Photocatalytic properties of TiO_2 supported on $NaTaO_3$ and $NaTaO_3$ doped with Sm and La: Effect of the synthesis route

A. Cruz-López*, O. Vázquez-Cuchillo, L. M. Torres-Martínez and I. Juárez Ramírez

Departamento de Ecomateriales y Energía, Facultad de Ingeniería Civil, Universidad Autónoma de Nuevo León, Av. Universidad y Av. Fidel Velázquez S/N, Cd. Universitaria, San Nicolás de los Garza Nuevo León, 66451 México

*cruz_lopeza@yahoo.com.mx

Introduction

The production of particles with a specific size and morphology is of primary importance for the development of new materials. Mesoscale spheres of ceramic materials (TiO_2, Nb_2O_5, Ta_2O_5, ZrO_2 and $NaTaO_3$) are of particular interest for fundamental research in order to interpret physical properties or surface interaction quantitatively as a function of the morphology and size of the spheres[1]. Recently, the importance of tailored particles has been recognized in a number of applications such as ceramics, catalysts, solar cell and photonic crystals. For photocatalytic applications, $NaTaO_3$ has been reported as interesting materials due to theirs physical, chemical and structural properties. However, $NaTaO_3$ is only photosensible under ultraviolet light > 4.0 eV[2,3,4]. For looking the improvement of the photocatalytic efficiencies, in this work are compare two methods of the synthesis (Sol-Gel and Colloidal) at iso-conditions (raw materials and equimolar ratio) researching to increase the photocatalytic activity of $NaTaO_3$ and $NaTaO_3$ doped with 1% mol of Sm and La by impregnate 5% TiO_2 and test them as photocatalyst materials under UV light.

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Materials and Methods

Perovskite-type oxides were prepared by both the sol-gel [4], and colloidal methods. The materials were characterized by means of X-ray diffraction analyzes. Morphology was observed by scanning electron microscopy (SEM) and Transmission electron microscopy (TEM). Textural analyzes were determined through the specific surface area (BET) and band gap energy (Eg) of each material was calculated from diffuse reflectance in a UV spectrometer coupled with an integration sphere. The photo-degradation of 2,4-Dichlorophenoxyacetic acid (2,4-D) was carried out in a batch-type reactor with an inner irradiation cell under UV light.

Results and Discussion

Samples were characterized by X-Ray powder diffraction (XRD), it was observed the presence of $NaTaO_3$ phase. According to the SEM analyzes, it was possible to obtain NaTaO3 with nanometric size through both methods, sol-gel and colloidal. Samples prepared by sol-gel showed agglomerated nanoparticles. In opposite, by the colloidal method homogeneous spherical nanoparticles (around 150 nm) were obtained. Specific surface area measured by the N_2 physisorption showed the following values: $NaTaO_3$ by sol-gel method (20 $m^2.g^{-1}$) and $NaTaO_3$ by colloidal method (12 $m^2.g^{-1}$). The photo-degradation of 2,4-Dichlorophenoxyacetic acid using $NaTaO_3$ prepared by the colloidal method showed a better half time life ($t_{1/2}$=32 min^{-1}) than using $NaTaO_3$ prepared by the sol-gel method ($t_{1/2}$=65 min^{-1}). In addition, $NaTaO_3$ was impregnate with TiO_2. Its characterization was carried out by TEM analysis, where it was observed that TiO_2 are deposited around $NaTaO_3$. A slightly displacement of the band gap energy from 4.0 to 3.3 eV was obtained due the presence of TiO_2 (see Figure 1). Photo-degradation experiments are in progress to determine its photocatalytic activity.

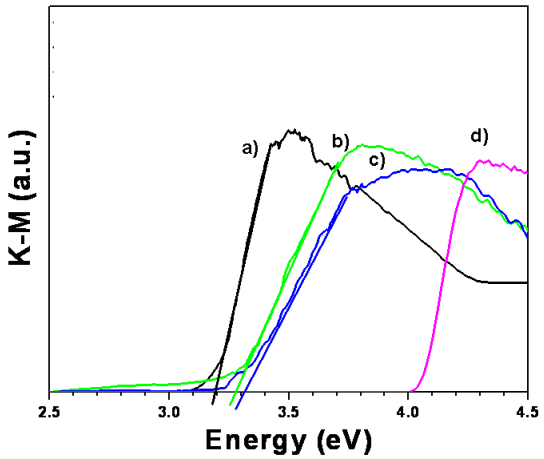

Figure 1. Results of band gap energy calculated by Kubelka Munk method. a)TiO_2, b)5%TiO_2-$NaTaO_3$, c) 1%TiO_2-$NaTaO_3$ and d)$NaTaO_3$.

References

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