

Ferrofluid-Based Preconcentration and Ultra-Trace Determination of Pt, Pd, Au, and Ag in Complex Matrices Using Inductively Coupled Plasma Mass Spectrometry

ABSTRACT:

This research focuses on developing a method for the ultra-trace determination of several noble metals (Pd, Pt, Au, and Ag) in natural waters through selective preconcentration using a ferrofluid. Specifically, Fe₃O₄ magnetic nanoparticles (MNPs) coated with silica and titania and functionalized with 3-mercaptopropyltrimethoxysilane and N-(2-aminoethyl)-3-aminopropyltrimethoxysilane were employed for the selective sorption of analytes. After injection of the ferrofluid into an aqueous sample, the functionalized MNPs adsorbed the target analytes within 5 min. The MNPs carrying analytes were then separated using an external magnet, followed by elution using 10% v/v aqua regia + 3% thiourea. The eluate was analyzed by inductively coupled plasma mass spectrometry. The effects of sample solution pH, eluent composition, elution time, and elution volume were investigated. Under the optimized conditions, the detection limits were improved by factor of 8 to 15 for Pt, Pd, Au, and Ag compared to those obtained without preconcentration. The accuracy of the method was verified by analyzing a certified reference material (CDN-PGMS-29) of ore containing noble metals, and the measured concentrations agreed with the certified values according to a Student's t-test at the 95% confidence level.

