3316
doi:10.1017/S1431927621011417

Microsc. Microanal. 27 (Suppl 1), 2021

Correlation of the structural and morphological property of the formation of ZnO nanoparticles using *Ricinus Communis* extract as a ligand and synthesized through two different precipitating agents

Nancy Gutiérrez[1], Dhirendra Kumar Tiwari[2], Javier Villegas[3] and Francisco Reynoso[4]

[1]Instituto Tecnológico de La Piedad, La Piedad, Michoacan de Ocampo, Mexico, [2]CONACYT, Michoacan de Ocampo, Mexico, [3]IIQB-UMSNH, Michoacan de Ocampo, Mexico, [4]Universidad de la Ciénega del Estado de Michoacán de Ocampo, Sahuayo de Morelos, Michoacan de Ocampo, Mexico

Abstract

The present work defines the structural and morphological behavior of ZnO nanoparticles (ZnONP) synthesized via using *Ricinus Communis* (Castor) extracts. Two precipitating agents (bases) were used to regulate the pH (10), in presence of this natural extract the determination of structural, morphological and functional groups availability was performed to evaluate the enhancement in crystallite size, shape formation and colloidal stability of the nanoparticle.

Introduction

Now a days, the increasing demand of nanomaterial in technological applications catching a great attention of industries as well the versatility of the materials is also an important factor in real world applications, where the engineered nanomaterial's showed limitation. To fulfill this materialistic-technological gap the natural extracts could play an important role where the availability of elemental and molecular compounds is wide. Since many years ZnO Nanoparticles have been a precious material in scientific and technological applications [1-4] such as; industrial, electronic, medical, and pharmaceutical purposes, because of their optical and electrical properties caused by their bandgap as well its low-cost production [1].

Although, there has been developed a great amount of information of its synthesis method, but those with green sources or substituting chemical agents with natural extracts are of great interest because of its ecofriendly nature, efficiency and less violating reaction [2,5]. The *Ricinus Communis* extract may works as a source for easy formation of particles as well improving chemical band availability on the surface of formed material in short to control the size and agglomerations.

Materials and methods

The materials of high purity; Zn (NO3)2.6H2O, C6H8O7, NH4OH, NaOH obtained from Sigma Aldrich were used for the synthesis of ZnO NP. The natural extract of *Ricinus Communis* (Castor) was obtained by simple decoction method using 1:25 ratio at hotplate (120°C) for 60 min. The temperature used for the synthesis of zinc oxide nanoparticles; first, C6H8O7 was dissolved in DI-Water by constant stirring then added the Zn nitrate in a stoichiometric ratio. The mixtures were heated up to 50°C to make sure their homogenization and finally added the Castor extract.

Next, the prepared solution was divided into 2 part to evaluate the formation of nanoparticles by adjusting the pH at 10, one by using NaOH (less aggressive in quite an eco-friendly reaction) and another with NH4OH (aggressive and non-friendly). In each set, the base solution was added drop-by-drop till its precipitation. Finally, it was filtered and the precipitated parts were calcined at 400°C for 3 hours to remove the impurities and make the formation of particles. Furthermore, the samples were characterized using different analytical techniques; X-ray diffraction (Bruker, D8 Advance), SEM (JEOL, JSM-6390LV), EDX (Oxford Instrument, 7582), The Fourier transform infrared spectroscopy (FTIR, Frontier MIR/NIR Perkin Elmer) which were used to study the Structural, Morphological, and functional groups of each prepared material.

Results and discussion

The spectra obtained from FTIR and EDX are shown in figure 1. The measurements of FTIR analysis were performed over a spectral range of 400-4000 cm-1. Figure 1a refers the spectrum obtained from FTIR shows the spectrum derived from the nanoparticles and Figure 1b shows the same spectrum, but for the lowest transmittance peaks reached at closer look.

The bands at 1159, 1422, 3350 (NaOH treated) and 1056, 1259, 3400 (NH4OH treated) can be assigned to the C-OH stretching band. The peaks obtained at 700,878, 1775, 2870, and 2967 (NaOH) and 676, 2898, and 2979 (NH4OH) corresponding to an alkene group of type C=CH2. Likewise, in both spectrums, there are two bands one at 2161 cm-1 belonging to an alkyne group (-C≡C-) and another at 2325 cm-1 may refers the presence of nitrile (-C≡N), while as the peak appeared at 2495 in NaOH treated material refers the presence sulfide group (S-H). Finally, the peaks obtained at 514 (NaOH) and 613 (NH4OH), presents the vibration frequencies band of the ZnO.

The figures 1c and 1d, shows the elemental composition of the materials the elemental composition of the synthesized material obtained from EDX at low vacuum, 20 KeV energy, and at 10 mm de operating distance. The peaks demonstrated in the EDX spectrograph confirm the presence of certain elements because of the castor extract.

Figure 2a shows the X-ray diffraction patterns of zinc oxide nanoparticle, the crystallite size was calculated by applying Debye-Scherrer equation, where we have found the crystallite size of prepared materials were of 24.43 and 33.75 nm for NaOH and NH4OH treated samples respectively. Figure 2b and 2c shows the SEM Micrographs of the formed materials. The micrograph shows a homogeneous formation of particle in NaOH treated synthesis while as the NH4OH treated synthesis there were formation of big crystals. Intake of each micrograph shows the high magnification view of the same.

Conclusion

The use of the *Ricinus Communis* extract as a ligand gave a good result in the formation of the nanoparticles in its crystal formation. The use of NaOH presents a better separation of particle formation as well the more available functional groups compared with NH4OH. However, the addition of Castor extract also creates certain impurities because of its high salt viability (Na and Cl). It is considered that it may exist a great possibility to decrease this kind of impurities in a way by developing a selective extraction of this kind of natural extracts.

Acknowledgment: Authors are highly grateful for the CONACYT Basic Science project (A1-S-47641).

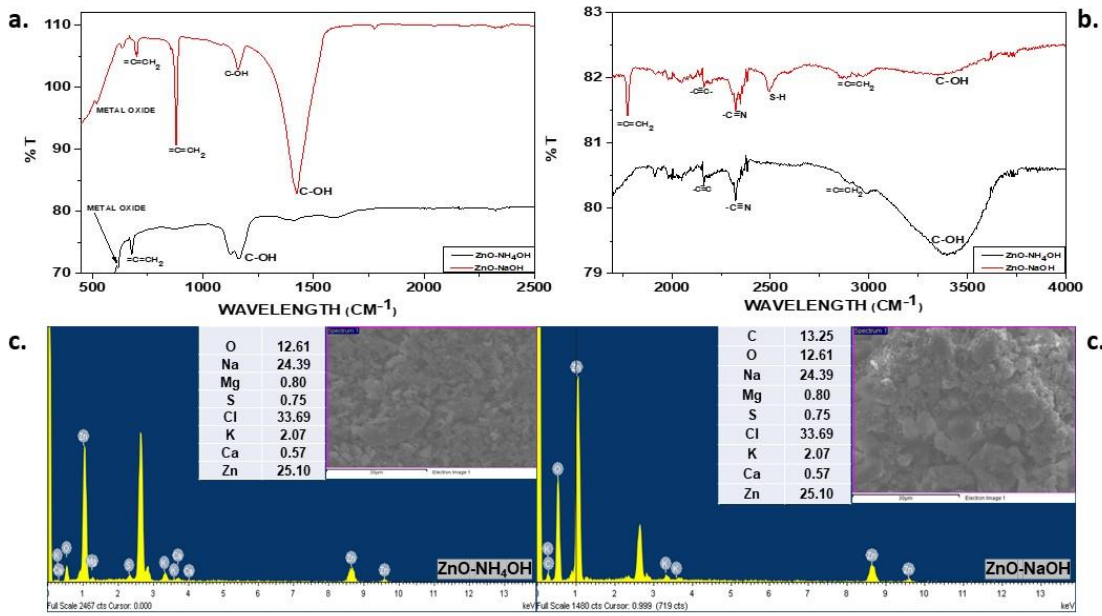

Figure 1. FTIR and EDX spectrum OF ZnO-NaOH and ZnO-NH4OH a.FTIR spectra of nanoparticles b.Close visualization of peaks obtained from lower transmittance. b. and c. Elemental composition of ZnO-NH4OH and ZnO-NaOH

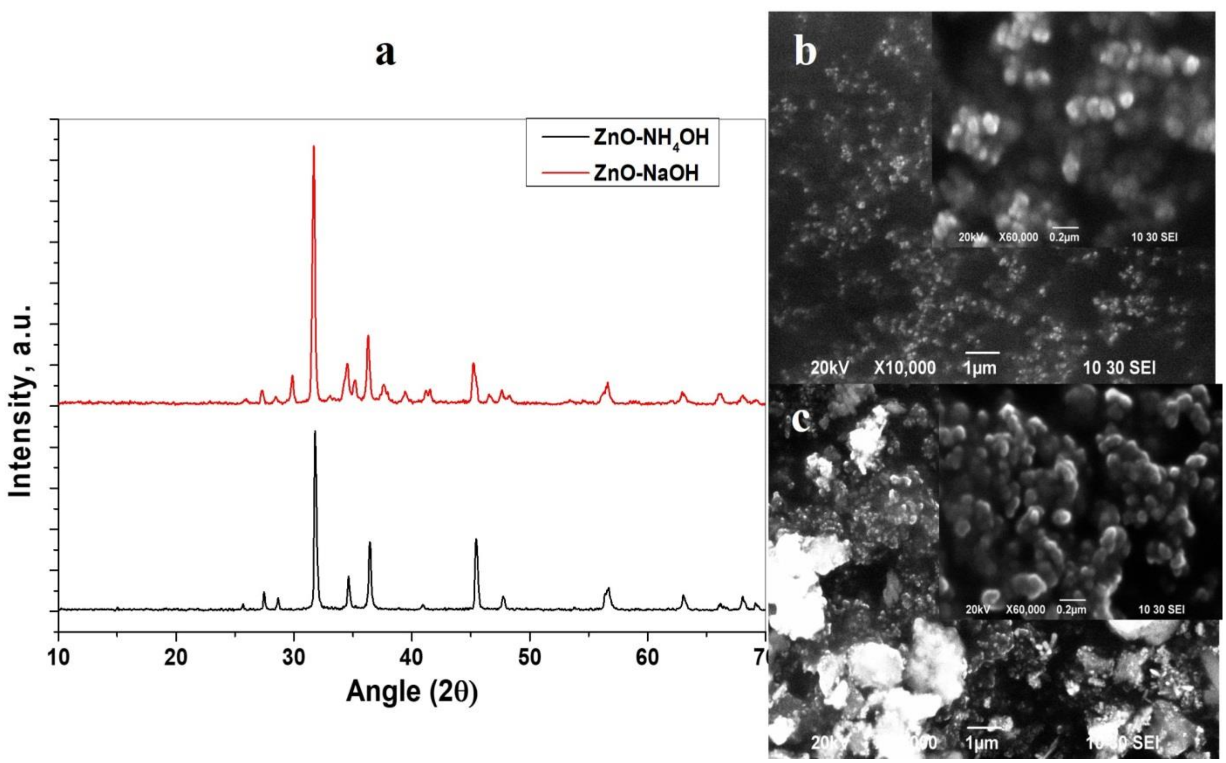

Figure 2. XRD and SEM spectra of the synthesized nanoparticles: a. Espectro de difracción de rayos X y b. Morfología superficial de ZnO-NaOH y ZnO-NH4OH

https://doi.org/10.1017/S1431927621011417 Published online by Cambridge University Press

References
< 1. 1. Aquino P., Osorio A., Ninán E., Torres F., (2018). Caracterización de nanopartículas de ZnOsintetizadas por elmétodo de precipitación y suevaluaciónen la incorporaciónen pinturas esmalte of SCIELO.
< !2.Fafal T, Tastan P, Tuzun B, Ozyazici M y Kivcak B., (2017). Synthesis, characterization and studies on antioxidant activity of silver nanoparticles using Asphodelus aestivusBrot. aerial part extract. South African J.
<3.Singh A., Dass J., Sil C., (2020). Zinc oxide nanoparticles: A comprehensive review on its synthesis, anticancer and drug delivery applications as well as health risks de ELSEVIER.
<4.Umavathi S., Mahboob S., Govindarajan M., Al-Ghanim K., Ahmed Z., Virik K., Al-Mulhm N., Subash M., Gopinath K., Kavithaa C., (2020). Green synthesis of ZnO nanoparticles for antimicrobial and vegetative growth applications: A novel approach for advancing efficient high-quality health care to human wellbeing de ELSEVIER.
<5.Vera G. P., Farías C. L., Castañeda, F. A., (2017). Síntesis de NanopartículasMetálicas por Rutas Verdes de Journal of BioProcess and Chemical Technology.

https://doi.org/10.1017/S1431927621011417 Published online by Cambridge University Press