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Structure and Morphology Changes of Zinc Oxide Nanoparticles

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Zinc oxide nanoparticles (ZnO-NPs and ZnO2-NPs) have a great potential for environmental applications due to its good antimicrobial and photocatalytic activity, with low toxicity and low cost [1]. Property optimization of these materials are of interest and can be done by modifying size, shape or by creating crystal defects such as oxygen vacancies [2] and microtensions. In this work particle size and shape of synthesized ZnO-NPs and ZnO2-NPs were studied by TEM and SAED.

ZnO-NPs were synthesized by a hydrothermal method. 1.09 g of zinc acetate was dissolved in 15 ml of distilled water, then 0.84 g of NaOH was added to the solution getting white precipitate. Afterwards, 15 ml of ethanol was added by slow dripping while stirring. The suspensions were transferred to a Teflon vial and treated at 180ºC for 18 h. To create oxygen vacancies 224 mg of synthesized ZnO-NPs was dispersed at 150 ml water, then added 150 ml of NaBH4 at 0.04M aqueous solution and stirred in N2 environment at room temperature for 24 h. Synthesized ZnO-NPs were labeled as ZnO-H and those treated with NaBH4 were labeled as ZnO-Vo. ZnO2-NPs were synthesized by 80 ml of an aqueous solution of zinc sulphate (75 mM) with 40 ml of an aqueous solution of NaBH4 (0.79M). Temperatures were maintained at room temperature and 60ºC for two different synthesis. Afterwards 24 ml of H2O2 (30%) was added and left stirring for 15 min. Samples were labeled as ZnO2-A for synthesis at room temperature and ZnO2-60 for obtained at 60ºC. Particle size and morphology were studied by TEM and SAED.

Fig. 1 shows the effect of NaBH4 treatment on ZnO-NPs. Synthesized particles (Fig. 1 I) are ZnO nano-sheets with a width of 200-400 nm and a homogenous thickness of 60 nm. When submitted to NaBH4 treatment (Fig. 1 II). The thickness of the ZnO-NPs is slightly reduced and microtensiones start to appear (as signaled with red arrows). In Fig. 2 we can see morphology of ZnO2-NPs for both temperatures. Fig. 2 I shows nanoparticles below 10 nm that are highly agglomerated. While in Fig. 2 II we can also see particles below 10 nm, with agglomerations size between 50 and 200 nm. SAED patterns (Fig. 2b) show that ZnO2-60 have a smaller crystal size than ZnO2-A. These results show how NaBH4 treatment and temperature variations in synthesis can modify size, morphology and crystal size of ZnO and ZnO2 NPs.

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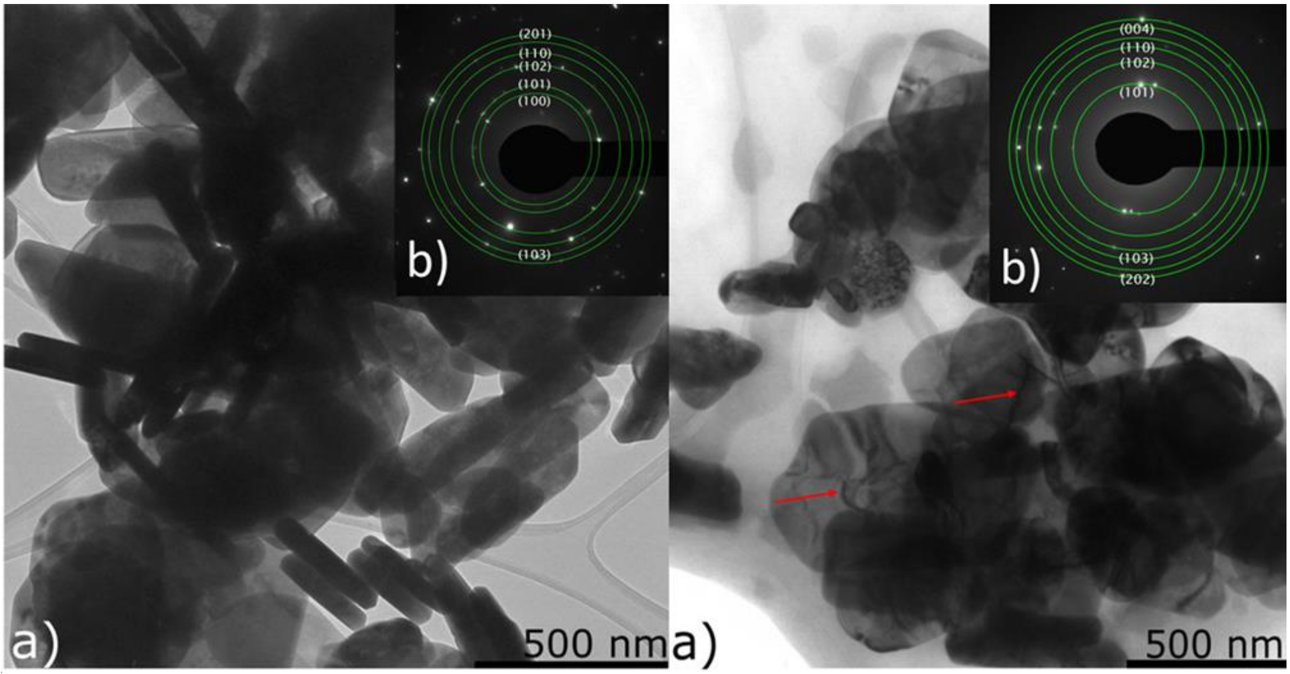

Figure 1. TEM micrographs (a) and SAED patterns (b) of ZnO-H (I) and ZnO-Vo (II).

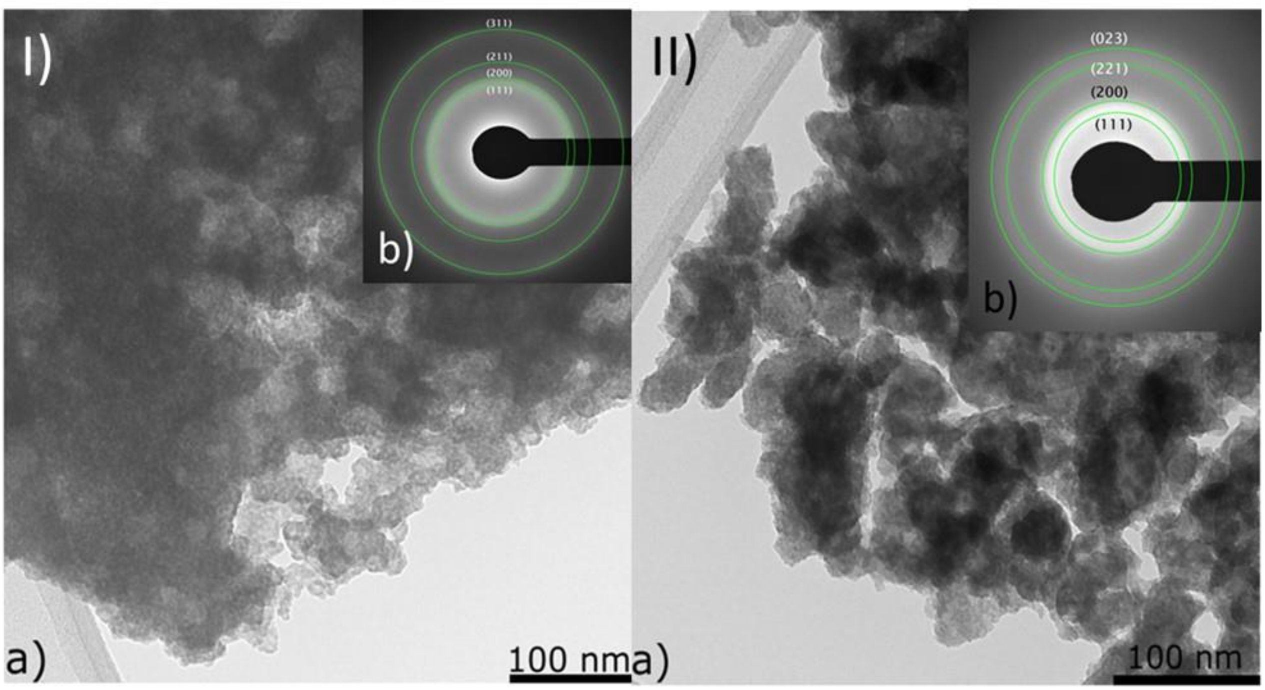

Figure 2. TEM micrographs (a) and SAED patterns (b) of ZnO2-A (I) and ZnO2-60 (II).

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