

Interference-free determination of Ca in ultrapure water, concentrated acids and hydrogen peroxide using isotope dilution, ICP-MS and CH₃F as a reaction gas

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Abstract

An analytical method was developed for Ca determination in ultrapure water, concentrated acids and hydrogen peroxide by ICP-MS, using CH₃F as reaction gas in the dynamic reaction cell (DRC) and isotopic dilution (ID) as strategy of calibration for improve the accuracy and allow interference-free Ca determination.

Introduction

Ultrapure water, concentrated acids and hydrogen peroxide are often used in the solution and sample preparation for the determination of elements at ultra-trace levels, therefore the monitoring of impurities in these reagents is important to ensure the quality of the analytical results. Major cations, such as calcium ion (Ca²⁺), may be presents in low concentrations as contaminant from manufacturing process or improper storage and, in this context, the inductively coupled plasma mass spectrometry (ICP-MS) can be considered a well established analytical technique, with high sensitivity and detection power for determination at ultra-trace levels. However, the Ca determination by ICP-MS is not a trivial task, due the occurrence of spectral interference caused by isobaric overlaps in all isotopes [1].

Collision/reaction cell technologies can be an alternative for overcoming of these interferences and differents gases can be used to react with the analyte, such as the methyl fluoride (CH₃F), a highly reactive gas that promotes distinct reactions, forming a product with different mass-to-charge ratio than the initial and interference-free

[2,3]. Other advantage in use ICP-MS is the possibility of carry out isotopic dilution (ID) as strategy of calibration, improving the precision and ensuring high accuracy for the analytical method [4]. In this work, evaluated the use of CH₃F as reaction gas in ICP-MS and the use of the isotopic dilution as strategy of calibration for Ca determination at trace levels in ultrapure water, concentrated acids and hydrogen peroxide.

Metodology

All the measurements were carried out using a ICP-MS instrument, NexIon 300X (Perkin Elmer, Waltham, US) equipped with a cell that can be used as a dynamic reaction cell (DRC) or kinetic energy discrimination (KED). A 1:9 gas mixture of CH₃F/He was used as reaction gas in the DRC.

All aspects of the method development, parameters such as limits of detection and quantification, sensibility, strategies to correct spectral overlaps and the results obtained from DRC-ID-ICP-MS will be critically discussed.

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