Comparison of optical spectrometers in inductively coupled plasma spectrometry

Quentin BERNABÉ

Introduction

The elemental analysis using inductively coupled plasma and optical emission spectrometry or ICP-OES is now established as a multi-element analytical technique for major elements, minor elements and traces. However, the detectors used in this type of devices are still less sensitive. Meanwhile, manufacturers are developing intensified Charged Coupled Devices cameras called "iCCD". During the completion of this project, a coupling of an ICP-OES with two different detection systems and a comparison of these two different assemblies were carried out.

Material and methods

The material used for this experiment was an ICP-OES Horiba/Jobin-Yvon JY138 Ultrace Prototype and a Horiba/Jobin-Yvon iHR 320 spectrometer with a photomultiplier detection and a Horiba/Jobin-Yvon iHR 320 spectrometer coupled with a Horiba/Jobin-Yvon iCCD camera model 320T. An optimization of each assembly was conducted before coupling to determine the optimal parameters to produce and detect plasma signal through the spectrometer. Then, the assemblies were carried out and different spectra for a multi-element solution containing 1 mg/L of Mg and 20 mg/L of Ni, Cd and Pb were obtained. The comparison was realized thanks to different analytical performance criteria like SBR, RSDb and finally LOD, obtained after calculation using spectra.

$$LOD\ (ppm) = \frac{3 \times SD \times Concentration\,(ppm)}{Signal\ net}$$

Results and discussion

An outstanding diminution of LOD is obtained with iCCD detector. The decrease is greater for elements like Cd and Ni with a factor about 20, than the diminution for elements like Mg. This difference is due to a variation of detection efficiency between the two detectors at some wavelengths.

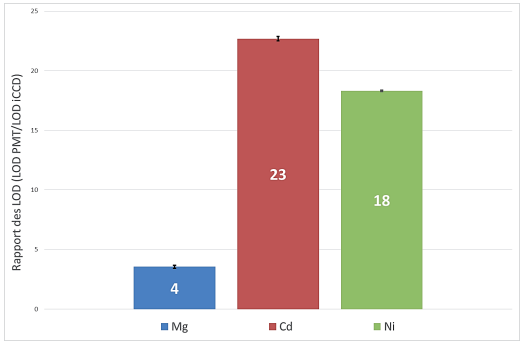

Figure 1: Histogram showing the relative PMT LOD / iCCD LOD depending on the studied element.

Conclusion

This study allows us to conclude that iCCD camera enables to increase sensitivity of the plasma detection compared to the detection with the PMT. It would be interesting to do this comparison in real condition, this means with an axial detection and a better connection by integrating the iCCD camera directly into the ICP-OES.

Institut des Sciences Analytiques
Equipe ANALISS
5, rue de la Doua
69100 Villeurbanne