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Influence of the alkaline chemical precursor in the morphologies of the ZnO particles synthesized by the Domestic Microwave Hydrothermal Method

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Abstract – ZnO nanostructures with different morphologies were obtained by the Domestic Hydrothemal Microwave Method at low temperature. Nanometric particles were obtained with different morphologies depending on the media, alkalis and synthesis time. Flower-like morphologies were obtained for synthesis in NH_4OH media, while nanoparticles and plates were obtained in NaOH.

Synthesis of ZnO nanostructures has received a lot of attention from scientific community, especially with the use of the hydrothermal microwave method [1,2], that allows synthesizing oxides at low temperatures and short times, besides making the control of particle size and morphology easier, favoring the control of the material properties [1-4].

In the present work, ZnO samples were synthesized at 100 ^oC, for 15, 30 and 45 min, in ethanolic/aqueous media (1:1), being alkalized with NaOH or NH_4OH. Samples were characterized by X-ray diffraction (XRD), Raman spectroscopy and field emission gun scanning electron microscopy (FEGSEM).

All samples crystallized with hexagonal wurtzite structure, without a meaningful variation in the unit cell volume. A higher short range order was observed for samples synthesized with NH_4OH. This was probably due to the formation of two ions with opposite charges, $Zn(OH)_4^{2-}$ and $Zn(NH_3)_4^{2+}$, that were attracted during hydrothermal synthesis, making the formation of the first nuclei easier, favoring the material crystallization and the increase of ZnO nanostructures. For these samples, flower-like morphologies were obtained, with petals formed by the union of stick-like particles, grown from the same nucleation site. The increase in the synthesis time led to the formation of morphologies with higher definition. Particle sizes varied between 20 and 570 nm at low synthesis times and between 500 nm and 1.5 µm at higher synthesis times. When NaOH was used, spherical nanoparticles and plate-like morphologies were obtained. These results indicated that control of the particle size and morphology may be attained with the variation of synthesis conditions.

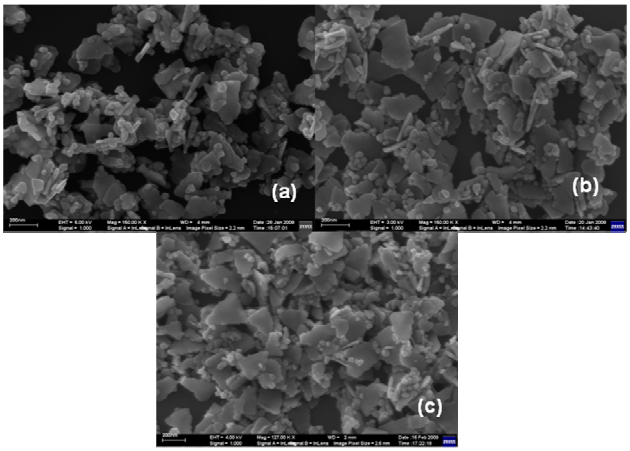

Figure 1: ZnO nanoestrutures for samples alkalized with NaOH (a) 15, (b) 30 and (c) 45 min

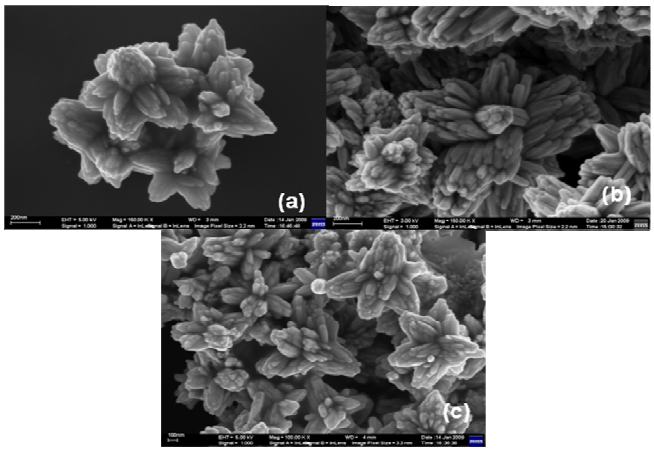

Figure 2: ZnO nanoestrutures for samples alkalized with NH_4OH (a) 15, (b) 30 and (c) 45 min

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