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Investigation of the atomization mechanism of gold nanoparticles in graphite furnace atomic absorption spectrometry

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Keywords

Graphite furnace atomic absorption spectrometry; Nanoparticle analysis; Atomization mechanism, Signal interpretation

Abstract

Recently, graphite furnace atomic absorption spectrometry (GFAAS) has been introduced as a new tool to distinguish between silver ions and nanoparticles using graphite furnace atomic absorption spectrometry (GFAAS) by evaluation of the newly presented parameters atomization delay (t_{ad}) and atomization rate (k_{at}). Moreover, sizing of NPs in aqueous suspensions by GFAAS measurement was shown by several authors. However, the atomization mechanism of NPs in GFAAS and possible differences to ionic salts introduced into the graphite furnace has not yet been investigated. In this work, therefore we study the newly introduced parameters and further peak characteristics, like full width at half maximum (FWHM), peak asymmetry and appearance time (t_{AP}) and their concentration-dependent trends applying ionic gold Au(III) standards as well as 5- to 100-nm-sized gold nanoparticles (AuNPs), respectively. Interpretation of the data helps to enlighten the atomization mechanism and kinetic of the atom release process of AuNPs in comparison to ionic Au(III). Ionic Au(III) shows a rising trend in t_{ad} with increasing gold concentrations, whereas t_{ad} is nearly constant for AuNPs over this concentration range. On the other hand, AAS peaks of ionic Au(III) reveal constant t_{AP}, while AuNPs show a shift in appearance time. Moreover, peak asymmetry differs for ionic Au(III) in comparison to AuNPs. These differences suggest different atomization mechanisms involved in the evaporation of gold atoms introduced into the graphite furnace as either ionic Au(III) solution or AuNP hydrosol.

1 Introduction

Metal nanoparticles are used in a wide field of industrial and consumer products due to their unique chemical and physical properties. Nanoparticles are applied in *e.g.*