A113 Chemical Characterization of Solder and Other Metal Components in Improvised Explosive Devices by Laser - Induced Breakdown Spectroscopy

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After attending this presentation, attendees will have learned how chemical characterization by LIBS can provide important information about elemental analysis of metal components and solder used to construct improvised explosive devices.

This presentation will impact the forensic science community by presenting that LIBS be used as a fast screening method, with the potential to be used in the field, for the chemical characterization of trace metal scraps and solder fragments of IEDs.

Pipe bombs and other improvised explosive devices (IEDs) now pose a serious threat to our troops in other countries, as well as to our homeland security. IEDs can be easily assembled, are common weapons of war/terrorism and are being placed in busy public areas, such as, schools, shopping malls, stadiums and other public places. Fast screening methods that can quickly characterize the chemical composition of the components of these devices may assist in the investigation of bombimgs or attempted bombimgs. IED's can be composed of commonly available materials including commercial solder and the other metal components. The IED housing can also become an important item of physical evidence and therefore the chemical analysis of the metal components is an important facet of the forensic investigation. IEDs that have not detonated can be examined to develop investigative leads and to associate the device to a source of manufacture. Trace metal scraps and solder fragments found at the scene can also be gathered post-blast and evaluated for similar reasons. This evaluation needs to be fast and provide the personnel with the chemical characterization that identifies the components of the sample.

Laser-Induced Breakdown Spectroscopy (LIBS) has the potential to assist in the forensic investigation when metal components are required to be characterized. This presentation presents an approach where LIBS can be used as a fast *screening method*, with the potential to be used in the field, for the chemical characterization of trace metal scraps and solder fragments of IEDs. LIBS is a relatively new but emerging method of atomic emission spectroscopy that allows for multi-element and real-time chemical analyses with little or no sample preparation. With the sensitivity of approximately 10-100 mg/Kg (ppm), LIBS is able to chemically characterize metal and solder scraps in-situ. The LIBS instrumentation presented in this work consisted of a 266 nm Nd:YAG New Wave Tempest laser focused onto a sample surface requiring a surface of less than 50 microns in diameter and a single laser pulse therefore making the sampling almost non-destructive. Dual pulse LIBS is constructed in an orthogonal beam geometry where the first pulse was 266 nm ablation followed by 1064 nm Nd:YAG Big Sky laser reheating of the plasma. Chemical characterization methods for metal and solder fragments were developed using peak area and intensity analyses for the proven discriminating element emission lines: Ag, Cu, Zn, Bi, In, Sb, Ce and La, with an Andor intensified CCD detector. Al, Cu, stainless steel and NIST 1131 standards were used in the development of the analytical protocols and to determine the precision, accuracy and repeatability of the LIBS analysis. Elemental profiling, both qualitative and quantitative, will also be conducted using X-Ray Fluorescence (XRF) for comparison and Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA- ICP-MS) for a confirmatory method. Different types of solders and metals were analyzed and results show that LIBS would is a viable method the chemical characterization of solder and other metal components of improvised explosive devices.

LIBS, Chemical Characterization, Improvised Explosive Devices

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