Impact of oxygen chemistry on the emission and fluorescence spectroscopy of laser ablation plumes

K.C. Hartig, B.E. Brumfield, M.C. Phillips, S.S. Harilal

PII: S0584-8547(17)30179-9
DOI: doi: 10.1016/j.sab.2017.07.002
Reference: SAB 5275

To appear in: *Spectrochimica Acta Part B: Atomic Spectroscopy*

Received date: 10 April 2017
Revised date: 5 July 2017
Accepted date: 6 July 2017

Please cite this article as: K.C. Hartig, B.E. Brumfield, M.C. Phillips, S.S. Harilal , Impact of oxygen chemistry on the emission and fluorescence spectroscopy of laser ablation plumes, *Spectrochimica Acta Part B: Atomic Spectroscopy* (2017), doi: 10.1016/j.sab.2017.07.002

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

K. C. Hartig[1,2,*], B. E. Brumfield[1], M. C. Phillips[1], and S. S. Harilal[1,*]

[1] Pacific Northwest National Laboratory, Richland, WA 99352, U.S.A.

[2] Nuclear Engineering Program, University of Florida, Gainesville, FL 32611, U.S.A.

[*] Corresponding Authors: kyle.hartig@ufl.edu; hari@pnnl.gov

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 ($3s^2 4s\ ^2S_{1/2} \rightarrow 3s^2 3p\ ^2P°_{3/2}$) 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 N_2 as the makeup gas was varied from 0 – 400 Torr O_2. 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