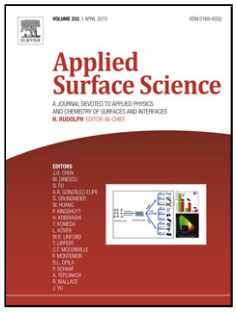

Title: Detailed microstructure analysis of as-deposited and etched porous ZnO films

Author: Congcong Shang Yohann Thimont Antoine Barnabe Lionel Presmanes Isabelle Pasquet Philippe Tailhades

PII: S0169-4332(15)00692-3
DOI: http://dx.doi.org/doi:10.1016/j.apsusc.2015.03.097
Reference: APSUSC 29974

To appear in: *APSUSC*

Received date: 4-2-2015
Revised date: 16-3-2015
Accepted date: 17-3-2015

Please cite this article as: C. Shang, Y. Thimont, A. Barnabe, L. Presmanes, I. Pasquet, P. Tailhades, Detailed microstructure analysis of as-deposited and etched porous ZnO films, *Applied Surface Science* (2015), http://dx.doi.org/10.1016/j.apsusc.2015.03.097

Detailed microstructure analysis of as-deposited and etched porous ZnO films.

Congcong SHANG, Yohann THIMONT, Antoine BARNABE,
Lionel PRESMANES, Isabelle PASQUET, Philippe TAILHADES.

Université de Toulouse III Paul Sabatier,
CIRIMAT – UMR CNRS 5085, Institut Carnot,
118 route de Narbonne, 31062 Toulouse Cedex 9, France

Abstract:

ZnO nanostructured materials in thin film forms are of particular interest for photovoltaic or photocatalysis processes but they suffer from a lack of simple methods for optimizing their microstructure. We have demonstrated that microporous ZnO thin films with optimized inter grain accessibility can be produce by radio frequency magnetron sputtering process and chemical etching with 2.75mM HCl solution for different duration. The as-deposited ZnO thin films were first characterized in terms of structure, grain size, inter grain space, open cavity depth and total thickness of the film by XRD, AFM, SEM, profilometry and optical measurements. A specific attention was dedicated to the determination of the surface enhancement factor (SEF) by using basic geometrical considerations and images treatments. In addition, the porous fraction and its distribution in the thickness have been estimated thanks to the optical simulation of the experimental UV-Visible-IR spectrums using the Bruggeman dielectric model and cross section SEM images analysis respectively. This study showed that the microstructure of the as-deposited films consists of a dense layer covered by a porous upper layer developing a SEF of 12-13 m^2/m^2. This two layers architecture is not modified by the etching process. The etching process only affects the upper porous layer in which the overall porosity and the inter-grain space increase with the etching duration. Column diameter and total film thickness decrease at the same time when the films are soaked in the HCl bath. The microporous structure obtained after the etching process could generate a great interest for the interfaces electronic exchanges for solar cells, photocatalysis and gas sensors applications.

Keywords:

ZnO, thin films, microstructure, surface morphology, optical properties, TCO, chemical etching, RF Sputtering