Biosynthesized CoS by *Shewanella algae* for efficient organic pollutants degradation via PMS activation: augmented catalytic activity and minimized environmental toxicity

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Abstract Microbiologically influenced corrosion (MIC) was a significant form of corrosion in marine environments, caused by various microorganisms with different metabolic activities, making making it of significant research value. In this paper, a corrosive microorganism *Shewanella algae* was isolated from the steel rust layer, and its potential in preparing functional nanomaterials was explored. Briefly, a novel cobalt-based catalyst, CoS nanoparticle (SA@CoS), was biosynthesized by *Shewanella algae* utilizing its sulfur metabolic activities. SA@CoS was a nanoflower coated with protein/peptide and contained a large number of sulfur vacancies. Traditional synthesis methods for cobalt-based catalysts were known to result in cobalt ion leakage, causing secondary pollution to the environment. Nevertheless, inductively coupled plasma mass spectroscopy (ICP-MS) analysis suggested that SA@CoS exhibited a lower cobalt ion release (0.13 g/L) and greater stability compared to chemically synthesized CoS (1.03 g/L). Drawing on this, SA@CoS was employed to degrade Rhodamine B (RhB) and tetracycline (TC) by activating peroxymonosulfate (PMS). The results indicated that the degradation efficiency of RhB and TC could reach 99.9% (k_{obs} = 0.397 min^{-1}) and 90.5% (k_{obs} = 0.167 min^{-1}) within 10 min, respectively. Quenching experiments and ESR analysis indicated that both radical (O_2^-, OH and SO_4^-) and non-radical ($^1O_2$) pathways were involved in the degradation of RhB and TC, and non-radical pathway dominated the degradation process. The degradation pathways of RhB and TC were identified using liquid chromatography-mass spectrometry (LC-MS), which included processes such as hydroxylation, decarboxylation, deethylation, chromophore cleavage, ring-opening and mineralization. Furthermore, T.E.S.T. results indicated that the SA@CoS/PMS system could reduce the ecotoxicity and potential environmental risks of intermediates. This work offered a facile approach for the biosynthesis of stable cobalt-based catalyst, and demonstrated the promise of using biogenic nano-catalyst for environmental remediation.

Keywords *Shewanella algae*; Biosynthesis; Cobalt-based catalyst; Rhodamine B; Tetracycline; Peroxymonosulfate activation

Reference

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