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Antibacterial Property of ZnO Nanoparticles: Effect of Intrinsic Defects

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Abstract : In recent years nanoforms of inorganic metallic oxides has attracted a lot of interest due to their small size and significantly improved physical, chemical and biological properties compared to their molecular precursor. Some of the inorganic materials such as TiO2, ZnO, MgO, CaO, Al2O3 have been extensively used in biological applications. Zinc Oxide is a Wurtzite-type semiconductor and piezo-electric material exhibiting excellent electrical, optical and chemical properties with a band energy gap of 3.1-3.4 eV. Nanoforms of Zinc Oxide (ZnO) are increasingly recognised for their utility in biological application. The significant physical parameters such as surface area, particle size, surface charge and Zeta potential of Zinc Oxide (ZnO) nanoparticles makes it suitable for the uptake, persistance, biological, and chemical activities inside the living cells. The present study shows the effect of intrinsic defects of ZnO nanocrystals synthesized by high energy ball milling (HEBM) technique in their antibacterial activities. Bulk Zinc oxide purchased from market were ball milled for 7 h, 10 h, and 15 h respectively to produce nanosized Zinc Oxide. The structural and optical modification of such synthesized particles were determined by X-ray diffraction (XRD), Scanning Electron Microscopy and Electron Paramagnetic Resonance (EPR). The antibacterial property of synthesized Zinc Oxide nanoparticles was tested using well diffusion, minimum inhibitory Concentration, minimum bacteriocidal concentration, reactive oxygen species (ROS) estimation and membrane potential determination methods. In this study we observed that antibacterial activity of ZnO nanoparticles is because of the intrinsic defects that exist as a function of difference in size and milling time.

Keywords : high energy ball milling, ZnO nanoparticles, EPR, Antibacterial properties
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