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Potential applications of Laser Induced Breakdown Spectroscopy (LIBS) in geoscience: from the environmental analysis to the space exploration

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Text of Abstract

The Laser Induced breakdown Spectroscopy (LIBS) technique is an analytical tool employed in many applications such as environmental monitoring (soil contamination, air or water quality), materials analysis in industrial processing (mineral resources, impurities, quality control, sorting), biomedicine studies (teeth, bones), military and safety needs, space exploration (meteorites and planet surface analysis), and artwork analysis. In the last decade, the most fundamental studies on Laser Induced Plasma (LIP) have been carried out for the improvement of the experimental conditions of the LIBS technique to perform quantitative analysis on different samples.

In particular, LIBS analytical peculiarities and the extended knowledge of LIP characteristics suggest that this technique can be efficiently applied in automatic and eventually compact systems to be employed in different and hostile environments.

The LIBS technique is defined as the optical emission spectroscopy of the plasma produced by laser-matter interaction, and has been largely investigated in the last two decades in many applications of LIP.

The main advantages of LIBS with respect to conventional analytical techniques are the fast response and high sensitivity (tens of ppm); the extremely wide range of materials that can be investigated without the use of an analytical chamber; the great chance to perform *in situ* analysis; no requirement for surface treatment of samples; and the flexibility of the experimental set–up configuration leading to a compactable and automatic system.

Recently, the Double Pulse Laser Induced Breakdown Spectroscopy (DP-LIBS) technique is becoming the analytical tool that is successfully employed in many applications from the analysis of soils, rocks, meteorites to underwater samples. The DP-LIBS is more sensitive and has a more stable emission signal as a consequence of the better performance, in terms of signal enhancement, as compared to Single Pulse LIBS (SP-LIBS).