Accepted Manuscript

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Author: Joanna Reszczyńska Tomasz Grzyb Janusz W. Sobczak Wojciech Lisowski Maria Gazda Bunsho Ohtani Adriana Zaleska

PII: S0169-4332(14)00799-5
DOI: http://dx.doi.org/doi:10.1016/j.apsusc.2014.03.199
Reference: APSUSC 27635

To appear in: *APSUSC*

Received date: 28-2-2014
Revised date: 26-3-2014
Accepted date: 27-3-2014

Please cite this article as: J. Reszczyńska, T. Grzyb, J.W. Sobczak, W. Lisowski, M. Gazda, B. Ohtani, A. Zaleska, Lanthanide co-doped TiO_2: the effect of metal type and amount on surface properties and photocatalytic activity, *Applied Surface Science* (2014), http://dx.doi.org/10.1016/j.apsusc.2014.03.199

Lanthanide co-doped TiO_2: the effect of metal type and amount on surface properties and photocatalytic activity

Joanna Reszczyńska[1a,e], Tomasz Grzyb[b], Janusz W. Sobczak[c], Wojciech Lisowski[c], Maria Gazda[d], Bunsho Ohtani[e], Adriana Zaleska[a]

[a] *Department of Chemical Technology, Faculty of Chemistry, Gdansk University of Technology, 80-233 Gdansk, Poland*

[b] *Department of Rare Earths, Adam Mickiewicz University, 60-780 Poznan, Poland*

[c] *Mazovia Center for Surface Analysis, Polish Academy of Sciences, 01-224 Warsaw, Poland*

[d] *Department of Solid State Physics, Faculty of Applied Physics and Mathematics, Gdansk University of Technology, 80-952 Gdansk, Poland*

[e] *Catalysis Research Center, Hokkaido University, Sapporo 001-0021, Japan*

Abstract

Preparation of new rare earth metal-containing TiO_2 nanocomposites (Nd^{3+}/Er^{3+}, Nd^{3+}/Eu^{3+}, Eu^{3+}/Ho^{3+}-TiO_2) using sol–gel route and their photoactivity under visible and ultraviolet light is reported. The obtained photocatalysts were subsequently characterized by Brunauer–Emmett–Teller (BET) method, UV–Vis diffuse-reflectance spectroscopy (DRS), luminescence spectroscopy, X-ray photoelectron spectroscopy (XPS) and X-ray powder diffraction analysis (XRD). Photodegradation efficiency of phenol and acetic acid was estimated for visible light (λ>420 nm) and UV irradiation. It was found that introduced rare earth (RE) metals are presented in the form of metal oxides (RE_2O_3) at TiO_2 surface. Our study demonstrated that Eu^{3+}/Ho^{3+}co-doped titania exhibited higher photocatalytic activity than P25 in phenol degradation under visible light, whereas Nd^{3+}/Eu^{3+} co-doped TiO_2 showed one of the highest activities in both phenol and acetic acid degradation reaction either under UV and visible light among all the rare earth doped samples. Action spectra analysis of the selected samples clearly showed that RE-doped TiO_2 could be excited under visible light in the range from 420 to 450 nm.

Keywords: lanthanides; co-doping; TiO_2; heterogeneous photocatalysis; action spectra analysis.

[1] Corresponding author. Tel.: +48 58 347 13 90. Fax: +48 58 347 20 65. Department of Chemical Technology, Gdansk University of Technology, G. Narutowicza 11/12 80-233 Gdansk, Poland, E-mail addresses:j.reszcz@gmail.com (J. Reszczynska)