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(I) Advances in Laser Induced Breakdown Spectroscopy Assisted with Laser Induced Fluorescence

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The Laser-Induced Breakdown Spectroscopy (LIBS) technique involves several fields of science, such as laser-matter interaction, plasma physics, atomic physics, plasma chemistry, spectroscopy, electro-optics, and signal processing. The LIBS plasma is transient, unlike an inductively coupled plasma, arc plasma, or glow discharge plasma, which are all stationary plasmas. This characteristic makes the LIBS technique suffer from poor sensitivity by comparison to other optical emission spectroscopy techniques. During the last three decades, extensive research has been carried out to improve LIBS sensitivity and performances by several approaches such as double pulse mode, combining LIBS with laser induced Fluorescence (LIF), combining LIBS with microwave among other techniques. The approach of LIBS combined with LIF (LIBS-LIF) is an emerging analytical tool that has the potential to analyse rapidly and in-situ with little or no preparation of any kind of material. LIBS-LIF is therefore a good candidate to fulfil the needs for real time analysis of contaminant traces for environmental applications.

The LIBS-LIF approach uses a first conventional laser tuned to a fixed wavelength to ablate the sample and generate the plasma. Then, a second tunable laser (such as an optical parametric oscillator (OPO)) selectively excites the plasmas ablation and thus enhances the emission of spectral lines of interest. Different combination of excitation! Lines as well as plasma generation creation conditions were studied to optimise the performances of the LIBS-LIF for spectrochemical analysis in our laboratory and elsewhere. In this presentation, we will discuss the most significant research contributions for improving the quantitative analysis by LIBS-LIF in terms of sensitivity and accuracy for environmental, agriculture and mining applications. We will present some novel approaches aimed at the improvement of the analytical figure of merit of LIBS-LIF. Finally, a view point on the LIBS and LIBS-LIF combination and their future will be given and discussed.

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