Design of Novel Ytterbium Molybdate Nanoflakes Anchored Carbon Nanofibers: Challenging Sustainable Catalyst for the Detection and Degradation of Assassination Weapon (Paraoxon-Ethyl)

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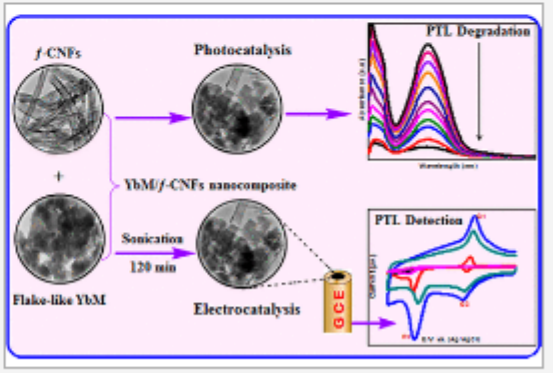
Abstract

Design of resourceful and sustainable catalyst for the trace level identification as well as detoxification of toxic pollutants into the environment is a major concern to researchers. In view of that, we developed novel flakelike ytterbium molybdate ($YbMoO_4$; YbM) anchored on carbon nanofibers (YbM/*f*-CNFs) nanocomposite via simple wet-chemical route followed by a sonication process. The physicochemical properties of as-prepared YbM/*f*-CNFs were carried out by several spectroscopic techniques. The YbM/*f*-CNFs nanocomposite exhibited excellent electrocatalyst as well as photocatalyst for the detection and detoxification of chemical warfare agent paraoxon-ethyl (PTL). Interestingly, the electrochemical results illustrated that the YbM/*f*-CNFs nanocomposite exhibited an excellent electrocatalytic activity in terms of enhanced cathodic peak current and lower peak potential when compared with other modified electrodes. Furthermore, the YbM/*f*-CNFs modified electrode showed more extended linear response ranges (0.01–12 and 14–406 μM), lower detection limit (2 nM), good sensitivity (2.8 $\mu A \mu M^{-1} cm^{-2}$), and excellent selectivity for the PTL sensing. Besides, the YbM/*f*-CNFs catalyst had good recovery to PTL in soil and water sample analysis. In addition, the YbM/*f*-CNFs nanocomposite possesses remarkable photocatalytic activity and stability toward the degradation and mineralization of PTL under visible light irradiation. Furthermore, a possible detection and degradation mechanism was proposed toward PTL. This study provides a novel idea for the design of proficient and stable bifunctional catalyst for the real-time identification and remediation of lethal pollutants.



KEYWORDS: Chemical weapon, Organophosphate, Paraoxon-ethyl, Detection, Degradation