XIV International Congress of the Mexican Hydrogen Society
Cancun, Mexico, 2014

XPS Study of Mixed Valence Titanium-Cobalt Oxides and it´s Electrocayalitic Activity for the OER.

J. Pérez Alvarez[1, 2,*], S.M. Fernández Valverde[3], L. Escobar Alarcón[2], A. Contreras Ramírez[3]

[1]Departamento de Física, Instituto Nacional de Investigaciones Nucleares, Apdo. Postal 18-1027, México DF, México.11801
[2] Centro Conjunto de Investigación en Química Sustentable UAEM-UNAM, Carretera Toluca-Atlacomulco Km 14.5, Unidad San Cayetano, Toluca, Estado de México, México 50200.
[3]Departamento de Química, Instituto Nacional de Investigaciones Nucleares, Apdo. Postal 18-1027, México DF, México.11801

* jonatan3101@yahoo.com.mx

ABSTRACT

Recently the electrocatalytic performance for the oxygen evolution reaction (OER) where correlated to the absorption energies OH and HOO* on oxide surfaces [1]. Co:TiO_2 thin films were deposited using two interacting plasmas produced from different targets [2], TiO_2 and cobalt. By keeping constant the laser ablation conditions on the TiO_2 target and changing them on the Co target, it was possible to vary in a controlled way the Co content in the films. The cobalt plasma parameters, such as the ion kinetic energy and plasma density, were determined for each deposition condition in an attempt to correlate them with the material's properties. The cobalt ion mean kinetic energy was varied from 36 to 789 eV, resulting in films with Co content from 1.2 up to 5.1 at.%, respectively, revealing that the cobalt content can be controlled by the Co^+ kinetic energy. The study of the optical properties showed that the optical band gap decreased from 2.9 to 2.0 eV as the Co content increased. Raman spectroscopy was use to characterize the microstructure of the deposits and the obtained results suggest the formation of two coexisting phases: TiO_2 in its rutile phase and $CoTiO_3$. It was found that as the Co^+ energy increases, the $CoTiO_3$ phase develops in a greater quantity. XPS measurements confirm the Raman spectroscopy results [3]. XPS study of the thin films with different cobalt content. The films where tested for the OER [4], the over potential, and the current density could be attributed to the different oxidation states of the Ti and Co present in the films. The presence of the different states since to change the distance between O-Ti-O-Co and consequently by electro catalytic activity for the oxygen evolution reaction. The obtained results be compare and discussed.

Keywords: Thin films ; Oxygen evolution reaction OER ; Xray Photoelectron Spectroscopy XPS

References.

[1] Isabela C. Man,Hai-Yan Su, Federico Calle-Vallejo, Heine A. Hansen,José I. Martínez, Nilay G. Inoglu, John Kitchin, Thomas F. Jaramillo, Jens K. Nørskov,and Jan Rossmeisl; *Universality in Oxygen Evolution Electrocatalysis on Oxide Surfaces*; **ChemCatChem**, 3, 1159–1165 (2011).

[2] Jonatan Pérez Alvarez; *Películas delgadas de TiO_2 modificado con Co para su aplicación en sistemas electrocatalíticos y fotocatalíticos*; **Tesis de Doctorado**, UAEMex, 2014.

[3] L. Escobar-Alarcón, J. Pérez- Alvarez, D. A. Solís-Casados, E. Camps, S. Romero, J. Jiménez-Becerril; *Preparation of Co:TiO_2 thin films by Crossed Beam Pulsed Laser Deposition*. **Applied Physics: A** 110 (4), 909-913 (2013).

[4] S. M. Fernández, J. Pérez Alvarez, J. Jimenéz, L. Escobar Alarcón; *TiO_2/Co_3O_4 Films Obtained by Pulsed Laser Deposition and sol-gel for the Oxygen Evolution Reaction in Alkaline Media* ; Proceedings of the 17th World Hydrogen Energy Conference; 601-604, (2008).