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DETERMINACIÓN ESPECTROGRÁFICA DE LAS VARIACIONES DE LA TEMPERATURA DEL PLASMA Y DE LA CONCENTRACIÓN DE ELECTRONES CERCA DEL LIMITE DE DETECCIÓN

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RESUMEN

Se prueba experimentalmente la factibilidad de la determinación de las variaciones de la temperatura del plasma y de la concentración de electrones para una pequeña cantidad de muestra (10^{-6} a 10^{-7} g) y durante tiempos de evaporación cortos ($<$ 10 segundos). De acuerdo con el procedimien-

to experimental descrito una selección apropiada de la altura de la hendidura del espectrógrafo y de la del fotómetro hace posible la fotometría de los pares termométrico y manométrico habituales de Zn y Mg.

ABSTRACT

The feasibility of determining the plasma temperature and the electron concentration variations is experimentally tested by a small sample amount (10^{-6} to 10^{-7}g) and during a short evaporation period ($\prec$ 10 seconds). According to the experimental procedure described, a proper selection of the spectrograph and photometer slit height allows the photometry of Zn and Mg common thermometric and manometric lines pairs.

INTRODUCTION

In this paper is our aim to give experimental evidence of the feasibility to record plasma temperature and electron concentration near the detection limits and during a short evaporation period.

To carry out racking plate spectra experiments by a small sample amount is troublesome, in optical emission spectroscopy. Generally it is no possible to obtain good density values for the spectral line.

In a previous paper (1) was described and theoretically

explained a experimental procedure to record racking plate spectra in the emission spectral analysis of solutions (2). Evaporations curves for Ti, Zn (10^{-7}g), Al, Pb, Fe, Ni (5×10^{-9}g) and Cu (10^{-9}g) were recorded.

The procedure consists in removing the schutter spring of the PGS-2 spectrograph slit (Carl Zeiss Jena). In this equipment it is also feasible to slide down the spectral plate with a constant speed (v).

The evaporation curve for a time period $t_1 \ldots t_2$ may be represented by $\Delta S(t)$, where S is the density value of the spectral line. $\Delta S(t)$ will be described generally by a distribution function with half width $\Delta t^{1/2}$ and length $t_b = t_2 - t_1$.

The spectrographs slit height (h) is of cardinal significance. This is due to the fact that as h increases the time resolution is reduced ($\Delta t^{1/2}$ growth). In this case the exposure time is also extended and higher S value at the maximum of the evaporation curve will be obtained. The optimum spectrograph slit height (h_{opt}) is given by

$$h_{opt} \approx t_b \cdot v$$

Fig. 1 ilustrates the relationship of the spectrograph slit height (h) with $\Delta t^{1/2}$ and S, for Pb and Fe spectral lines. Thus, (h) should be settle in order to obtain a good time resolution and an S value as high as possible.

A proper selection of the photometer slit height (h_{phot}) allows also the photometry of the common thermometric and manometric line pairs. The estimated value of h_{phot} is:

$$h_{phot} \leq \alpha \, h_{opt}$$

where α is the photometer amplification.

The photometer slit width can be selected as is usual in the optical emission spectroscopy.

The evaporation of Ni, Sn, Cd, Pb and As spectral lines (10^{-6}g) is showed in Fig. 2. The plasma temperature and electron concentration variation was obtained for a evaporation time of 6 seconds.

Fig. 2 makes evident the evaporation behaviour of the different spectral lines. The variations of the plasma temperature and the electron concentration values could be measure with a fair degree of accuracy.

The plasma temperature determination was performed with Zn 307,6/328,2nm (Zn 5 x 10^{-6}g). The electron concentration with Mg 279,5/ 278,0 nm (Mg 1 x 10^{-6}g). Normal spectral plates for spectrografic purposes (WU.3.ORWO), were used.

The plasma parameters record during the evaporation, according to this procedure, may be useful for the interpretation of the evaporation mechanism, or carrier selection in the optical emission spectroscopy with small sample amounts and near the detection limits.

REFERENCES

1. K. Doerffel, W. Matzkowski y J. González. Z. Chem, 18, 225 (1978).
2. J.I. Silberstein. J. Fis Tejnika 25, 1491 (1955)

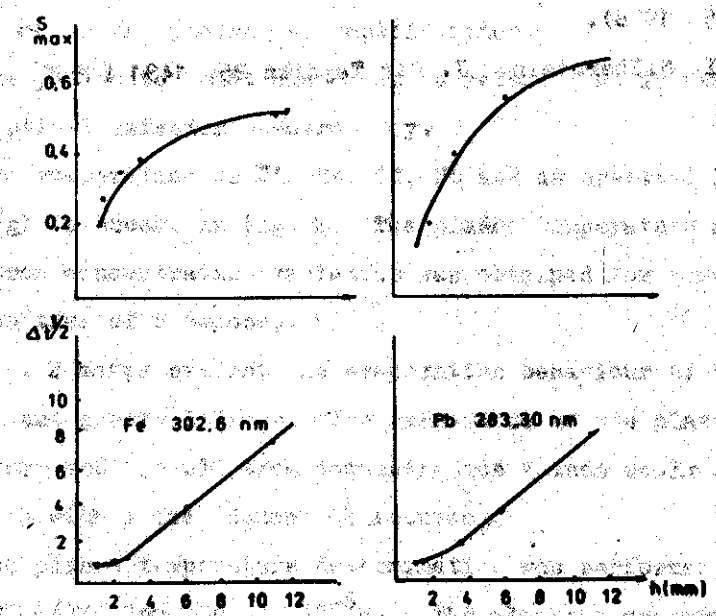
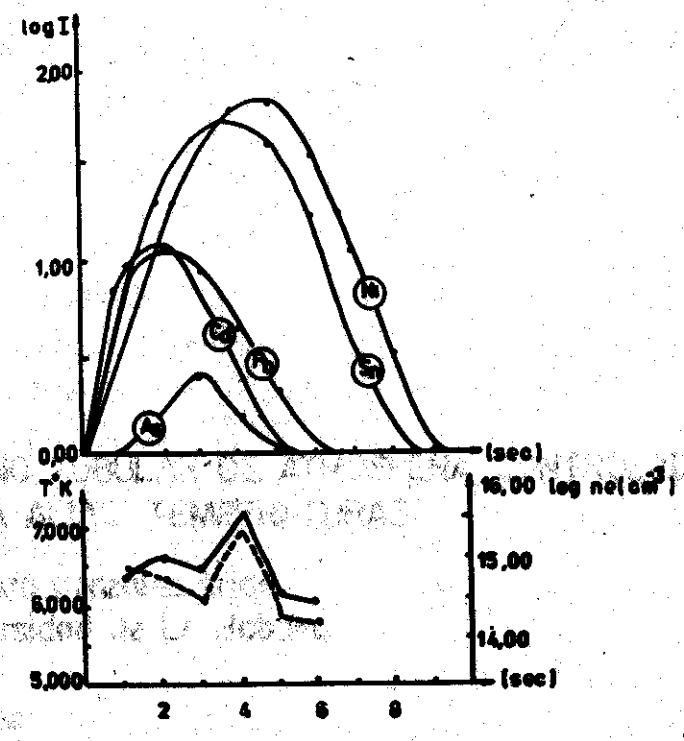


Fig. 1 Dependence of the spectrographs slit height with $\Delta t^{1/2}$ and S.



---- electron concentration

—— temperature

Fig. 2 Evaporation curves and plasma parameters variation