Laser-Induced Breakdown Spectroscopy for Quantification of Heavy Metals in Soils and Sediments

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Abstract: Laser-induced breakdown spectroscopy (LIBS) will be used to determine the contents of heavy metals in soils and sediments. LIBS results will be compared with the results obtained by inductively coupled plasma-optical emission spectrometry (ICP-OES) and inductively coupled plasma-mass spectrometry (ICP-MS).

1. Introduction

Pollution of the environment is a matter of great concern throughout the world. In particular, concern over the possible ecological effect of the increasing accumulation of heavy metals in the environment is growing. Soil is unanimously considered as one of the most important recipients of heavy metals released by several human activities [1]. Rapid analysis of heavy metals in soil is an important factor in modeling the effect of industrial pollution on agricultural soil. Determination of heavy metals in natural and polluted soils is generally conducted using flame-atomic absorption spectrometry (F-AAS), graphite furnace-atomic absorption spectrometry (GF-AAS), ICP-OES and ICP-MS, after appropriate sample pre-treatment. In recent years, LIBS is an emerging technique for quantitative analysis of heavy metals in environmental matrices [2]. Because of lack of pre-treatment of the sample as well as the speed of analysis, not mentioning the possibility of in situ analysis, this technique offers an attractive solution for a wide range of environmental applications. The main objective of this work is to demonstrate the feasibility of LIBS for detection of heavy metals in soils and sediments.

2. Results

The experimental setup was designed using a Q-switched Nd-YAG laser (10 Hz, $\lambda = 1064$ nm) and the emission signals were collimated by a lens into an optical fiber coupled to a high resolution LIB2000+ Ocean Optics Spectrometer with CCD detector. In this study, soil and sediment samples will be oven dried, ground, sieved and thereafter pelletized before analysis using LIBS. Calibration curves for determination of heavy metals will be constructed employing certified reference materials. In order to test the validity of LIBS technique, LIBS results will be compared with the results obtained on the same soil and sediment samples using ICP-OES and ICP-MS. The feasibility of LIBS for screening of heavy metals contamination in soils and sediments will be assessed.

3. References

[1] Senesi, G.S., Dell'Aglio, M., Gaudiuso, R., De Giacomo, A., Zaccone, C., De Pascale, O., Miano, T.M. & Capitelli, M., Heavy metal concentrations in soils as determined by laser-induced breakdown spectroscopy (LIBS), with special emphasis on chromium, Environmental research, **109**, 413-420 (2009).

[2] Santos Jr., D., Nunes, L.C., Trevizan, L.C., Godoi, Q., Leme, F.O., Braga, J.W.B., Krug, F.J., Evaluation of laser-induced breakdown spectroscopy for cadmium determination in soils, Spectrochimica Acta Part B, **64**, 1073-1078 (2009).