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Communication

A dual-functional membrane for bisphenol A enrichment and resonance amplification by surface-enhanced Raman scattering

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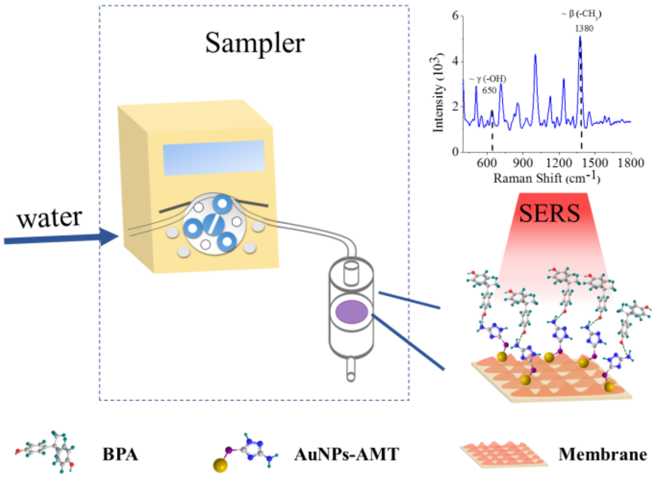
Graphical Abstract



A dual-functional membrane with enrichment and resonance amplification property, combined with an automatic sampler was designed for bisphenol A detection by surface-enhanced Raman scattering.

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ABSTRACT

Bisphenol A (BPA) was one of the environmental hormones that would cause endocrine and metabolic disorders in human or wildlife. This paper proposed a method to detect the trace amounts of BPA in water samples by fully utilizing the enrichment and resonance amplification functions of a new dual-functional membrane. In this work, gold nanoparticles (AuNPs) modified by 3-amino-5-mercapto-1,2,4-triazole (AMT) were embedded in nylon66 membrane to produce a dual-functional membrane which could carry out sample enrichment by capturing BPA molecules from water and achieve resonance amplification by connecting BPA to the surfaces of AuNPs. By designing an automatic sampler for large-volume enrichment, the SERS enhancement factor (EF) of the method was further improved to 1.2 $\times 10^5$. The present method had been successfully applied to detect BPA in drinking water and environmental water by SERS with the detection limit of 0.012 μg/L. It had the potential for on-site detecting of BPA in various water samples.

Bisphenol A, a raw material to produce polycarbonate plastic, epoxy resin, polysulfone resin and polyphenylene ether resin, is added to sealants of food cans, beverage packages, milk bottles and water bottles. It dissolves from plastic films and migrates to food, beverage and environmental water [1-4]. The endocrine system and reproductive system will be seriously interfered if excess amounts of BPA are absorbed [5-7] by human or wild animals. Many countries had adopted related regulations on BPA. The contents of free phenols including BPA must lower than 0.05 mg/L in PC bottle water in China. In European Union, migration of BPA from food contact plastic should be less than 0.05 μg/mL. In America, FDA had prohibited adding BPA in baby bottles and cups.

Conventional analytical methods for BPA detection including fluorescence analysis [8], cyclic voltammetry (CV) [9], gas chromatography–mass spectrometry (GC-MS) [10], high-performance liquid chromatography (HPLC) [11-13], have been used for quantification of BPA in waters. Fluorescence analysis is characterized by high sensitivity, but experiment conditions should be strictly controlled to eliminate influences from interferences. For cyclic voltammetry, the detection accuracy will be affected by the solution conditions. With the advantages of wide range of applications and excellent reproducibility, GC-MS and HPLC can greatly improve the efficiency of separation and quantitative analysis, but they are limited by low analytical speed and not suitable for on-site detection.

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