Journal of Analytical Atomic Spectrometry 1993 vol.8 N3, pages 387-395

Shadow spectral filming: A method of investigating electrothermal atomization. Part 3. Dynamics of longitudinal propagation of an analyte within graphite furnaces

Gilmutdinov A., Zakharov Y., Voloshin A.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

The dynamics of formation and dissipation of an Ag absorption layer in electrothermal atomic absorption spectrometry was investigated using the shadow spectral filming technique with different operating modes (i.e., gas-stop and gas-flow conditions and wall and platform atomization). The use of chemically inert Ag as the test element allowed the characterization of the influence of physical factors (mass transfer and adsorption-condensation of the vapour on the wall) during atomization in a graphite furnace. It has been shown that under gas-stop conditions the cross-sectional structure of the Ag absorbed layer is practically uniform. This uniformity testifies to the high efficiency of diffusional mass transfer in graphite furnaces. The use of an internal gas flow leads to pronounced distortion of the uniformity: for the duration of the atomization process there is a sharp decrease in the gas-phase concentration of Ag when going from the bottom of the furnace to the top. The results of imaging Hg vapour propagation along the length of the tube are presented. The results were obtained by replacing the graphite furnace by a quartz tube having the same geometry; the absence of the vapour near the cooler ends of the tube is shown. Analysis of all of the results allows the introduction of a new characteristic atomization parameter, the disappearance temperature, and a cascade mechanism of the analyte propagation in non-isothermal furnaces. The mechanism consists of a number of condensation-vaporization processes of the analyte as the temperature wave propagates along the length of the furnace during heating. The mechanism is important for relatively low heating rates when the velocity of diffusional propagation of the analyte vapour is higher than the velocity due to temperature propagation.

Keywords

Cascade mechanism of vapour propagation, Electrothermal atomic absorption spectrometry, Graphite furnace, Silver atomization