Colloids and Surfaces A: Physicochem. Eng. Aspects 411 (2012) 40–49

Contents lists available at SciVerse ScienceDirect

Colloids and Surfaces A: Physicochemical and Engineering Aspects

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

Miniemulsion polymerized titania/polystyrene core–shell nanocomposite particles based on nanotitania powder: Morphology, composition and suspension rheology

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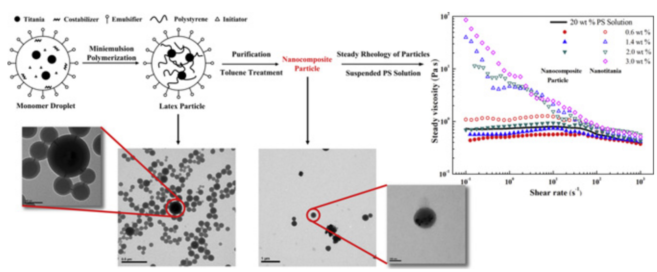
HIGHLIGHTS

- ► MPS modification improves the dispersibility of nanotitania in organic medium significantly.
- ► Core–shell nanocomposite particles of controllable size are prepared.
- ► Nanocomposite particles of 200 nm in diameter contain 22 wt.% cross linked PS shell.
- ► Nanocomposite particle suspensions deviate from Stokes–Einstein prediction.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 28 February 2012
Received in revised form 2 June 2012
Accepted 27 June 2012
Available online 10 July 2012

Keywords:
Miniemulsion polymerization
Core–shell nanocomposite
Polystyrene
Titania
Rheology

ABSTRACT

Core–shell nanocomposite particles with a diameter of 200 nm and containing 22 wt.% polystyrene (PS) and 78 wt.% titania were fabricated via miniemulsion polymerization of styrene in the presence of modified nanotitania powder. The PS shell of nanocomposite particles had a crosslinked structure. The effects of reaction temperature, emulsifier concentration, and costabilizer on morphology, size and size distribution were investigated. By adjusting these parameters, it was able to control the size and morphology of the nanocomposite particles. The nanocomposite particles had a fine dispersibility and compatibility with PS solution. Steady rheology of the core–shell nanocomposite particles suspended PS solution revealed a slight viscosity reduction deviating from Stokes–Einstein prediction at 0.6 wt.% particle loading and a slight viscosity increase to the level of pure PS solution at 2.0 wt.% particle loading, which was significantly different from the nanotitania suspensions.

1. Introduction

The design and fabrication of inorganic-polymer core–shell nanocomposite particles have gathered considerable interests recently, since these particles provide a new approach to construct functional nanostructured materials [1–3]. Inorganic-polymer core–shell structure combines the properties of the rigid core and the flexible shell ideally. The polymer shell provides the particles a fine compatibility with polymeric materials and also prevents the agglomeration of particles. Moreover, by adjusting the chemical composition of core–shell nanocomposite particles, for instance, titania is employed, they show some special properties in optics [4], electronics [5], and photocatalysis [6] and hence are potentially useful in the areas of coatings, cosmetics, catalysts and solar cells [7].

Varieties of encapsulation techniques have been developed to fabricate core–shell nanocomposite particles including emulsion polymerization [8,9], dispersion polymerization [10,11], miniemulsion polymerization [12–14], surface initiated controlled/living radical polymerization [15,16] and so on. Among these methods, the use of miniemulsion polymerization has been critical to fabricate core–shell nanocomposite particles with regular morphology

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http://dx.doi.org/10.1016/j.colsurfa.2012.06.043