ELECTRON AND ATOMIC FORCE MICROSCOPY STUDIES OF ELECTROCHROMIC TUNGSTEN OXIDE THIN FILMS DEPOSITED ON GLASS BY THE PNEUMATIC SPRAY PYROLYSIS METHOD

Dwight R. Acosta, Jesús M. Ortega,, Arturo I. Martínez, Carlos R. Magaña, Aguilar Franco M., Juan. G. Morales.

Instituto de Física-UNAM. A. P. 20-364, 01000 México D. F.
dacosta@fisica.unam.mx

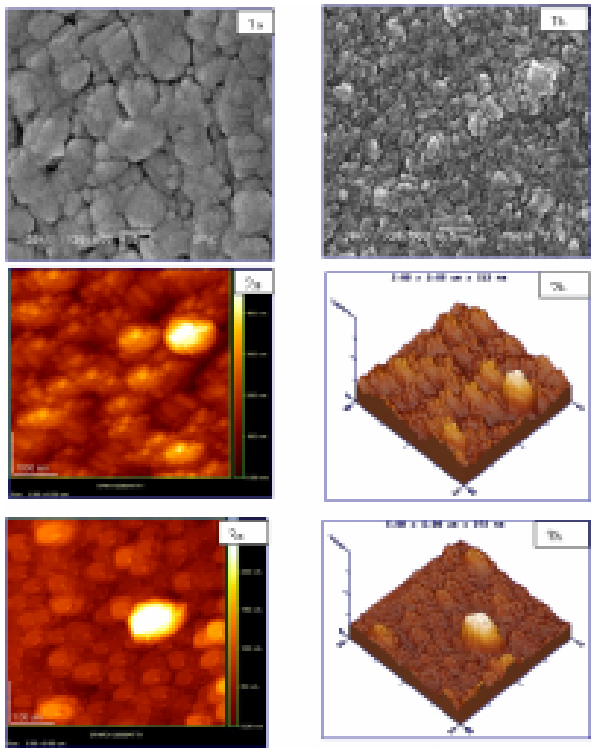
Thin films of electrochromic materials have a great interest because of their practical and potential applications in systems like displays, smart windows, variable reflectance mirrors, thermal radiators with variable emission, etc. The electrochromic materials are capable of changing their optical properties (transmittance and/or reflectance) under applied electric potentials; when that potential is stopped or it goes on reverse, these materials keep or return to its original optical state in a reversible way [1]. The variation of the optical properties is caused by of insertion/extraction of cations in the electrochromic film. The electrochromism is observed in many materials, but particularly intensive studies related to electrochromic, optical and structural properties have been performed in transition metal oxides like WO_3 [2].

Electrochomic thin films of Tungsten Oxide (WO_3) were deposited by the spray pyrolysis technique spraying 20 ml of 0.2 M solutions of WCl_6 in dimethylformamide at substrate temperature of 500 °C on FTO and glass substrates. In this work we have studied the substrate effects on the structural properties of the WO_3 layers, e.g. the triclinic structure was obtained on amorphous glass substrates and on polycrystalline FTO substrates, the triclinic structure was detected. Additionally, in WO_3 layers on FTO with different electrical resistivity, the electrochromic properties have been studied with the cyclic voltammetry technique using as electrolyte, 0.001 M of sulfuric acid. The effects of substrate on structural, surface morphological and optical properties of the films are presented and discussed in this work.

In this work we present the results of the synthesis and characterization of the WO_3 electrochromic films, which were produced using the spray pyrolysis technique. This technique is an interesting alternative to produce thin film coatings; the system wprk low price materials and it can be useful for large-area applications. Results of the electrochromic properties of pyrolytic WO_3 were presented in earlier works [3,4]; here we present new fabrication conditions that provide films with superior electrochromic properties, becoming an interesting alternative for fabricating electrochromic coatings respect to other techniques, like those based on vacuum deposition conditions.

References

1] C.G. Granqvist, Handbook of Inorganic Electrocromic Materials, Elsevier, Amsterdan,1995.
[2] Z. Guanghui, S. Awessel, H. Colbow, J. Phys, D: 21 (1988) 1802-1806.
[3] M. Camperter, R. S. Conell, D. A. Corrigan, Solar Energy Mater, 16 (1987) 333.
[4] J. Arakaki, R. Reyes , M. Horn, W. Estrada, Solar Energy Material, 37 (1995) 33.



Figures 1a and 1b. SEM micrographs from sample with 20 and 30 mL in the starting solution
Figures 2a and 2b. 2D and 3D AFM micrographs from sample with 20 mL in the solution
Figures 3a and 3b. 2D and 3D AFM micrographs form sample with 30 mL in the solution