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Plasmonic Photocatalyst for Photodegradation with Spinning Optical Disk Reactor

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1. Introduction

Since concern has been raised over the environmental contamination issue, environmental remediation and green energy has become one of the most high-profile topics in recent years. In this work, we developed an environmental benign process of growing large-area ZnO nanorods on optical disk substrate, which can easily accompany with the spinning optical disk driver to significantly accelerate the surface photocatalytic degradation reaction[1].

2. General Instructions

method of approach

In order to promote photocatalytic efficiency and make use of visible light, we deposit silver nanoparticles on the ZnO nanorods surface, see Fig. 1. (a, b). Noble metal nanoparticles dispersed into semiconductor photocatalysts was considered as plasmonic photocatalysis that possesses two prominent features—a Schottky junction and localized surface plasmonic resonance (LSPR), provided better charge separation and strong absorption of visible light, respectively[2]. UV and visible light source were fixed inside the reactor and employed during the reaction process for excitation of ZnO and plasmon, respectively. The photocatalytic activity was evaluated by the degradation of methyl orange dye (MO for short) as a model compound in aqueous solution. The degradation of MO molecules can be monitored by the optical spectroscopy measurements, thus the decomposition rate could be calculated accordingly[3].

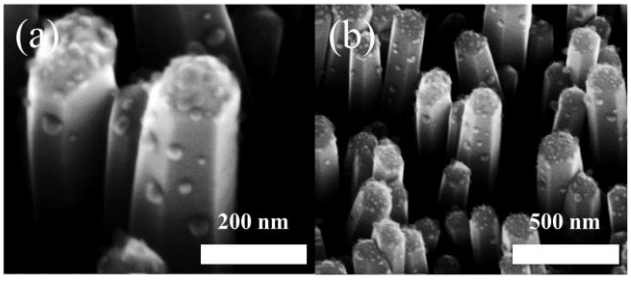

Fig. 1. (a, b) The SEM images of silver-sputtered ZnO nanorods. The sizes of the silver nanoparticles range from 10 to 45 nm.

Results

In the MO decomposition experiment, the variation of MO concentration directly displayed the photocatalytic ability of the ZnO nanorods. More than 13.9% MO was decomposed after a 20-minute treatment with visible light turned on, and the calculated chemical reaction rate constant was almost 50% larger than the one from experiment without any plasmonic effect, see Fig. 2. These results indicated that the plasmonic effect is well demonstrated through the apparent enhancement of photocatalytic reaction rate.

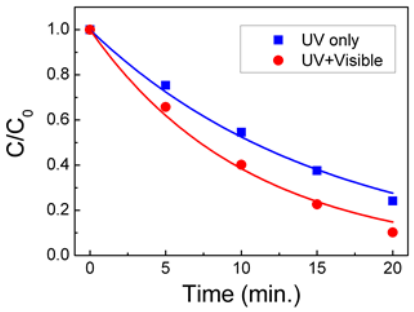

Fig. 2. The relative concentration at different time of reaction with and without visible light source. C is the concentration of MO molecules at time t, and C_0 is the original concentration.

3. Conclusions

In this work we had combined the intelligent spinning optical disk reactor with the plasmonic photocatalysis nanostructure, both promote the reaction efficiency and the latter also accomplish to make further use of visible light region, which composed a major part of sunlight. As the optical disk is widely used and quite available material in our daily life, this work is very prospective for the environmental treatment.

References

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