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ZnO Nanofibers Easily Synthesized by Electrospinning. A New Formula.

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ZnO is well known as a wide band gap (3.37 eV) semiconductor and for its special properties like piezoelectricity and photoconductivity, photoluminescence [1], among others, which can result in innovative solutions in high technology, such as lasers, solar cells, gas and chemical sensors, etc. However, the reduction of ZnO size to nanometric scale (nanotubes, nanoparticles, nanofibers, nanowires, etc.), increases the range of technological applications. Particularly ZnO nanofibers, due to its electrical and optical properties, make it a good candidate for to develop solar cells, nano sensors and opto-electronic devices.

The aim of this work was to synthesize and to study ZnO nanofibers. The synthesis was realized by Electrospinning Technique (Fig. 1), a simple, continuous and scalable technique to produce polymer composite and metal oxide nanofibers with high aspect-ratio and controlled morphologies [2]. An electrospinning equipment Nabond Unit_Standard was used for producing the nanofibers. Previously, two separate precursor solutions were prepared, one of them containing zinc acetate (Zn (CH3COO)2·2H2O) (0.5M) and absolute ethanol, and the other containing polyvinylpyrrolidone (PVP) and water (30%) and absolute ethanol (70%), used as solvents. The solutions were mixed and the resultant solution was stirred for 24 hours and immediately it was loaded in a syringe of 10 ml, connecting to the electrospinning equipment with a thin hose. A needle was placed at the end in the other extreme of the hose and at 15 cm from collecting surface. A 20 kV voltage was applied between the needle and the collector, resulting in a layer formed by the polymeric fibers. The material produced was heated in air in a furnace at 600 °C for 1 hour to remove the polymer layer for generating the ZnO structure.

The ZnO nanofibers characterization was performed by the High Resolution Transmission Electron Microscopy (HRTEM), Energy Dispersive Spectrometry (EDS), Scanning Electron Microscopy (SEM), X Ray Diffraction (XRD) and Thermo-gravimetric Analysis (TGA) techniques.

In Fig. 1 (a), it can be observed in the SEM images, the precursor PVP fibers with an average diameter of around 163 nm.

TGA study showed the temperature range to eliminate the organic material and to get the reaction for obtaining ZnO nanofibers. After some tests, the best calcination temperature was 600°C. Then the material was examined by the XRD technique and the result is illustrated in Fig. 2(a), showing that the produced material matches with ZnO Wurzite phase.

The calcined material was observed in HRTEM (Fig. 2(b)) showing nanofibers with an average diameter of 100 nm. An EDS study complements the results (Fig. 2 (b)). Fig. 3 illustrates a union in a nanofiber. Results indicate that the method employed to produce ZnO nanofibers in this work, allows obtaining them with a good quality.

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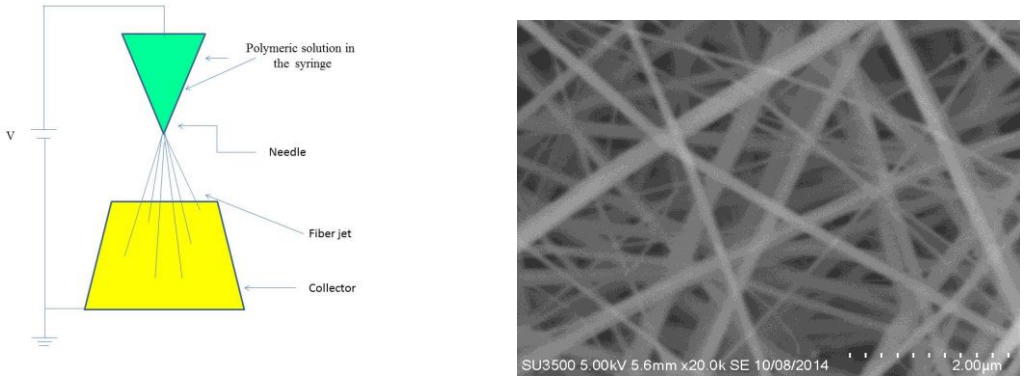

Fig. 1 (a) Electrospinning method diagram and **(b)** Sem Micrograph of Polymeric ZnO nanofibers

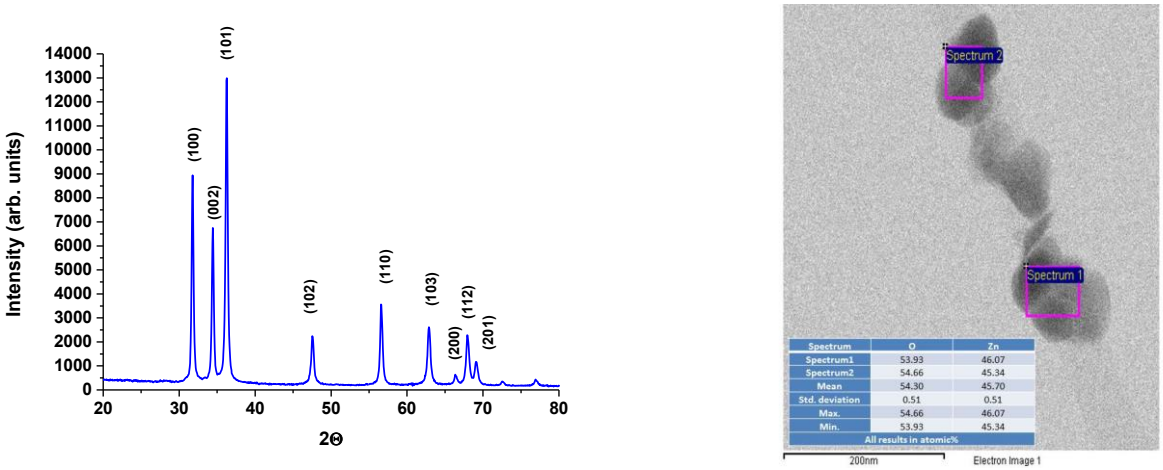

Fig. 2 (a) XRD of the material showing Wurzite Structure and **(b)** EDS of a nanofiber showing two different zones

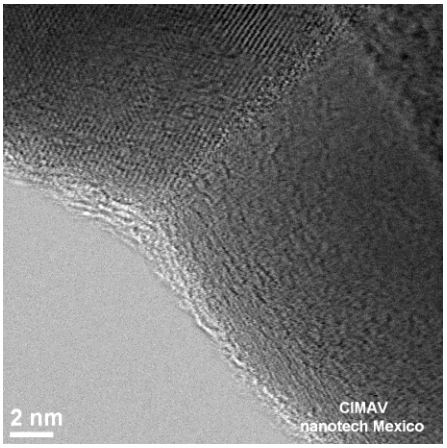

Fig. 3 HRTEM micrograph of a detail of a union into a nanofiber.

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