A new route for synthesis of Ag-ZnO nanocomposite with enhanced photocatalytic activity

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Abstract

In this paper, a facile, green and cost efficient process was proposed for fabricating uniform Ag-ZnO nanocomposite with enhanced photocatalytic performance from layered double hydroxide (LHD). LDH material, based Zinc and Aluminum and intercalated by carbonates (Zn-Al-CO_3) were synthesized by co-precipitation method at Zn/Al molar ratio of 3. For increasing photocatalytic activity of LDH, the material was calcined at different temperatures (300, 400, 500, 600, 800 and 1000°C). Then the catalysts was doped by Ag noble metal with various Ag amounts (0, 1, 3 and 5 wt%) using ceramic process. The as-prepared photocatalysts were characterized by X-ray diffraction (XRD), fourier transform infrared spectroscopy (FTIR), thermal analysis (TGA-DTA) and transmission electron microscopy coupled to the energy dispersive spectroscopy (TEM/EDX). The photocatalytic activities of as-prepared undoped and Ag-doped LDH photocatalysts were evaluated for the photocatalytic degradation of caffeine as a model of pharmaceutical pollutant in aqueous solutions under UV irradiation. The effect of irradiation time, initial concentration of caffeine, catalyst dosage, initial pH and reuse was investigated. The Ag-doped LDH materials showed a significantly higher rate of degradation compared to undoped and standard Degussa P-25

titanium dioxide. The photodegradation of caffeine was increased with an increase in the Ag amounts. After 55 min of irradiation, 99.3% of caffeine solution (20 $mg.L^{-1}$) was removed with 0.3 $g.L^{-1}$ of the Ag-doped LDH (5 wt%) catalyst. The photocatalyst showed the height stability after 3 cycles. Therefore, this process can be developed as an economically feasible and environmentally friendly method to treat wastewater using sunlight.

Keywords: Ag-doped LDH; Photocatalytic activity; Caffeine; Wastewater treatment.