

## ZnO and MgO Decorated with Spherical Gold Nanoparticles

Fernando D. Cortes-Vega<sup>1</sup>, Nikte M. Gomez-Ortiz<sup>2</sup>, S. E. Borjas-Garcia<sup>2</sup> and P. Martinez-Torres<sup>2</sup>

<sup>1</sup>- Instituto de Investigaciones en Metalurgia y Materiales, Universidad Michoacana de San Nicolás de Hidalgo, Morelia, Michoacán, México.

<sup>2</sup>- Instituto de Física y Matemáticas, Universidad Michoacana de San Nicolás de Hidalgo, Morelia, Michoacán, México.

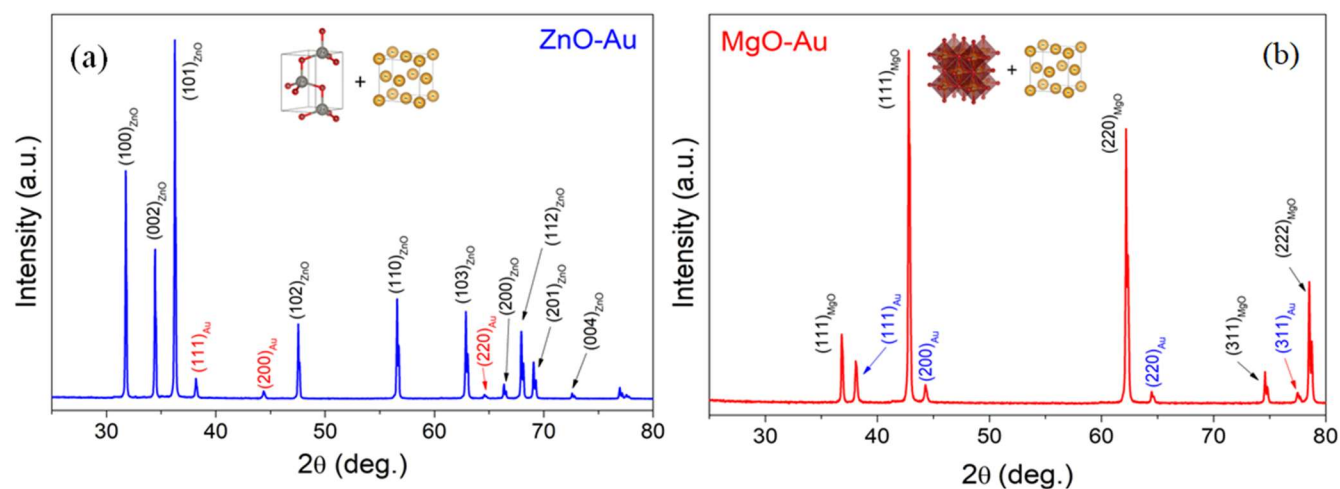
ZnO and MgO are attractive materials for its use in applications of catalysis, optics, chemical and electrochemical biosensors, optoelectronics, bioactivity and many others [1,2]. Gold nanoparticles are able to generate localized surface plasmon resonance. The addition of these nanoparticles to metal oxide materials like ZnO and MgO could improve their optical properties. It has been reported that the surface plasmon of Au nanoparticles enhanced MgZnO used as ultraviolet photodetector [3]. In this work we present the synthesis and process for decoration of these oxides with spherical gold nanostructures, as well as their characterization by means of SEM and XRD.

The ZnO and MgO were synthesized from Zinc and Magnesium nitrate hexahydrate ( $\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$  and  $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ ), using NaOH as the precipitant agent. The solutions of  $\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$  and  $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$  were prepared at 0.2 M, then the NaOH solution at 0.4 M (100 ml) was dropped slowly at room temperature and constant stirring until the end of the reaction. The as-obtained precipitates (hydroxides) were washed several times with water and ethanol to ensure the elimination of residual nitrates. The products obtained after washing were dried at 50 °C for 24 h and then calcined at 500 °C for 2 h to obtain ZnO and MgO. In order to synthesize the Au nanoparticles, we followed the process reported in ref. [4], using gold (III) chloride trihydrate and trisodium citrate (TSC) as raw materials. Initially, 50 ml of deionized water and 50 mg of TSC were added into a flask and heated to boiling temperature with vigorous stirring. Then, 150 ml of  $\text{HAuCl}_4$  0.25 M were added keeping temperature and stirring up to the solution turns into a ruby-red color, which indicates the formation of the Au nanoparticles. The oxide powders were mixed with 120 ml of colloidal Au nanoparticles and stirred for 1 h followed by a drying process at 100 °C for 24 h. These powders were placed into a stainless steel die to obtain green pellets of 1 cm of diameter and 1.5 mm of thickness. The green pellets were calcined at 1000 °C for 2 h using a conventional furnace. The crystal structure of both ZnO/Au and MgO/Au pellets was identified using X ray diffraction.

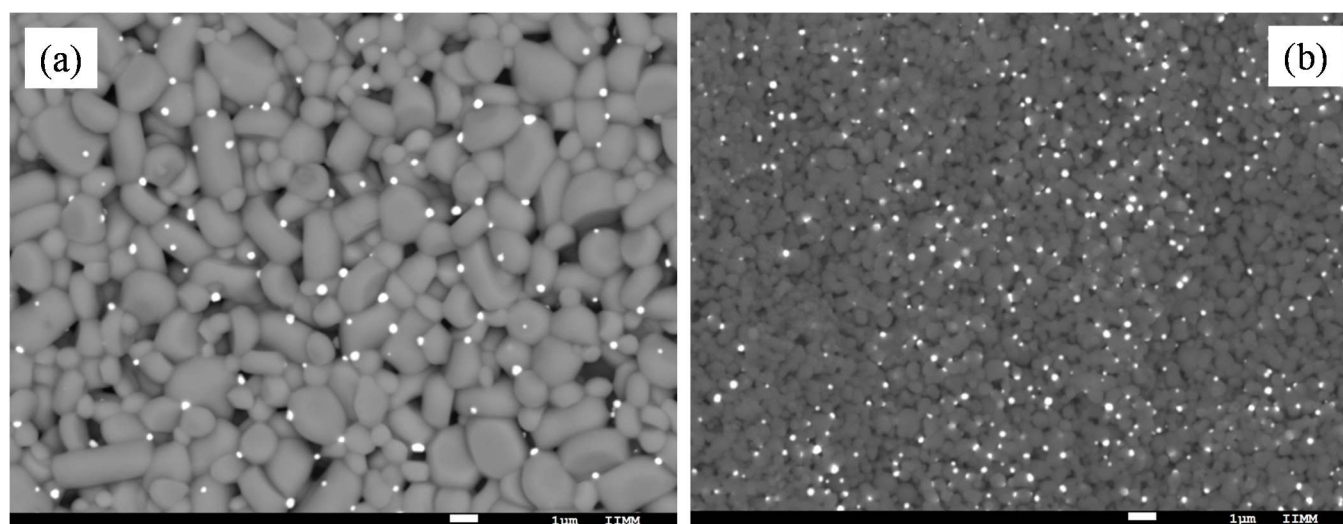
In Figure 1a and 1b are showed the well crystallized phases from both oxides, which are in good agreement with the pattern references JCPDS 00-036-1451 and 00-087-0653 for ZnO (zincite) and MgO (periclase), respectively. The presence of gold is evident in both samples by the identification of the reflections (111), (200), (220) and (311) according to the standard reference JCPDS 04-0784 [5]. The SEM images displayed in Figure 2a and b show plates and spheres morphology for ZnO and MgO, respectively. Au nanoparticles were spheres with homogeneous distribution for both cases, ZnO and MgO. Surprisingly, the size of the Au nanoparticles increased considerably from 20 nm (asynthesized nanoparticles) to  $276 \pm 53$  nm for the ZnO decorated with Au nanoparticles and, similarly, the Au nanoparticles deposited on MgO showed an increase in size from 20 nm to  $181 \pm 55$  nm. However, other works have reported the sustainability of size of the Au nanoparticles at temperatures up to 1000 °C [5]. This growth of the Au nanoparticles may be associated to the agglomeration and subsequent sintering of them. On the other hand, the ZnO and MgO particles exhibit different morphology to that observed for conventional synthesis of the materials without Au nanoparticles [6].

## References:

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**Figure 1.** XRD analyses of ZnO and MgO decorated with gold nanoparticles after heat treatment at 500 °C.



**Figure 2.** SEM images of ZnO and MgO decorated with spherical gold nanoparticles.