A mechanothermal approach for the synthesis of Fe_3O_4 nanoparticles as dopant on mesoporous TiO_2 for electrochemical determination of catechol

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Abstract
The subject of water contamination and how it gets defiled to the society and humans is confabulating from the past decades. Phenolic compounds widely exist in the water sources and it is emergent to determine the toxicity in natural and drinking water, because it is hazardous to the humans. Among these compounds, catechol has sought a strong concern because of its rapid occurrence in nature and its potential toxicity to humans. The present work aims to develop an effective electrochemical sensing of catechol using mesoporous structure of Fe_3O_4–TiO_2 decorated on glassy carbon (GC) electrode. The creation of pure TiO_2 using the sol-gel technique was the first step in the synthesis protocol for binary nanocomposite, which was then followed by the loading of Fe_3O_4 nanoparticles on the surface of TiO_2 using the thermal decomposition method. The resultant Fe_3O_4–TiO_2 based nanocomposite exhibited mesoporous structure and the cavities were occupied with highly active magnetite nanoparticles (Fe_3O_4) with high specific surface area (90.63 m2/g). When compared to pure TiO_2, catechol showed a more prominent electrochemical response for Fe_3O_4–TiO_2, with a significant increase in anodic peak current at a lower oxidation potential (0.387 V) with a detection limit of 45 μM. Therefore, the prepared magnetite binary nanocomposite can serve as an efficient electroactive material for sensing of catechol, which could also act as a promising electrocatalyst for various electrocatalytic applications.

Author keywords
Catechol; Magnetic nanoparticles; Mesoporous; Modified electrode; Sol-gel