NANO SPONGE Mn$_2$O$_3$ AS A NEW ADSORBENT FOR THE PRECONCENTRATION OF Pd(II) AND Rh(III) IONS IN VARIOUS SAMPLES

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Nanomaterials as adsorbents, with particle size of less than 100 nm in one or more dimensions, have attracted considerable attention from scientists in recent years, mainly due to their unique, attractive, thermal, mechanical, electronic and biological properties. One of the most interesting properties of nanomaterials is that a high percentage of the atoms of the nanoparticle are on the surface. The unsaturated surface atoms can bind with other atoms possessing strong chemical activities which produce a high sorption capacity and it can adsorb metal ions selectively.

In this study, a nano sponge Mn$_2$O$_3$ adsorbent was synthesized and characterized by X-ray diffraction, scanning electron microscopy and Brunauer-Emmet-Teller nitrogen adsorption–desorption analysis. The nano sponge Mn$_2$O$_3$ was used for the first time as an effective adsorbent for the preconcentration of the Pd(II) and Rh(III) ions in various samples prior to atomic absorption detection. Various parameters affecting the recovery values of Pd(II) and Rh(III), including pH, adsorption and elution contact times, centrifugation rate and time, eluent type, volume and concentration, sample volume, and interfering ions were examined. Optimum pH for both metal ions was found to be 6. The contact time of 30 s was enough for both adsorption and elution. Centrifuge speed and time were found to be 3500 rpm and 3 min. The elution was easily made with 2 mL of 2.0 mol L$^{-1}$ HCl. A preconcentration factor of 100 was obtained. Adsorption capacities were found to be 42 mg g$^{-1}$ for Pd(II) and 6.2 mg g$^{-1}$ for Rh(III). The tolerance limits (≥90%) for both Pd(II) and Rh(III) ions were found to be 75,000 mg L$^{-1}$ Na(I), 75,000 mg L$^{-1}$ K(I), 50,000 mg L$^{-1}$ Mg(II) and 50,000 mg L$^{-1}$ Ca(II). The detection limits for Pd(II) and Rh(III) were 1.0 µg L$^{-1}$ and 0.37 µg L$^{-1}$, respectively. The method was validated by analyzing the standard reference material, SRM 2556 (Used Auto Catalyst Pellets) and spiked real samples. The optimized method was applied for the preconcentration of Pd(II) and Rh(III) ions in water (sea water and wastewater), rock, street sediment and catalytic converter samples.

KEYWORDS: Nano-sponge manganese oxide, palladium, rhodium, solid phase extraction, rapid kinetic, atomic absorption spectrometry

REFERENCES: