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Solar light-driven CoFe₂O₄/α-Ga₂O₃ heterojunction nanorods mediated activation of peroxymonosulfate for photocatalytic degradation of norflurazon

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Abstract

Low frequency (40 kHz) ultrasound-assisted technique was utilized in the synthesis of CoFe₂O₄, GaOOH and α-Ga₂O₃ nanorods. CoFe₂O₄ was tethered successfully at the crystal matrices of GaOOH and α-Ga₂O₃ nanorods to form heterojunction nanocatalysts (CoFe₂O₄/GaOOH; CoFe₂O₄/Ga₂O₃). The heterojunction nanocatalysts were characterized using various analytical tools to confirm the expected modifications. The band gap of GaOOH (E_g = 4.50 eV) and α-Ga₂O₃ (E_g = 4.46 eV) are reduced in the formed heterojunction nanocatalysts CoFe₂O₄/GaOOH (E_g = 2.56 eV) and CoFe₂O₄/Ga₂O₃ (E_g = 2.51 eV), respectively. Moreover, the XRD and HR-TEM analyses demonstrate the formation of heterojunction nanocatalysts composed of the lattice diffusion of Co and Fe of CoFe₂O₄ into the matrix of α-Ga₂O₃ nanorods with good crystallinity. The photocatalytic efficiency was assessed during solar light-driven photocatalytic oxidation of norflurazon in single treatments and also assisted by peroxymonosulfate addition. The experimental results indicate that ~ 98% of the norflurazon (NRF) is oxidized within 40 min of solar light irradiation in the presence of CoFe₂O₄/α-Ga₂O₃ heterojunction nanophotocatalyst, having higher photocatalytic efficiency than benchmarked TiO₂ nanoparticles (Degussa P25). Moreover, the results also show that the addition of peroxymonosulfate (PMS) boosts the photocatalytic oxidation and achieving 99% NRF oxidation within 10 min of solar light irradiation by the generation of SO₄^{•−} and •OH radicals. The novel synthesized heterojunction nanophotocatalyst (CoFe₂O₄/α-Ga₂O₃) results to be highly stable after six consecutive operating cycles. © 2021 Elsevier Ltd

Author keywords

Low-frequency ultrasound; Magnetic nanocomposites; Mineralization; Norflurazon; Photocatalysis

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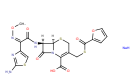
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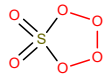
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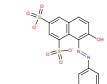
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