Zinc oxide nanostructures are considered materials with real potential in different scientific fields. In the case of these nanostructures, it was found that the morphology of ZnO plays an essential role in the development of further applications, but it is necessary a rigorous control of the main factors that influence the size, shape, agglomeration tendency, uniformity, and orientation of the nanostructures. In the present work, our efforts are oriented to synthesize different types of ZnO nanostructures by chemical method, and optimization was achieved with varying parameters, such as the concentration of precursors, types of solvents, pH, time or temperature, as well as the parameters required for thermal treatment. To obtain the characteristic structural and morphological information, ZnO nanostructures were investigated using Fourier transform infrared spectrometry (FTIR), scanning electron microscopy (SEM), and X-ray diffraction (XRD). SEM analysis confirms that the morphology and size of the ZnO nanostructures depend on the process parameters. The XRD results reveal that the synthesized samples have a wurtzite crystalline structure, and FTIR spectra show the presence of Zn-O bonding. The wetting capacity of continuous ZnO surfaces with different morphologies was studied by measuring the contact angle, indicating that the wetting and percolation capacity, depend on the orientation of the synthesized nanostructures.

The absorption band centered at about 385 cm\(^{-1}\) can be attributed to the vibrational mode of the Zn-O bond in the wurtzite structure of ZnO, for the sample synthesized from the acetate precursor. In the case of the obtained oxide from the sulfate precursor, the existence of the second peak at 410 nm, associated with the Zn-O bond, indicates the coexistence of an oxide with different morphologies.

The ZnO obtained from acetate has spherical formations, with a slight tendency to agglomerate, and with sizes varying between 25-70 nm. The sample obtained from zinc sulfate shows irregular morphologies with different shapes, spherical nanoparticles with a tendency to aggregate, but also types of sheets/plates of various sizes.

ZnO nanostructures with two types of zinc precursors have been synthesized by the sonochemical method.

The FTIR spectra of ZnO nanostructures showed the characteristic absorption of Zn-O bond, regardless of the type of precursor used in their synthesis.

The FESEM morphology of the analyzed samples indicates the formation of some spherical particles in the case of using acetate and the coexistence of different morphologies for sulfate oxide, with a tendency to agglomerate and keep the dimensions in the nanometric range.

The XRD results show that the synthesized powders possess crystalline, wurtzite hexagonal phases of ZnO for both samples, and the crystal lattice size is strongly influenced by morphology, and respectively by the type of precursor used.

ZnO nanostructures exhibit hydrophilic wetting character and good percolation properties, better for ZnO synthesized from in acetate precursor than sulfate.

Based on the obtained results, ZnO could be considered a functional material with applicability in multidisciplinary fields.