



Platform-to-platform sample transfer, distribution, dilution, and dosing via electrothermal vaporization and electrostatic deposition[☆]

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Abstract

A novel system for solid sample pretreatment, handling and dosing for analytical atomic spectrometry is described. A primary solid or liquid sample is vaporized in a graphite furnace and then condensed in a specially designed condensation zone. On the further transport path, the analyte aerosol can be diluted and distributed in pre-set ratios in the laboratory made flow control system. Applying a corona discharge, aerosol particulates are then quantitatively re-collected by means of intra-furnace electrostatic precipitation on the platform of another graphite furnace or by external precipitation on one or a set of platforms. This makes possible to produce a set of secondary platforms with equal analyte compositions from one individual primary sample. Such multitudes allow sequential multi-element determinations with single-element instrumentation or comparative measurements with different techniques. Furthermore, the described procedure allows external thermal sample pretreatment with preceding pyrolysis and additional vaporization, condensation, and re-precipitation that significantly reduces or removes the sample matrix. Owing to different losses, transport efficiencies of electrothermal vaporization (ETV) instrumentation depend on analyte element, matrix, vaporization temperature, ramp rate, and tube history. In order to reduce the losses and therewith such dependencies of the losses, new laboratory constructed ETV unit with analyte condensation in an axially focusing upstream convection zone has been constructed. Analytical performance of the new setup is compared with the performance of a commercial end-on flow-through ETV unit when analyzing both liquid dosed samples and certified solid reference materials. The new system shows much higher transport efficiencies that are, in addition, more uniform for elements of different volatility. The effects of chemical sample modifiers and elements supporting analyte condensation are studied. Most of the analytical measurements were carried out with a continuum source coherent forward scattering multi-element spectrometer. Comparative measurements were also carried out independently in the co-authors' laboratories with atomic absorption and inductively coupled plasma mass spectrometry techniques. © 2004 Elsevier B.V. All rights reserved.

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1. Introduction

Quantitative determination of trace elements in different matrices has become increasingly important practically all areas of human activity. Electrothermal atomic

absorption spectrometry (ET AAS), and inductively coupled plasma optical emission and mass spectrometry (ICP-OES and ICP-MS) are the most established techniques for the sensitive analysis of element trace concentrations. However, sample wet digestion with the risk of contamination and analyte losses, the use of concentrated acids at the sample preparation, and complications with analyte-matrix separation at the thermal sample pretreatment can considerably confine their application. These problems can be avoided by using direct solid sampling techniques [1].

[☆] Dedicated to Prof. Dr Drs h.c. mult. Arthur Scharmann on the occasion of his 75th birthday.

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