РАЗНОЕ

ENHANCED ANTIBACTERIAL AND ANTICANCER ACTIVITIES OF VANADIUM-DOPED ZnO NANOPARTICLES: EFFECT OF DOPING CONCENTRATION

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Vanadium-doped zinc oxide nanoparticles are synthesized by the hydrothermal method with different doping concentrations. The main objective of the research is to analyze the role of doping concentration against septicemia and human colon cancer. The prepared nanoparticles are extensively characterized by the X-ray diffraction technique. The crystallite size, stain, lattice constants and bond lengths are examined. The vanadium doping enhances the antibacterial activity against bacterial strains...

Keywords: vanadium, septicemia, colon cancer, MTT assay, apoptosis.

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1. Introduction. Zinc oxide nanoparticles have gained significant importance in scientific research due to their unique properties, such as a wide band gap and high excitation binding energy at room temperature. The hexagonal wurtzite geometry of ZnO provides piezoelectric properties where the zinc and oxygen ions are tetrahedrally coordinated [1]. These unique properties make the ZnO nanoparticles an effective candidate in various fields which including LED [2], solar cell [3], photodetectors [4], biodiesel production [5], energy harvesting [6], spintronics [7], ionomer cement [8] and cancer analysis [9]. The ZnO nanoparticles are considered to be advantageous over other nano-preparations for biomedical applications since they are relatively biocompatible based on their size [10]. The strong positive charge of ZnO nanoparticles under physiological conditions is an attractive feature for its use as an anti-cancer agent through the preferential killing of cancer cells. The possible explanation is because of their interaction with the cancer cells, which have a high concentration of anionic phospholipids on the outer membrane and a large membrane potential facilitates cellular uptake through phagocytosis and results in cytotoxicity [11, 12].

Apart from the advantages, the recombination rate of electron-hole pairs in ZnO is the major drawback and doping is an effective way to reduce the recombination rate. The recombination rate is a major key factor that decides the photocatalytic and antibacterial properties of the ZnO nanoparticles. Strong 3d hybridization among ZnO and the strong coulomb force between the electrons of $3d - 3d$ subshells are the reasons behind the choice of 3d transition metal as a dopant in the Zn lattices [13]. Since the coordination number of zinc with oxygen and vanadium with oxygen is the same, effective doping can be achieved by vanadium doping. Vanadium reduces the optical band gap [13], decreases the crystallite size [14], enhances the photocatalytic activity [15], reduces the resistance of the material [16], induces the paramagnetism [17], induces the ferromagnetism [18], enhances the electron concentration [19] and improves the visible luminescence [20]...

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