Microchimica Acta (2018) 185: 150
https://doi.org/10.1007/s00604-018-2692-y

ORIGINAL PAPER

# Polypyrrole coated ZnO nanorods on platinum wire for solid-phase microextraction of amitraz and teflubenzuron pesticides prior to quantitation by GC-MS

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Received: 8 November 2017 / Accepted: 18 January 2018 / Published online: 1 February 2018


## Abstract
The authors describe a new sorbent for amitraz and teflubenzuron pesticides. It consists of a platinum wire coated with polypyrrole-coated ZnO nanorods. The nanocomposite was prepared by a two-step process. In the first step, oriented ZnO nanorods were hydrothermally grown in situ on a platinum wire. Subsequently, oxidative vapor phase polymerization of pyrrole was performed on $FeCl_3$-impregnated ZnO nanorods to give a porous polypyrrole film. The organic/inorganic nanocomposite synthesized through hydrothermal deposition and chemical vapor deposition polymerization yields material with attractive properties. The coated wire was applied to solid-phase microextraction of amitraz (in the form of 2,4-dimethylaniline resulting from the hydrolysis of amitraz) and teflubenzuron. The effects of extraction temperature, extraction time, sample pH value and salt concentration were optimized. The analytes 2,4-dimethylaniline and teflubenzuron were then quantified by GC-MS. Under optimum conditions, the LODs range between 0.1 and 0.15 $ng.mL^{-1}$. Relative standard deviations at two concentration are <8.3% for intraday precision and <10.3% for inter-day precision. In all cases, the fiber to fiber reproducibility is <12.2%. For both analytes the linear dynamic ranges are 0.5–300 $ng.mL^{-1}$. The procedure was successfully applied to the analysis of spiked agricultural water samples.

**Keywords** Hybrid nanomaterials PPy/ZnO nanocomposite · Chemical vapor deposition polymerization · Hydrothermal deposition · Agriculture water samples

## Introduction

Sample preparation step is vital prior to the determination of organic compounds in environmental aquatic samples by chromatographic methods [1]. However, in order to uphold the principles of green chemistry, the extraction methods such as solid-phase microextraction (SPME), micro solid phase extraction (μ-SPE), stir bar sorptive extraction (SBSE) and liquid phase micro extraction (LPME) that minimize organic solvent consumption, are preferred to methods with high solvent consumption like solid-phase extraction (SPE) or liquid-liquid extraction (LLE) [2]. Various polar/ nonpolar compounds are available as commercial SPME fiber coatings. However, these fibers usually do not show significant chemical and thermal stability [3]. To overcome these problems, alternative coatings for SPME fibers were investigated. For example, the aluminum wire [4], stainless steel [5], zinc [3] and Pt wire [6] as metallic SPME fibers have been reported for the extraction of organic compounds. In SPME technique, a small amount of an intended adsorbent is immobilized on the surface of fused silica fibers, metal wires or stir bars as the stationary phase. The preconcentration and purification efficiency of SPME is directly linked to the type of coating. Adsorbent coatings play a key role in SPME and have always been the research hotspot [7].

**Electronic supplementary material** The online version of this article (https://doi.org/10.1007/s00604-018-2692-y) contains supplementary material, which is available to authorized users.

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