J Nanopart Res
DOI 10.1007/s11051-009-9820-x

RESEARCH PAPER

Titanium dioxide-coated nanofibers for advanced filters

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Received: 29 January 2009 / Accepted: 23 November 2009

Abstract This article reports on titanium dioxide (TiO_2)-coated nanofibers deposited on a filter surface by the electrospinning process. After depositing a micrometer-thick film of polyamide 11 nanofibers on polypropylene fabric, TiO_2 nanoparticles can be directly electrosprayed onto the nanofibers. X-ray diffraction and Raman spectroscopy showed minimal change in the phase composition (anatase and rutile) and no change in the particle size of nanocrystalline TiO_2 after coating. Scanning electron microscopy demonstrated that nanofibers were uniformly coated by titanium dioxide nanoparticles without agglomeration. TiO_2-coated filters showed excellent photocatalytic-bactericidal activity and photo-induced hydrophilicity.

Keywords Electrospinning · Titanium dioxide · Photocatalyst · Filter · Fibers · Electrospraying · Nanomanufacturing

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Introduction

The electrospinning technique has been widely used for manufacturing nanofibers with different functionalities required in drug delivery systems, nanosensors, micro/nano electronic devices, scaffolds for tissue engineering and filtration media (Li and Xia 2004; Burger et al. 2006). In particular, electrospun nanofibers have high specific surface areas with a distinctive nanoscale surface texture, for which they have been extensively studied in applications ranging from high-performance filters to chemical and biological sensors, and protective clothing because their small mesh allows trapping of very small (submicrometer) particles (Ko 2006). As a result of this increased interest, the electrospinning method has been applied not only to polymeric materials but also to ceramics, particularly to metal oxides (Li et al. 2003). Among the metal oxides, titanium dioxide has attracted a great deal of interest for electrospinning applications because of its unique photoinduced catalytic activity and superhydrophilicity coupled with low cost, chemical stability and biological inertness (Im et al. 2008; Li and Xia 2003). In general, electrospun hybrid organic–inorganic fibers have been prepared either by co-electrospinning (Ko et al. 2003; Ko et al. 2006; Ye et al. 2004) or by impregnating inorganic precursors into a polymeric solution followed by the nucleation and growth of functional inorganic particles on the electrospun polymer fibers. However, co-electrospinning is not

Published online: 10 December 2009