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Synthesis, characterisation and antimicrobial activity of manganese- and iron-doped zinc oxide nanoparticles

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The present work reports study on antimicrobial activity of pure and doped ZnO nanocomposites. Polyvinyl pyrrolidone capped Mn- and Fe-doped ZnO nanocomposites were synthesised using simple chemical co-precipitation technique. The synthesised materials were characterised using transmission electron microscope (TEM), X-ray powder diffraction (XRD), energy dispersive X-ray fluorescence (EDXRF), Fourier transform infrared (FTIR) spectroscopy and ultraviolet (UV) visible spectroscopy. The XRD and TEM studies reveal that the synthesised ZnO nanocrystals have a hexagonal wurtzite structure with average crystalline size ~7–14 nm. EDXRF and FTIR study confirmed the doping and the incorporation of impurity in ZnO nanostructure. The antimicrobial activities of nanoparticles (NPs) were studied against fungi, gram-positive and gram-negative bacteria using the standard disc diffusion method. The photocatalytic activities of prepared NPs were evaluated by degradation of methylene blue dye in aqueous solution under UV light irradiation. Experimental results demonstrated that ZnO NPs doped with 10% of Mn and Fe ions showed maximum antimicrobial and photodegradation efficiency in contrast with that of the 1% loading. The enhancement in antimicrobial effect and photocatalytic degradation is attributed to the generation of reactive oxygen species due to the synergistic effects of Mn and Fe loading.

Keywords: antimicrobial activity; ZnO NPs; XRD; TEM; FTIR

1. Introduction

Pathogenic microbial contaminations and eradication of organic pollutants have been a major threat to mankind as well as to the environment. Therefore, the development of more efficient material with enhanced antimicrobial and photocatalytic activity is of great significance. Despite the great progress in antimicrobial development, many infectious diseases like intracellular infections are difficult to treat.[1,2] Major reasons of difficulty are transportation through cell membranes, low activity in the cells, antimicrobial toxicity to healthy tissues and acquired resistance of infectious microbes.[3–6] To address these issues, nanoscale materials have been emerged up as novel antimicrobial agents. Nanoparticles (NPs) are ideal forms of antimicrobial agents because these materials exhibit large surface

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