SPATIALLY RESOLVED STUDIES OF OPTICAL EMISSION FROM DISCHARGE SOURCE FOR MASS SPECTROMETRY

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Radiofrequency Glow Discharges (rf-GD) are commonly used as plasma sources in combination with optical emission spectroscopy (OES) or mass spectrometry (MS) due to their ability to produce temporally and spatially separated atomization and excitation/ionization processes. Rf-GD spectroscopy is a fast and reliable analytical technique, which allows bulk and depth profile analysis, of conducting and non-conducting solid samples[1]. In addition, the time resolved signal acquisition of pulsed- rf-GD has been shown to be of particularly interest for analytical applications[2].

In this work, we have developed a new experimental set-up based on a rf-GD source coupled to GD-MS instrument. The ionization and excitation processes that take place in the GD plasma, which is operated in continuous and pulsed mode, have been characterized. In particular, the spatial distribution of the species in the GD has been investigated.

Two different plasma regimes have been observed when analyzing a copper sample. It was observed that their presence depends on the argon flow rate and pressure: for certain operating conditions the plasma colour is violet, principally due to discharge gas (argon) emission; while at the higher pressures the plasma turns into a green colour, due to an enhancement of the copper emission. Atomic and ionic emission lines have been measured at different distances from the cathode, along the plasma plume, for the two plasma regimes. Moreover, spatio-temporal 2D images of the emission of the pulsed-rf-GD plasma have been analyzed. The results show different population distributions of ionic, atomic and metastable states depending on the excited levels involved in the transitions. This work is relevant to the study of the ion production and ion transport phenomena from the discharge to the mass-spectrometer entrance.

1. R.K. Marcus, “Radiofrequency powered glow discharges: Opportunities and challenges”, J. Anal. At. Spectrom., 1996,11, pp. 821-828.
2. Ph. Belenguer, M. Ganciu, Ph. Guillot, Th. Nelis, “Pulsed glow discharges for analytical applications”, Spectrochim. Acta Part B, 2009, 64, pp. 623-641.

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