Colloids and Surfaces A: Physicochem. Eng. Aspects 414 (2012) 132–139

Contents lists available at SciVerse ScienceDirect

Colloids and Surfaces A: Physicochemical and Engineering Aspects

journal homepage: www.elsevier.com/locate/colsurfa

Synthesis of ZnO nanoparticles using PS-b-PAA reverse micelle cores for UV protective, self-cleaning and antibacterial textile applications

Burçin Acar Çakır, Leyla Budama, Önder Topel, Numan Hoda*

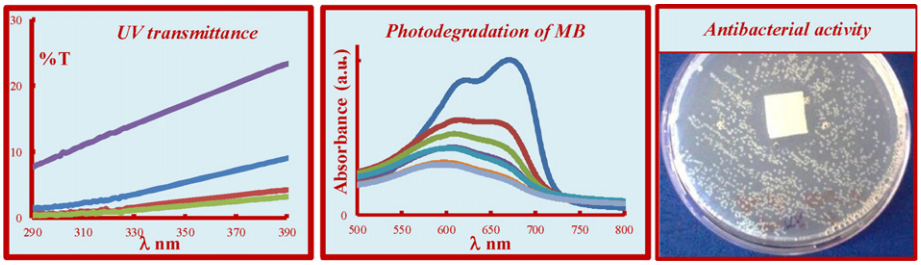
Department of Chemistry, Faculty of Sciences, Akdeniz University, 07058 Antalya, Turkey

HIGHLIGHTS

- ZnO nanoparticles were synthesized within PS-b-PAA reverse micelle cores.
- The copolymer solution including nano ZnO has been coated onto textile fabrics.
- The ZnO coated fabrics show UV-blocking, self-cleaning and antibacterial properties.
- Ultraviolet protecting factor (UPF) was determined as 50+ for all Zn:copolymer ratios.
- Photocatalytic efficiency of the nano ZnO coated fabrics was 78.2%.

GRAPHICAL ABSTRACT

UV-protective, self-cleaning and antibacterial properties of nano ZnO coated textile fabrics.



ARTICLE INFO

Article history:
Received 29 May 2012
Received in revised form 6 August 2012
Accepted 8 August 2012
Available online 2 September 2012

Keywords:
ZnO nanoparticles
Reverse micelle cores
UV-protective
Self-cleaning
Antibacterial
Functional textile fabrics

ABSTRACT

Zinc oxide (ZnO) nanoparticles have been synthesized in reverse micelle cores of PS(10912)-b-PAA(3638) copolymer synthesized by atom transfer radical polymerization (ATRP) at various precursor:copolymer ratios. The size and morphology of nano ZnO particles have been characterized via TEM and XRD measurements. The average size of nano ZnO particles were determined as 25 ± 6, 21 ± 4 and 22 ± 6 nm for Zn^{+2}:copolymer ratios of 10:1, 20:1 and 40:1, respectively. The copolymer solution including nano ZnO particles has been coated onto textile fabrics to enhance UV-blocking, self-cleaning and anti-bacterial properties. Ultraviolet protecting factor (UPF) indicating UV-blocking properties of nano ZnO coated textile fabrics were determined as 60, 179 and 271 for Zn^{+2}:copolymer ratios of 10:1, 20:1 and 40:1, respectively. Also, self-cleaning capacity was determined by investigating photocatalytic activity of methylene blue as well as antibacterial activity against facultative gram-negative *Escherichia coli* and aerobic gram-positive *Staphylococcus aureus*. It has been determined that the UV protective textile fabrics have rather high photocatalytic efficiency with 78.2% and antibacterial activity against *E. coli* and *S. aureus*.

© 2012 Elsevier B.V. All rights reserved.

1. Introduction

ZnO nanoparticles are widely studied materials due to their unique photocatalytic, electrical, electronic, optical, dermatological, and antibacterial properties [1–9]. ZnO nanoparticles need to be dispersed homogeneously in various matrices for these applications and as a result a number of synthesis strategies have been developed over the years. Several methods were employed to produce ZnO nanoparticles in solution such as gas-phase synthesis [10], wet-chemical synthesis [11], sol–gel [12], micro-emulsion [13], dry-casting [14] and micellar templating [15]. Among these, micellar templating technique provides excellent control on size and morphology of ZnO nanoparticles. In this method, block copolymer micelles are used as nanoreactors and nanoparticles are synthesized within micellar cores [16].

Breakdown of ozone layer in the earth's atmosphere has become more and more risky to human daily life. Since UV radiation triggers free radicals, long-term exposure of human skin to UV radiation

* Corresponding author. Tel.: +90 242 3102301; fax: +90 242 2278911.
E-mail address: nhoda@akdeniz.edu.tr (N. Hoda).

0927-7757/$ – see front matter © 2012 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.colsurfa.2012.08.015