

High-rich graphene doped polymer nanofibers prepared via alternating current electrospinning for straightforward preconcentration of pollutants in environmental waters

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Abstract: A novel sorbent for solid phase extraction (SPE) based on hybrid nanofibrous polycaprolactone (PCL) containing graphene nanoparticles has been prepared. The preparation of hybrid polymer nanofibers with a very high – up to 1:1 polymer/graphene (w/w) ratio was achieved for the first time using alternating current electrospinning. The final appearance of these nanofibers was a thick porous layer that was cut into the shape of easy-to-handle extraction discs. Based on the preliminary study in which the graphene content varied, 30% graphene-doped nanofibers exhibited the highest recoveries and enabled a significant increase in the retention of analytes, 2–25 times in comparison to PCL. The incorporation of graphene resulted in a higher surface area of 12 g/m² compared to 2 g/m² determined for the native PCL nanofibers. This unique material was applied for a simple stirred disc sorptive extraction and preconcentration of trace levels of emerging organic environmental contaminants, bisphenols A, AF, AP, C, S, Z, 3-chlorophenol, and pesticides fenoxycarb, deltamethrin, and kadethrin from surface waters prior to HPLC-DAD determination. Optimization of the extraction procedure included conditioning, sample volume, extraction time, and elution solvent. Our novel desorption procedure carried out in a vial used for the direct injection into the HPLC system significantly reduced sample handling and minimized potential human error.

Keywords: Chromatography, Nanofibers, Sorptive extraction, Graphene, Disc, Environment pollutant

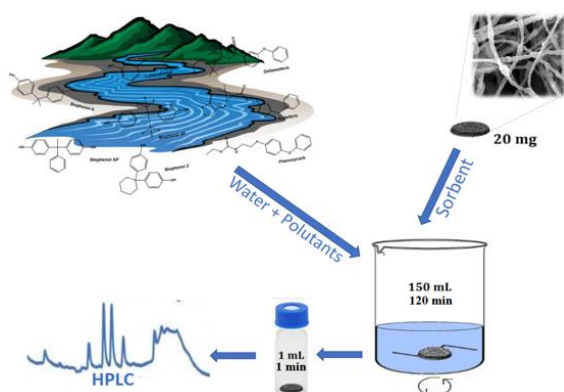


Figure 1 Graphic overview of the presented research

The research was based on several premises: Nanofibrous sorbents for solid phase extraction (SPE) have shown great promise for environmental analysis using liquid chromatography. AC electrospinning technique for the production of polymer nanofibers demonstrates indisputable advantages in the production of nanofibrous extraction sorbents with a high degree of porosity and amount of filler compared to conventionally used DC electrospinning [1].

This was accomplished by stirring the unsupported nanofiber disc in a large-volume sample with RSD of five extractions of 3–15%. Recoveries yielded 87–120%, except 52% for bisphenol S due to its high polarity [2]:

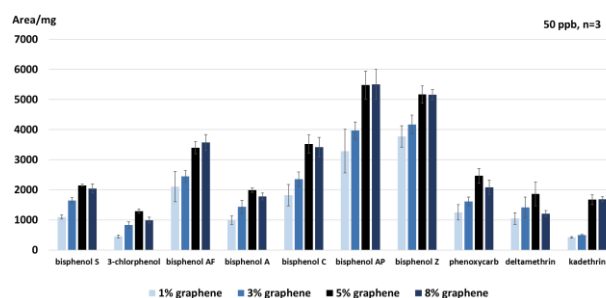


Figure 2 Extraction efficiency comparison of nanofibrous disks with various graphene ratio in nanofibers

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