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POS-1 Investigation of Emission Enhancement in Dual-Pulse and Resonance-Enhanced Laser-Induced Breakdown Spectroscopy

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Laser-induced breakdown spectroscopy (LIBS) is an elemental analysis technique in which a high powered laser is used to create a plasma on the surface of a sample. The light emitted from this plasma through a de-excitation process is then collected and used to spectrally analyze the sample. Two techniques that can improve the signal-to-noise ratio of LIBS spectra are dual-pulse LIBS, which utilizes a second laser that couples into the plasma created by the first laser pulse; and resonance-enhanced LIBS, which is similar to dual-pulse LIBS except that the second laser pulse has its wavelength tuned to match a known atomic transition in the sample in order to improve the coupling to the plasma. This enhancement can be useful for applications where a single pulse LIBS signal would be too weak to produce accurate or even detectable measurements, such as in handheld LIBS.

Presented here are measurements utilizing these two techniques on steel and neodymium samples. The first pulse was provided by a 1064 nm Nd:YAG laser and the second pulse was provided by a tunable OPO laser (both having 10 ns pulse duration). Time resolved LIBS spectra were acquired using an echelle spectrometer with a time-gated intensified CCD providing sub-nanosecond timing resolution. LIBS emission enhancement due to the second laser pulse was measured as a function of laser power, OPO wavelength, interpulse delay time, and gaseous environment present in the chamber. These tests were conducted to determine optimal parameters for signal enhancement. Additionally, attempts to replicate these measurements in a vacuum chamber will be discussed.

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