Water Air Soil Pollut (2013) 224:1773
DOI 10.1007/s11270-013-1773-0

The Influence of Ni Dopant on the Structure and Photocatalytic Properties of Sol-Gel TiO_2 Nanopowders

Mălina Răileanu · Maria Crișan · Adelina Ianculescu · Dorel Crișan · Nicolae Drăgan · Petre Osiceanu · Simona Şomăcescu · Nicolae Stănică · Ligia Todan · Ines Nițoi

Received: 17 July 2013 / Accepted: 2 October 2013

Abstract In the present paper, undoped and Ni-doped TiO_2 sol-gel nanopowders have been prepared in order to establish the effect of Ni dopant on both material structure and photocatalytic properties. Two dopant concentrations of the transition metal (0.5 and 2 wt%) have been tested. The influence of both Ni dopant concentration and temperature of thermal treatment on the prepared powders has been followed using X-ray diffraction (XRD) method. A proper program has been used in order to establish the complete XRD structural characterization (lattice parameters, crystallite sizes, internal strains). X-ray photoelectron spectroscopy (XPS), transmission electron microscopy (TEM), and high-resolution transmission electron microscopy (HRTEM) coupled with surface area electron diffraction (SAED) techniques have completed the structural and morphological characterization of the prepared materials. Magnetic measurements and photocatalytic activity determinations have also been performed. The correlation between the results of the mentioned methods has been accomplished, and the detailed interpretation of the relation between structure and photocatalytic activity measurements has been done. The concentration of 0.5 wt% of Ni dopant ensures a better photocatalytic activity, compared to that of 2 wt%.

Keywords Sol-gel · Titania · Ni dopant · Structural study · Photocatalytic activity

M. Răileanu (✉) · M. Crișan · D. Crișan · N. Drăgan · P. Osiceanu · S. Şomăcescu · N. Stănică · L. Todan
"Ilie Murgulescu" Institute of Physical Chemistry, Romanian Academy, 202 Splaiul Independenței, 060021 Bucharest, Romania
e-mail: mraileanu@icf.ro

A. Ianculescu
Department of Oxide Materials Science and Engineering, "Politehnica" University of Bucharest, 1-7 Gh. Polizu, 011061 Bucharest, Romania

I. Nițoi
National Research and Development Institute for Industrial Ecology (ECOIND), 71-73, Drumul Podu Dâmboviței Street, 060652 Bucharest, Romania

1 Introduction

The semiconductor photocatalysts have been intensively studied in the past decades. They have been applied to a variety of problems of environmental interest in which the purification of water is concerned, with a primary focus on TiO_2 (Macwan et al. 2011; Malato et al. 2009). In spite of its advantages, TiO_2 presents the drawback of a limited photocatalytic activity to irradiation wavelengths in the ultraviolet region. In order to extend the TiO_2 spectrum response to the visible light domain, many attempts have been made, such as doping with transition metals. Their low cost and availability represent important advantages. Furthermore, the transition metal ions are commonly employed due to their property to strongly absorb the visible light as well as to their similar ionic radii to that of the parent titanium ion (Hermawan et al. 2011).

Published online: 19 October 2013