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Laser-Induced Breakdown Spectroscopy (LIBS): A Highly Adaptive Spectroscopic Sensor for Process Monitoring

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Laser-induced breakdown spectroscopy (LIBS) is traditionally known as an atomic emission spectroscopy (AES) technique that has the inherently attractive and useful capability to detect, identify, and quantify the chemical composition of any material in any form (e.g. gas, liquid, solid, conductive or non-conductive). The technique utilizes a pulsed laser focused on a small spot to create a micro-plasma. The resulting light emission is collected optically and then resolved temporally and spectrally to produce a spectrum containing emission lines from the atomic, ionic, and molecular fragments created by the laser-induced plasma. There is also enormous potential when LIBS is instrumentally configured in a stand-off design for chemical stand-off analysis. LIBS is being used as an analytical method by a growing number of research groups. The growing interest in LIBS, particularly in the last decade, has led to an increasing number of publications on its applications, both in the laboratory and in industry.

In this presentation we will discuss new approaches which enhance the LIBS capabilities in terms of selectivity, sensitivity and accuracy. Also, we will give an overview on the LIBS state of the art and its application, both in industry for real time measurements for process monitoring and in the laboratory. Additionally, the foundation of Molecular-LIBS (MO-LIBS) applied to the analysis of pharmaceutical materials will be presented. MO-LIBS is the result of the innovative combination of LIBS with chemometrics. The development of MO-LIBS may lay the foundation for analytical and spectroscopic advances. The broad range of current LIBS applications, instrumental configurations, and novel analytical applications that result from the unique selectivity of atomic and molecular emission and adaptively made possible by LIBS make it an attractive sensor technology. This spectroscopic technique may open up new fields in analytical chemistry.