

Glass pearl analysis by means of LIBS technology

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Introduction

The LIBS (Laser-Induced Breakdown Spectroscopy) technology is an elemental analysis known for being a non-destructive and a semi-quantitative method. Moreover, it covers a large field of applications. Indeed, thanks to that technology, it is now possible to analyze a variety of elements from art pieces to fingerprints to rocks for instance. Besides, experiments are fast and easy, and remote measurements can also be practiced. That is why this developing technology has been chosen: the objective is to be able to analyze glass pearls (glass incorporated into a matrix). Calibration curves were plotted with elements of known concentrations. Using those curves will allow finding the LoD of some elements in order to determine the performances of the LIBS.

Experimental procedures

To determine calibration curves with each element from the pearl, the Czerny-Turner spectrograph which covers a spectral range of approximately 30nm was used. A plasma was created into the glass by a 266 nm ns Nd:YAG laser with an energy of 12 mJ. The light produced was collected by an optical fiber and the spectra were recorded using an Intensified Charge Coupled Device (ICCD). Measurements were carried out in ambient air at atmospheric pressure since the cameras are really fragile pieces. A tiny portion of matter was ablated by means of the laser by a 10x10 matrix sites. The duration of an experiment is typically about 1 min.

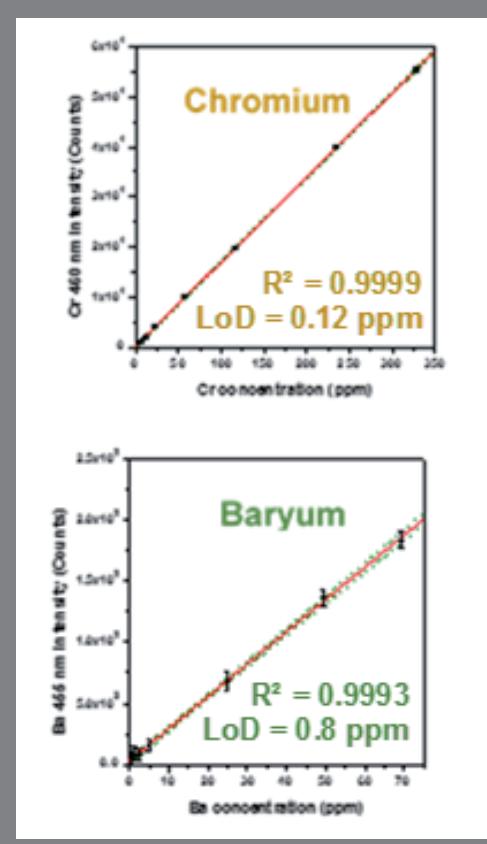
Results and discussion

Calibration curves were plotted with 8 reference samples in order to quantify unknown pearls then. Afterwards, we could carry out a quantitative analyze however, it is not the subject of this article. Firstly, the pearls were analyzed from the least concentrated to the most concentrated in Chromium and Barium amongst others shown in table 1. The results are illustrated in figure 1. An excellent linearity is observed. Moreover, the obtained LoDs are almost always below ppm. Determining the concentration of the unknown pearls in the elements

Element	Al I	Ba II	Ca I	Cr I	Fe II	K I	Na I	Si I	Ti II
Line (nm)	309.27	455.4	431.87	357.87	259.94	769.9	330.24	263.13	334.9
LoD (ppm)	0.29	0.91	3.9	0.12	4.99	0.56	7.9	39.1	0.6
LoQ (ppm)	58.5	2.1	322.2	2.9	19.4	59	434.4	873.7	1.4

Table 1 - Results of all the calibration samples

Figure 1 : Calibration curves of Chromium and Barium



Conclusion

The LIBS performances are shown through those results since elements below the ppm degree can be detected.



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