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IMPACT OF OXYGEN CHEMISTRY ON THE EMISSION AND FLUORESCENCE SPECTROSCOPY OF LASER ABLATION PLUMES

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ABSTRACT

Oxygen present in the ambient gas medium may affect both laser-induced breakdown spectroscopy (LIBS) and laser-induced fluorescence (LIF) emission through a reduction of emission intensity and persistence. In this study, an evaluation is made on the role of oxygen in the ambient environment under atmospheric pressure conditions in LIBS and laser ablation (LA)-LIF emission. To generate plasmas, 1064 nm, 10 ns pulses were focused on an aluminum alloy sample. LIF was performed by frequency scanning a CW laser over the 396.15 nm ($3s^24s\ ^2S_{1/2} \rightarrow 3s^23p\ ^2P^{\circ}_{3/2}$) Al I transition. Time-resolved emission and fluorescence signals were recorded to evaluate the variation in emission intensity caused by the presence of oxygen. The oxygen partial pressure (p_o) in the atmospheric pressure environment using N₂ as the makeup gas was varied from 0 – 400 Torr O₂. 2D-fluorescence spectroscopy images were obtained for various oxygen concentrations for simultaneous evaluation of the emission and excitation spectral features. Results showed that the presence of oxygen in the ambient environment reduces the persistence of the LIBS and LIF emission through an oxidation process that depletes the density of atomic species within the resulting laser-produced plasma (LPP) plume.

KEYWORDS

Laser ablation (LA); Laser induced fluorescence (LIF); Laser-induced breakdown spectroscopy (LIBS); Plasma chemistry; Combustion

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