

Ionic liquid oxidation synthesis of Ag@AgCl core-shell structure for photocatalytic application under visible-light irradiation

Yuanguo Xu^a, Hui Xu^a, Huaming Li^{b,*}, Jia Yan^b, Jiexiang Xia^b, Sheng Yin^b, Qi Zhang^b

^a School of the Environment, Jiangsu University, Zhenjiang 212013, PR China

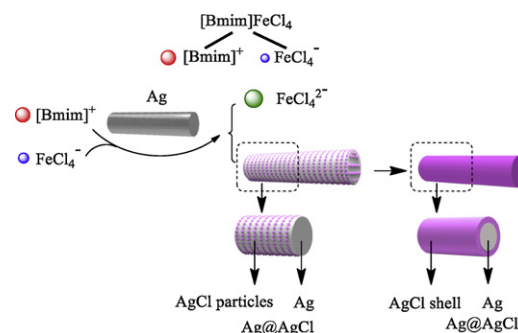
^b School of Chemistry and Chemical Engineering, Jiangsu University, Zhenjiang 212013, PR China

HIGHLIGHTS

- There was no report investigate Ag@AgCl core-shell structure synthesized by [Bmim]FeCl₄ IL.
- The photocatalytic activity of the catalysts is greatly depends on the etching time.
- The photocatalytic ability of the catalyst enhanced with the increasing of the plasmon absorption.
- The possible photocatalytic mechanism was proposed.

GRAPHICAL ABSTRACT

This is the first report investigates Ag etched into Ag@AgCl by [Bmim]FeCl₄ IL and its photocatalytic activity. The photocatalytic activity of the as-prepared materials had been investigated by the degradation of methyl orange and 4-chlorophenol under visible-light irradiation. The influence of the etching time on the photocatalytic activity of the sample was studied. We deduced the formation process of the catalyst and discussed the mechanism of the reaction process based on X-ray diffraction (XRD), scanning electron microscopy (SEM), UV–visible diffused reflectance spectroscopy (DRS), and X-ray photoelectron spectroscopy (XPS).



ARTICLE INFO

Article history:

Received 13 March 2012

Received in revised form 6 July 2012

Accepted 11 July 2012

Available online 20 July 2012

Keywords:

Ag@AgCl

Plasmon photocatalysts

Methyl orange

[Bmim]FeCl₄

4-Chlorophenol

ABSTRACT

Ag@AgCl core-shell nanocomposite was synthesized by using [Bmim]FeCl₄ IL etching Ag nanowires into Ag@AgCl in solution at room temperature. The obtained samples exhibited highly visible-light photocatalytic ability for the degradation of methyl orange and 4-chlorophenol in water solution. X-ray diffraction (XRD) and X-ray photoelectron spectroscopy (XPS) confirmed the presence of Ag and AgCl crystals. Scanning electron microscopy (SEM) images and X-ray energy-dispersive spectroscopy (EDS) of the samples revealed that AgCl nanoparticles (NPs) formed on the surface of Ag nanowires. UV–vis spectroscopy showed that Ag@AgCl core-shell structure enhanced its absorption in the visible-light region. The results showed that the absorption ability of Ag@AgCl was related to the change of Ag@AgCl. The absorption ability of the samples increased with the increasing etching time, and the enhancing photocatalytic ability was due to the increasing plasmonic absorbance of the photocatalysts. The effect of the etching time on the photocatalyst activity was studied, and the reaction mechanism was proposed.

© 2012 Elsevier B.V. All rights reserved.

1. Introduction

In the past decades, TiO₂ is widely used as a photocatalyst in the degradation of organic contaminants, disinfection, and other fields due to its high catalytic activity, non-toxicity and abundance.

* Corresponding author. Tel.: +86 511 88791800; fax: +86 511 88791708.
E-mail address: lihm@ujs.edu.cn (H. Li).