ablated but not analyzed, while the next three layers of the glass are analyzed following ablation. For each layer that is ablated, 10 laser scans are taken and each scan is comprised of 12 isotopic mass spectro- metric analyses. Discrimination of different glass samples was accom- plished by comparison of data taken from the same layer of the respective glasses (*e.g.*, data from layer 1 from glass A is compared to data from layer 1 from glass B).

Twenty three (23) automobile glass samples (253 pair-wise compar- isons) were used for this study. Discrimination of the automobile glasses was achieved with the inclusion of the refractive index (RI) for each sample. Discrimination capability was measured for both LIBS and LA- ICP-MS at a 99% confidence interval (CI). For the LA-ICP-MS, data was collected for each layer of glass individually and was subsequently averaged. Using LA-ICP-MS and RI, 98.00% of the samples could be dis- criminated at a 99% CI. The use of LIBS and RI allowed 96.00% of these same glass samples to be discriminated at a 99% CI.

LIBS, Automobile Glass, Elemental Analysis

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