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Synthesis, modification, characterization and application of AC@Fe_2O_3@MnO_2 composite for ultrasound assisted dispersive solid phase microextraction of refractory metals in environmental samples

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Abstract

Activated carbon-coated iron oxide @ manganese oxide nanoparticles (AC@Fe_2O_3@MnO_2) were synthesized by sol-gel method. Activated carbons (AC) were prepared from tyres after carbonization at 900°C and chemically activated using H_2O_2. The composite was characterized by scanning electron microscope/energy dispersive x-ray spectroscopy (SEM/EDS), transmission electron microscope (TEM), X-ray powder diffraction (XRD), nitrogen adsorption and FTIR. The Fourier Transform Infrared (FTIR) confirmed the presence of carboxyl and hydroxyl groups on the surface of AC. In addition, the TEM, SEM/EDS and XRD revealed attractive properties of the composite which further confirmed the union of metal oxide nanoparticles with the surface of AC. The composite was used as an adsorbent for ultrasound assisted dispersive solid phase microextraction (UA-DSPME) of Ge, Hf, Mo, Nb, Sb, Ta, Te, Sn, Ti, W and Zr in environmental water samples. Under optimized conditions, the limits of detection and quantification ranged 0.0004-0.02 µg L^{-1} and 0.001-0.07 µg L^{-1}, respectively. The precisions expressed in terms of the relative standard deviation (%RSD) were less than or equal to 5.2%.

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