Accepted Manuscript

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PII: S0013-4686(18)31735-3

DOI: 10.1016/j.electacta.2018.07.217

Reference: EA 32414

To appear in: *Electrochimica Acta*

Received Date: 7 March 2018

Revised Date: 23 June 2018

Accepted Date: 30 July 2018

Please cite this article as: T. Zhang, H. Zhang, Y. Ji, N. Chi, Y. Cong, Preparation of a novel Fe_2O_3-MoS_2-CdS ternary composite film and its photoelectrocatalytic performance, *Electrochimica Acta* (2018), doi: 10.1016/j.electacta.2018.07.217.

Preparation of a Novel Fe_2O_3-MoS_2-CdS Ternary Composite Film and its Photoelectrocatalytic Performance

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Abstract: A novel Fe_2O_3-MoS_2-CdS film was fabricated by electrodeposition, hydrothermal reaction and chemical bath deposition. Its photoelectrochemical (PEC) performance for water oxidation and pollutants removal under visible light were studied. The results indicated that it is an effective strategy to fabricate the ternary heterojunction by Fe_2O_3, MoS_2 and CdS. The photocurrent density of Fe_2O_3-MoS_2-CdS composite increases by 40 times relative to pure Fe_2O_3 at 0.45 V vs. Ag/AgCl in 0.1 M NaOH aqueous solution under visible light irradiation. Among the tested films, Fe_2O_3-MoS_2-CdS exhibited the highest PEC activity for phenol degradation. The highest degradation efficiency (90.47%), rate constant (0.0076 min^{-1}) and electrochemical enhancement value (97.37%) were achieved under the optimized conditions. Hydroxyl radicals and superoxide radicals were considered as main active species. The excellent PEC performance was attributed to the ternary heterojunction structure formed by Fe_2O_3, MoS_2 and CdS, which efficiently reduced charge transfer resistance, facilitated charge transfer, and improved photoelectric conversion efficiency. Fe_2O_3-MoS_2-CdS is a promising composite material for PEC application in water oxidation and pollutants removal.

Keywords: Fe_2O_3-MoS_2-CdS; Visible light; Photoelectrocatalytic; Water oxidation; Phenol removal

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