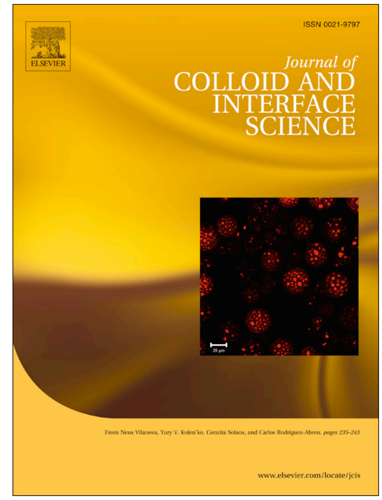
Accepted Manuscript



Yolk-porous shell nanospheres from siliver-decorated titanium dioxide and silicon dioxide as an enhanced visible-light photocatalyst with guaranteed shielding for organic carrier

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PII: S0021-9797(18)31126-3
DOI: https://doi.org/10.1016/j.jcis.2018.09.052
Reference: YJCIS 24103

To appear in: *Journal of Colloid and Interface Science*

Received Date: 2 August 2018
Revised Date: 3 September 2018
Accepted Date: 15 September 2018

Please cite this article as: J. Zhao, W. Li, L. Fan, Q. Quan, J. Wang, C. Xiao, Yolk-porous shell nanospheres from siliver-decorated titanium dioxide and silicon dioxide as an enhanced visible-light photocatalyst with guaranteed shielding for organic carrier, *Journal of Colloid and Interface Science* (2018), doi: https://doi.org/10.1016/j.jcis.2018.09.052

Yolk-porous shell nanospheres from siliver-decorated titanium dioxide and silicon dioxide as an enhanced visible-light photocatalyst with guaranteed shielding for organic carrier

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Abstract

A nagging problem for the decompostion of photocatalyst organic carrier can be expected to be resolved by shielding effect from our yolk-porous shell nanospheres. The nanospheres were synthesized by a facile strategy: polyporrole (PPy) and silver were deposited together on TiO_2 by chemical oxidative polymerization; then PPy/Ag-coated TiO_2 nanoparticles were encapsulated in silicon dioxide (SiO_2) shell with polyethylene glycol (PEG) as a pore-forming agent via sol-gel method based on hydrolysis of tetraethyl orthosilicate (TEOS). After removing intermediary PPy between yolk and shell by calcination and washing off PEG in shell, yolk-porous shell (SiO_2@void@Ag/TiO_2) nanospheres were formed. The voids in SiO_2@void@Ag/TiO_2 can serve as photocatalytic reactors. The channels in porous shell at outer layer provide passages for light transmission, dye molecule accessing and degradants out. More importantly, the euphotic and porous shell exhibited an impressive protection to organic carrier, lest unfavorable decomposition occurred. Yolk-porous shell nanospheres showed commendable performance with >99.5% of dye removal efficiency under 3 h visible light irradiation, higher than pristine TiO_2 and Ag/TiO_2 nanoparticles, due to the synergy effect of robust adsorption capacity and photocatalysis. Our work could provide a good strategy for developing novel carrier-based photocatalysts for environmental remediation application, which can be readily extended to the combination of other nanophotocatalysts and organic carriers for enhancing sustainable photocatalytic performance.

Keywords: yolk-porous shell nanosphere; photocatalyst; protective effect; dye removal; carrier

1. Introduction

Photocatalysis has received much attention in remedying air pollution and aqueous environmental problems in recent decades. As the most representative and popular commercial photocatalyst, TiO_2 has been widely used in self-cleaning, VOCs removal, water purification and splitting, as well as energy storage solution due to its low-cost and good chemical stability.[1] However, TiO_2 cannot harvest sunlight for economical and widespread availability because of its wide band gap (Eg=3.2 eV) only for ultraviolet light response. To address this problem, TiO_2 doped/decorated with noble metals/metal oxides has been extensively investigated, resulting in a variety of TiO_2-based nanophotocatalysts such as tungsten–nitrogen codoped TiO_2,[2] nitrogen-ion doped