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ТЕХНИКА И ТЕХНОЛОГИЯ

СЕЛЬСКОЕ ХОЗЯЙСТВО

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STUDY OF THE PHOTOCATALYTIC ACTIVITY OF AG-ZnO AND Au-Ag-ZnO FILM IN THE DEGRADATION OF RHODAMINE B (RHB)

Summary

The degradation of organic pollutants based on semiconductor photocatalysts has attracted immense interest due to their vast potential for environmental protection and sustainable development. Among prominent semiconductors, zinc oxide (ZnO) is considered one of the most promising photocatalysts owing to its superior characteristics, such as environmental friendliness, high chemical stability, low cost, high efficiency, high electron mobility, large exciton binding energy (60 meV) at room temperature, and excellent photocatalytic performance. However, ZnO possesses certain drawbacks, including a wide band gap (3.3 eV) that limits its absorption to the ultraviolet (UV) region and a high electron-hole recombination rate, which reduces its photocatalytic efficiency.

Consequently, continuous research efforts have recently been conducted to extend the light absorption range and enhance charge separation efficiency to overcome these limitations. One effective approach involves anchoring noble metals, such as Au, Ag, and Pt, onto ZnO nanostructures. The surface plasmon resonance (SPR) properties of these noble metal nanoparticles effectively improve the photocatalytic capability of ZnO.

Keywords:

Ag-ZnO films, Au-Ag-ZnO films, Photocatalysis

I. Introduction

ZnO films decorated with Ag and Au nanoparticles were fabricated using the plasma jet technique. The thickness and physicochemical properties of the Ag-ZnO films were investigated as a function of varying Ag precursor concentrations. Furthermore, after depositing Ag nanoparticles at two different precursor concentrations, the addition of Au to the material system was also studied. The positive effects of Ag and (Ag, Au) nanoparticle deposition on the crystal structure, morphology, and optical properties of the ZnO films were comprehensively examined. Finally, the Ag-ZnO and Au-Ag-ZnO systems were evaluated for their photocatalytic performance in the degradation of Rhodamine B (RhB).

II. Plasma jet-assisted fabrication of ag- and au-loaded zno nanostructured films

In this section, a combination of hydrothermal synthesis, plasma jet deposition, and photoreduction was employed for film fabrication. First, the hydrothermal method was used to synthesize ZnO thin films on glass substrates. To prepare the Ag-ZnO films, a plasma jet technique was utilized to deposit and anchor Ag nanoparticles onto the ZnO surface.

Subsequently, a photoreduction process was applied to reduce the HAuCl4 precursor into Au nanoparticles, which were then loaded onto the Ag/ZnO structure to form the final Au-Ag/ZnO composite system.

1. Fabrication of ZnO Thin Films.

• **Step 1:** Preparation of the ZnO Seed Layer via Spin-Coating

A precursor solution was prepared by dissolving zinc acetate dihydrate Zn(CH3COO)2.2H2O in ethanol, with ethanolamine added as a stabilizer. The mixture was stirred at 50 °C for 1 hour to obtain a homogeneous solution. This solution was then deposited onto glass substrates using the spin-coating technique. Finally, the