Summary and Conclusion

CHAPTER 9

Summary and Conclusion

9.1 Summary and Conclusion of the present work

Zinc oxide and Carbohydrate biotemplate and Transition metal doped zinc oxide nanostructures were successfully synthesized and characterized. The grain size was controlled by using Transition metals and Carbohydrate biomolecules. Different techniques were used to study their structural, morphological, optical and antibacterial properties. As evident from the results of XRD and EDX and analysis it shows that addition of Carbohydrate (Glucose, Sucrose & Starch) and Transition metals (Mn, Co & Ni) ions substitute the Zn sites without changing the wurtzite structure. From morphological analysis (SEM, FE-SEM & AFM) proved that the addition biomolecules and transition metals affect the ZnO nanostructure and exhibited different nanostructure like nano-rod, nano-flower, nano-sheet, needle, spherical, rope and cluster were achieved. FTIR spectra prove the presence of organic and inorganic materials. From UV–visible spectroscopy, the optical band gap energy increased by the addition of biomolecules and transition metal. Photoluminescence analysis of prepared samples showed four most essential emission bands including a strong UV emission band, a weak blue band, a weak green band and a weak blue-green band which designated their high structural, optical characteristics quality and could improve the antibacterial properties. Improved bioactives were confirmed by analysing the antibacterial behavior of ZnO, Cbts-ZnO and TM-ZnO samples. Enhanced antibacterial activity is attributed to the higher surface area for the smaller particle size.

In this work mainly focused, the antibacterial effect of ZnO, carbohydrate biotemplate ZnO and Transition Metals doped ZnO NPs and TFs using Disc Diffusions method (DDM). The prepared samples were tested antibacterial property for *Escherichia coli, Klebsiella pneumonia, Proteus vulgaris and Staphylococcus aureus*. The highest antibacterial activity was measured for Transition metals doped ZnO NPs and Carbohydrate bio-template ZnO TFs samples. From mathematical analysis, the minimum Mean Deviation was measured and Co-efficient of Mean Deviation calculated and the results have indicated maximum deviation of the samples used for antibacterial activity against cattle pathogens which revealed that better control. Karl Pearson's Co-efficient of Correlation gave the corrected correlation for NPs and TFs for the samples and the values in between ± 1. These results exhibit a perfect correlation for the prepared samples of NPs and TFs. It is also found that the antibacterial efficacy of ZnO samples is increased with decreasing particle size. The improved bioactivity of less significant particles is almost certainly ascribed to the privileged surface area. Carbohydrate bio-template ZnO TFs samples have enhanced antibacterial activity than other samples. The antibacterial activity of ZnO samples is dependent on the define morphology, size and doped materials. Due to this intense antibacterial properties of prepared samples can be addressed in biomedical applications and also suitable for water purification system with non-toxic.

The antibacterial effect of carbohydrate biotemplate nanoparticles and thin film samples against food borne pathogen may lead to the proficient application in food packaging and food preservation process. Hence, these material can also suggested incorporating with the medical lab fabrics, gloves etc., antimicrobial garments may be useful for individuals coming into contact with patients such as visitors, nurses, doctors and other healthcare workers with non toxic. Due to this intense antibacterial properties of prepared samples can be addressed in biomedical applications and also suitable for food packaging, water purification and preservative system with non-toxic.

9.2 Scope of the future work

ZnO is a very promising material for mathematical applications like photovoltaic, optoelectronic device, sensing and dilute magnetic semiconductors when doped with inorganic and organic materials. However, in the biological aspects ZnO properties is to be extended to the areas of antibacterial and biomedical application. The following different ways this work can be extended in future.

1. Doped or biotemple ZnO nanostructure exhibits superior antibacterial activities against both gram positive and bacteria gram negative and also to test their toxic actions for biomedical applications.

2. Doped ZnO nanostructures showed better luminescence properties in the present investigations. So in future attempts, it can be formulate to recognize the (NLO) non-linear optical property for the optoelectronics applications.

3. The other nanoparticles for examples CuO, NiO and CdO can also be prepared through green synthesis for other carbohydrate related biomaterials and their properties can be compared to ZnO. Further the parameters are essential to be optimized suitable for antibacterial, antifungal, anticancer cell treatment.