# Environmental and biological applications of Laser-induced breakdown spectroscopy

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## Abstract

Laser-induced breakdown spectroscopy (LIBS) was used to determine the total amount of carbon and nitrogen in soils, and it was also used to determine the total amount of palladium and silver metal in biofilms. These results were correlated to standard laboratory based techniques such as soil combustion technique for carbon and nitrogen analysis and atomic absorption spectroscopy in the case of calibrating metals in biofilms. The greatest advantage of LIBS is its capability for remote chemical analysis of samples with minimal handling and little or no sample preparation, which minimizes generation of waste to the micro gram per pulse of ablated material. The ultimate goal is the development of field portable instrumentation using this technique.

## Introduction

The ability of LIBS to provide rapid multi elemental microanalysis of bulk samples (solid, liquid, gas, aerosol) in the parts-per-million (ppm) range with little or no sample preparation has been widely demonstrated [1,2]. Laser spectroscopic techniques are very versatile for environmental chemical analysis because they offer real-time monitoring capabilities with high analytical sensitivity and selectivity [3,4]. These techniques are valuable for laboratory research. However, to take an instrument or technology into the field requires another level of research and development to ensure ruggedness, stability, reliability, a small instrument footprint, and calibration algorithms that have been tested for a variety of matrices that is the ultimate goal. The instrumentation and operation of a LIBS system is simpler than some of the more sensitive techniques, and analysis times on the order of minutes for LIBS make it more amenable for real-time analyses of chemical processes. Although calibration standards are required for quantitative analysis, the generation of a single calibration curve will suffice for analysis of samples in a similar matrix.