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Synthesis of cyclodextrin-silicate sol–gel composite embedded gold nanoparticles and its electrocatalytic application

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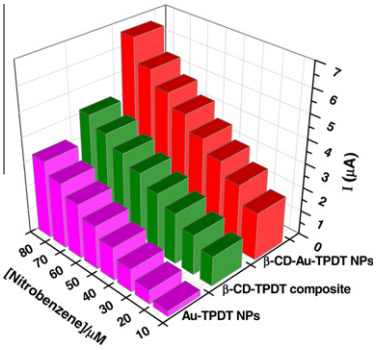
HIGHLIGHTS

- Synthesis of Au NPs embedded in TPDT sol–gel and β-CD nanocomposite materials.
- Size controlled Au NPs of ~4.9 nm embedded in β-CD–TPDT size obtained.
- TPDT–CD–Au electrode was used for nitrobenzene electrocatalysis and sensing.
- β-CD played a major role both in the synthesis and electrocatalysis.

GRAPHICAL ABSTRACT

The green and single step synthetic method for the preparation of gold nanoparticles (Au NPs) embedded in amine functionalized silicate (TPDT) and β-cyclodextrin (CD) composite in aqueous solution using biocompatible β-CD is presented. The electrocatalytic reduction and sensing of nitroaromatics were evaluated at the GC/β-CD–Au–TPDT modified electrode using the cyclic voltammetric and the square-wave voltammetric techniques.



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ABSTRACT

Single step synthesis of gold nanoparticles (Au NPs) in aqueous solution using amine functionalized silane and β-cyclodextrin (CD) composite is reported. High resolution transmission electron microscopy was used to characterize the 3 and 5 nm Au NPs embedded in β-CD-silicate sol–gel matrix (TPDT) composite. The electrocatalysis and the sensing of nitroaromatics were studied at the Au NPs embedded in the β-CD–TPDT composite modified electrode using the cyclic voltammetric and the square-wave voltammetric techniques. The square-wave voltammetric technique provides a facile, simple and fast quantitative method for the detection and determination of nitroaromatics at the Au NPs modified electrode. It is inferred that the β-CD plays a predominant role both in the green synthesis of Au NPs embedded in β-CD–TPDT composite and its applications in the electrocatalysis and sensing of nitroaromatics.

1. Introduction

The synthesis of Gold nanoparticles (Au NPs) with various sizes and shapes is always the fundamental key point for various applications [1,2]. Au NPs with the characteristic size dependent properties show a wide range of applications in catalysis, nanoelectronic and optical devices, and biosensor and other related areas [3–7]. Among the conventional synthetic methods, the most popular one is the reduction of $HAuCl_4$ by citrate in water to obtain Au NPs with size range varying from 10 nm to 150 nm [8–10]. The Au NPs, which display unusual physical and chemical properties

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