Journal of Alloys and Compounds 501 (2010) 143–147

Contents lists available at ScienceDirect

Journal of Alloys and Compounds

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

The effect of rare earth dopants on the structure, surface texture and photocatalytic properties of TiO_2–SiO_2 prepared by sol–gel method

R.M. Mohamed [a,b,*], I.A. Mkhalid [a]

[a] Chemistry Department, Faculty of Science, King Abdul Aziz University, Jeddah, Saudi Arabia
[b] Nanostructured Material Division, Advanced Materials Department, Central Metallurgical R&D Institute, Helwan, 11421 Cairo, Egypt

ARTICLE INFO

Article history:
Received 23 January 2010
Received in revised form 3 April 2010
Accepted 7 April 2010
Available online 20 April 2010

Keywords:
TiO_2–SiO_2
Rare earth
Photocatalytic
Oxidation
EDTA

ABSTRACT

The sol–gel method was successfully used to prepare a series of TiO_2–SiO_2 and rare earth (RE) (La^{3+}, Nd^{3+}, Sm^{3+}, Gd^{3+})-doped TiO_2–SiO_2 nanoparticles at a doping level of 3 atomic percent. The structural features of parent TiO_2–SiO_2 and RE–TiO_2–SiO_2 fired at 550 °C have been investigated by XRD, UV-diffuse reflection, SEM and nitrogen adsorption measurements at −196 °C. XRD data verified the formation of typical characteristic anatase form in all the prepared RE-doped TiO_2–SiO_2 samples. In comparison with the pure TiO_2–SiO_2 samples (ca. 35 nm in diameter), the RE–TiO_2–SiO_2 samples have relatively small particle size indicating that the doping with RE metal ions can improve the particle morphology, and retard the grain growth of TiO_2–SiO_2 during heat treatment. The results indicated that Gd^{3+} doped TiO_2–SiO_2 has the lowest bandgap and particle size compared with pure TiO_2–SiO_2 and other nanoparticles of RE-doped TiO_2–SiO_2. The highest surface area (S_{BET}) and pore volume (V_p) values were recorded for Gd–TiO_2–SiO_2 as well. The effect of doping on the photoactivity was evaluated by the photocatalytic degradation of EDTA as a probe reaction. Among all the pure and RE-doped TiO_2–SiO_2, Gd^{3+}–TiO_2–SiO_2 performed the highest catalytic activity towards the tested reaction. That might be due to its special characteristics of particle size, surface texture and bandgap properties. Details of the synthesis procedure and results of the characterization studies of the produced RE–TiO_2–SiO_2 are presented in this paper.