以 gCN 為基底之聚合納米複合材料作為磁性固相萃取應用 LC-MS/MS 檢測環境水質樣品中的全氟化合物

gCN Based Polymeric Nanocomposite Material as Magnetic Solid Phase Extraction for The Detection of Perfluoro Compounds in Environmental Water Samples Using LC-MS/MS

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Abstract

The intrinsic adsorption properties of magnetic powder materials are typically challenging to study due to the agglomeration between particles. As a result, various functionalizations of the core shells have been studied extensively for the adsorption of specific target analytes. Functionalized polymer-based materials have grown in importance as removal medium from aqueous solutions during the past ten years. Polypyrrole and its modified form are crucial media in the removal of pollutants from water because of their inherent properties, such as adhesive coating with substrate, ease of chemical substitution, high chemical stability, ion exchange behavior, good electrical conductivity, and efficiency. To exemplify and examine the enrichment performance of polypyrrole functionalization on the adsorption of perfluorinated alkyl substances (PFAs), gCN based polymeric nanocomposite was synthesized and used as an adsorbent material. The diffusion and adhesion of PFAs on the adsorbent surface are known to be enhanced by significant electrostatic attractions, π-π interactions and hydrogen bonding. The prepared magnetic nanocomposite was tested against 9 PFAs in environmental water samples. Transmission electron microscopy, scanning electron microscopy, powder X-ray diffraction, X-ray photoelectron spectroscopy, dynamic light scattering and fourier transform infrared spectroscopy were used to characterize the produced nanocomposites. The developed magnetic solid phase extraction (MSPE) coupled with UHPLC-MS/MS technique has the following qualities: low detection limit in sub ppb levels, limit of quantification, high recovery, viable usage (>3), and acceptable range relative standard deviations which can fulfill the demands of ultra-trace PFAs according to standard CDC guidelines. This approach addresses the primary shortcomings of previously reported methodologies, including their higher detection limits, lengthy processes, and excessive use of organic solvents, thus making it viable for the detection and quantification of PFAs at ultra-trace levels.

Keywords: Magnetic solid phase extraction, Perfluorinated alkyl substances, Environmental water pollution identification, Environmental analysis, UHPLC-MS/MS detection