doi:10.1017/S1431927619004938
Microsc. Microanal. 25 (Suppl 2), 2019

SEM Study of Growth of SnO_2 Nanoflowers in Thin films by Spray Pyrolysis

A. Faudoa-Arzate[1*], H. Morales-Rodriguez[1], M. Sanchez-Carrillo[1], A. González-Vázquez[1], P.R. Realyvazquez-Guevara[2], J. Rojas[3], W.A Chávez-Montes[3]

[1] Universidad Tecnológica de Chihuahua Sur, Chihuahua. Chih. México.
[2] Instituto Tecnológico y de Estudios Superiores de Monterrey, Chihuahua, Chih., México.
[3] Centro de Investigación en Sustentabilidad Energética y Ambiental del Noreste, Matamoros, Tamps, México.
*Corresponding author: afaudoa@utchsur.edu.mx

It is well known that tin oxide is considered as one of the most important and studied materials for the fabrication of semiconductor gas sensors. A range of SnO_2 nanostructures, such as nanoparticles [1], crystalline nanowires [2], nanotubes [3], and nanoflowers structures [4], have been synthesized. Nanoflowers are formed by several layers of petals, forming structures of very large surface area in small volumes, improving the kinetics of adsorptions and reactions. According to the sensing mechanisms of gas sensors, the adsorption/desorption processes take place on the surface of the thin film and determine the response of the sensors. The sensitivity of gas sensors depends on the size, shape and specific surface area of the sensing material. Compared to other nanostructures, nanoflowers are promising candidates due special structures can normally provide a large surface to volume ratio that can facilitate gas diffusion and mass transport in the thin film sensor, thereby improving the sensitivity and response time of the gas sensor [5]. SnO_2 thin films were prepared by spray pyrolysis technique using an amount of 6g of $SnCl_4.5H_2O$ that was dissolved in 5 ml of methanol with 0.5ml of HCl by heating at 60°C for 10 minutes. Then 2 ml of distilled water and 5 ml of methanol was added in stirring for 10 minutes, subsequently the solution was diluted by 50 ml methanol. Microscope glass slides, cleaned with organic solvents and royal water, were used as substrates.

In Figure 1 shows the Grazing Incidence X-Ray Diffraction, the grazing angle was set at 0.2° over an angular range from 20° to 90°, with a scan step of 0.02° and a 10 s per step counter time. The prominent peaks were 33.69°, 37.89°, 51.69° that belongs to (101), (200), (211) planes. The XRD peaks with a SnO_2 tetragonal phase corresponded well with the JCPDS 41-1445. The intensities of the plane (110) are dismissed, in comparison with other SnO2 thin films, this phenomenon can be attributed to the petals growth. This type of petals is very similar to the ones founded in cupper nanoflowers. In the figure 2, show the nanoflowers of SnO_2 in the thin films, the petals have 130 nm average. The nanoflowers are distributed uniformly in the film, the petals of different flowers are in contact with one another. In this figure, it can be observed nanoflowers without any preferential direction, in contrast with the individual petals.

It is shown that through spray pyrolysis is possible the growth of nanoflowers of SnO_2

References

[1] M Kumar, *et al*, Materials Letters **215** (2018), p. 121.
[2] G Sberveglieri, *et al* Vacuum **86** (2012), p. 532.
[3] N Du, *et al*, Materials Research Bulletin **44** (2009), p. 211.
[4] J Chao, *et al*, Materials Letters **229** (2018), p. 244.
[5] H Gao, *et al*, Journal of Colloid and Interface Science **535** (2019).

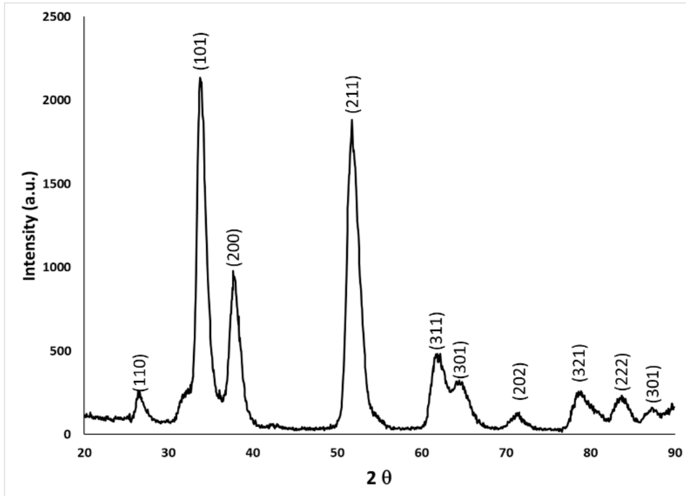

Figure 1. GXRD pattern of the SnO_2 thin film. The phase is tetragonal

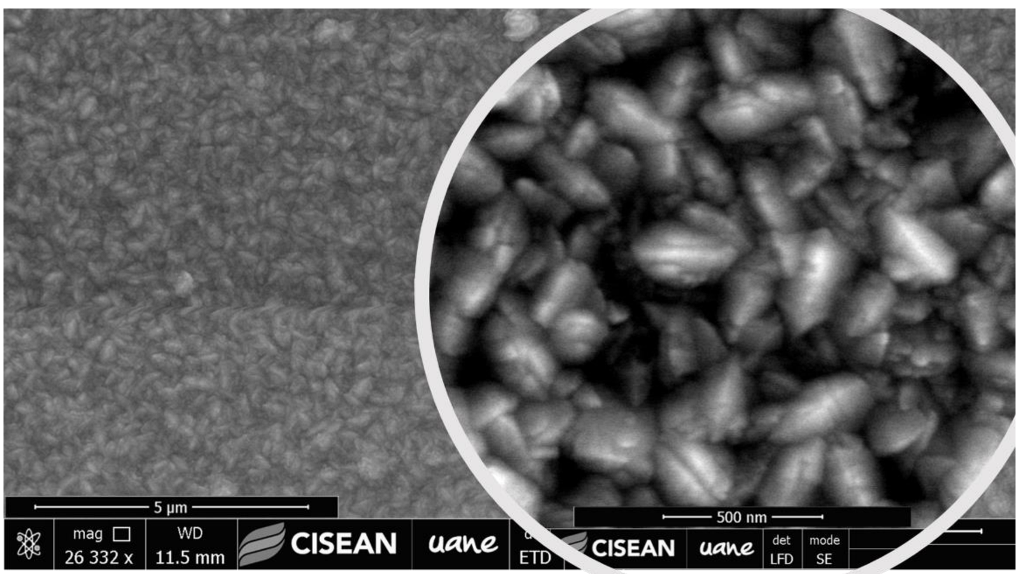

Figure 2. SEM image the nanoflowers of SnO_2 in thin films at different scales for 5 μm and 500nm