**Abstract**

Nano [ZnO](https://www.sciencedirect.com/topics/materials-science/zno%22%20%5Co%20%22Learn%20more%20about%20ZnO%20from%20ScienceDirect%27s%20AI-generated%20Topic%20Pages) has been synthesized at different pH values using [chemical precipitation](https://www.sciencedirect.com/topics/physics-and-astronomy/precipitation-chemistry) technique. The X-ray diffraction pattern shows the hexagonal [wurtzite](https://www.sciencedirect.com/topics/physics-and-astronomy/wurtzite%22%20%5Co%20%22Learn%20more%20about%20Wurtzite%20from%20ScienceDirect%27s%20AI-generated%20Topic%20Pages) phase of ZnO [nanoparticles](https://www.sciencedirect.com/topics/materials-science/nanoparticles%22%20%5Co%20%22Learn%20more%20about%20Nanoparticles%20from%20ScienceDirect%27s%20AI-generated%20Topic%20Pages). The [crystallite](https://www.sciencedirect.com/topics/physics-and-astronomy/crystallites) size is found to decrease with increasing the pH value. From FE-SEM analysis, it can understand with increasing the pH value from 8 to 12, the morphology of ZnO nanoparticles changed from hexagonal faceted structure to nanospheroid structure. The [HRTEM](https://www.sciencedirect.com/topics/materials-science/high-resolution-transmission-electron-microscopy) images are in well accordance with the FE-SEM images. The average particle size of nanospheroid morphology is 31.1 nm. The SAED pattern confirms the crystalline nature with multifaceted growth of the samples. EDAX spectrum of ZnO nanoparticles at different pH values confirms the formation of Zn and O. The [absorption spectrum](https://www.sciencedirect.com/topics/physics-and-astronomy/absorption-spectra) of ZnO nanoparticles shows that the absorbance band is slightly shifted towards the lower wavelength with increasing the pH value. The band gap energy values (by Tauc plot relation) of the ZnO nanoparticles are found in the range of 3.0–3.03eV. FTIR spectra revealed the presence of the characteristic stretching vibrational band of Zn-O bonding at 445–418 cm−1 and this is shifted to lower frequency with increasing the pH value from 8 to 12. PL spectra of ZnO nanoparticles at various pH values exhibit a strong UV emission band and green emission band. The most intense green emission band is obtained for ZnO nanoparticles at pH12. The synthesized nanoparticles show potential [antibacterial activity](https://www.sciencedirect.com/topics/physics-and-astronomy/antibacterial-activity) against Gram-positive (B. subtilis and S. aureus) and Gram-negative bacteria (P. auregenia and K. Pneumonia). The cytotoxicity of ZnO nanoparticles at pH12 was evaluated against Normal (L929) and Breast cancer cell line (MB231).