

Sintering study of ZnO nanoparticles obtained with different precursors

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Abstract – Sintering and grain growth of ZnO nanoparticles were studied as a function of the heating temperature and the used precursor. ZnO nanoparticles were obtained by precipitation of aqueous solutions of $Zn(NO_3)_2$, $Zn(CH_3COO)_2$ or $ZnCl_2$ with Na_2CO_3 solution. The nanoparticles with different size were calcined, pressed and sintered at temperatures of 1000, 1200 and 1300 °C. The structural and textural characteristic of the ZnO nanoparticles and sintered pellets were evaluated. Scanning electron microscopy was used to investigate the nanoparticles and sintered body morphologies. The characteristics of the obtained materials were compared.

Zinc oxide nanostructure is an important technological material due to their new applications on solar cells, gas sensor, photocatalysis, varistors, paints, rubber, ceramics and cosmetic, among others. Investigations on ZnO sintering process also are of scientific and technological interest [1-3].

In this work, ZnO nanoparticles were obtained using precipitation process by the reaction between aqueous solutions of $Zn(NO_3)_2$, $Zn(CH_3COO)_2$ or $ZnCl_2$ with Na_2CO_3 solution. The obtained precipitates were filtered, washed, centrifuged and dried at 110 °C for 48 h. The nanoparticles were calcined at 800 °C for 2 h to solvent elimination. The calcined nanoparticles were pressed at 7MPa in cylindrical pellet forms with diameter of 11.2 mm and thickness of 2 mm. The green bodies were sintered at temperatures of 1000, 1200 and 1300 °C during 2 hours. The ZnO nanoparticles and sinterized bodies were investigated by X-ray diffractometry to structural determination. Helium picnometry and nitrogen gas adsorption were used to evaluate the textural characteristics. Scanning electron microscopy was used to investigate the nanoparticles and sintered body morphologies.

The influence of the used precursor and the heating temperature on structural, textural, and morphological properties of the nanoparticles and sintered bodies were investigated. The nanoparticle size and shape change with the used precursor. At 800 °C the calcined samples show an intense growth of particle size, with values between 0.2 and 5.0 microns, depending of the precursor. The grain sizes grow with the increase in the sintering temperature. For example, the grain size of the ZnO pellets sintered at 1200 °C were found to be between 4-20, 2-13 and 1-8 μm for $Zn(NO_3)_2$, $Zn(CH_3COO)_2$ and $ZnCl_2$ precursors, respectively (Figure 1).

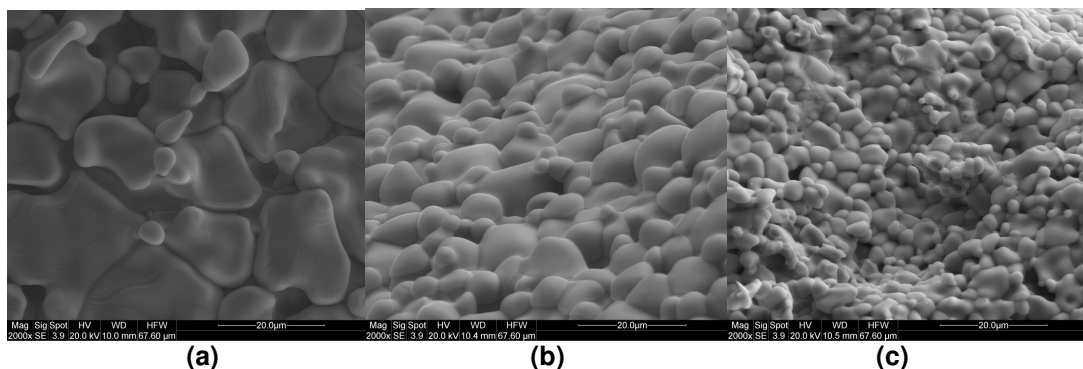


Figure 1: SEM of the ZnO pellets sinterized at 1200 °C using different precursors: (a) $Zn(NO_3)_2$, $Zn(CH_3COO)_2$ and $ZnCl_2$.

References

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