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A brief study on the boosted photocatalytic activity of AgI/WO_3/ZnO in the degradation of Methylene Blue under visible light irradiation

Shirin Ghattavi[a,b,c], Alireza Nezamzadeh-Ejhieh[a,b,d,*]

[a]*Department of Chemistry, Shahreza Branch, Islamic Azad University, P.O. Box 311-86145, Shahreza, Isfahan, Iran,*
[b]*Young Researchers and Elite Club, Shahreza Branch, Islamic Azad University, Shahreza, Iran*
[c]*Department of Chemistry, Firoozabad Branch, Islamic Azad University, Firoozabad, Iran, email: ghattavi_44@yahoo.com (S. Ghattavi)*
[d]*Razi Chemistry Research Center (RCRC), Shahreza Branch, Islamic Azad University, Isfahan, Iran,*
email: arnezamzadeh@iaush.ac.ir (A. Nezamzadeh-Ejhieh)

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ABSTRACT

A novel visible-light-driven AgI/WO_3/ZnO nanocomposite was synthesized for the photodegradation of methylene blue (MB). The composite was characterized by XRD, UV-Vis DRS, SEM, BET, electrochemical impedance spectroscopy (EIS) and photoluminescence (PL) techniques. PL results confirmed lower PL intensity for the composite confirming a lower e^-/h^+ recombination for it. Both PL intensity and photodegradation activity of the resulted composites depended on the mole ratio of AgI, WO_3 and ZnO in the composite. The composite with a mole ratio of 2:1:1 (AgI:WO_3:ZnO) showed a broad PL peak at 698 nm which is 11.3 times weaker than that of WO_3 and ZnO and 3 times weaker than that of AgI alone. Among the composites with different mole ratios, this composite had also the lowest PL intensity. Initial photodegradation experiments showed that about 21%, 36%, 56% and 69% of MB molecules can remove by single ZnO, WO_3, AgINps and the composite (with a mole ratio of 1:1:1), respectively. The composite with a mole ratio of 2:1:1 showed also the best photodegradation efficiency and it removed about 79% of MB molecules during 40 min photodegradation process. MB solutions before and after photodegradation process were subjected to FTIR analysis and the results showed appearance of new peaks at 3452 and 1655 cm^{-1}, confirming degradation of MB molecules into the smaller fragments. The pseudo-first order reaction rate constants of 0.055 and 0.025 min^{-1} were estimated based on COD and UV-Vis results based on the Hinshelwood model. The catalyst showed good reusing applicability after 4 successive runs.

Keywords: AgI; WO_3; ZnO; Methylene Blue; Photodegradation catalysis; Composite

*Corresponding author.

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