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A novel green synthesis route to extract Polyphenol loaded ZnO nanoparticles and their exciting structural and optical properties
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Abstract: Zinc oxide (ZnO) is a wide and direct band gap (˜3.37 eV) semiconductor with significant exciton binding energy. Some of its applications include UV detectors, high sensitivity gas sensors, biosensors, solar cells, photoluminescence materials and antibacterial therapy. Due to its exciting properties, one dimensional ZnO nanostructures have been the subject matter of intense research in recent years. The emphasis has been on its extraction from natural sources that outperforms chemical and physical methods in terms of cost, environmental friendliness and ease of scaling up for large-scale synthesis. In this study, we report a novel process to extract nano-sized ZnO particles using Datura metel leaf polyphenolic extract as capping agent.
In a typical reaction, 1M Zinc acetate dihydrate [Zn(CH3COO)2.2H2O] solution is prepared in distilled water and agitated for about 15 minutes. During the stirring process, Datura metel leaf extract is added dropwise to the aforesaid solution. To the above combination, NaOH solution is added until the pH is adjusted to 12. Following addition, the complex mixture is continuously stirred in a magnetic stirrer for another 2 hours and then left undisturbed at room temperature overnight for completion of the reaction. This results in the formation of ZnO nano colloid. The final product is dried for 48 hours in 80℃ using a hot air oven before being ground to fine powder. Figure 1 shows a schematic diagram of the preparation process involved in the synthesis of ZnO nanomaterials.
The production of hexagonal wurtzite structure in ZnO nanocrystallites is confirmed using X-ray diffraction (XRD). The calculated crystallite size from the prominent (101) plane is found to be 33 nm - 26 nm. To further confirm the presence of Zn and O, Energy Dispersive X-ray analysis (EDAX) was performed. The production of ZnO nanoparticles is also revealed from the transmission electron microscopy (TEM) images. Furthermore, Fourier transform infrared spectroscopy (FTIR) is used to identify the various polyphenolic functional groups present in Datura metel leaf extract. The specimens'optical band gaps are determined to be in the range of 3.39-4.10 eV. We aim to evaluate the agro-horticultural applications of the synthesized ZnO nanoparticles as potential antimicrobials against spoilage microorganisms contaminating agricultural goods, which would be significant economically. To the best of our knowledge, this is the first report on synthesis of ZnO from Datura metel leaf extract and therein lies the novelty of this report.

Fig.1. Schematic diagram illustrating the preparation of ZnO nanomaterials from Datura metel leaf extract .

Keywords: ZnO nanomaterials, Polyphenols, Green Synthesis, XRD, TEM, FTIR.
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