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Zinc Oxide Nanoparticles Synthesis Methods and its Effect on Morphology: A Review

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Abstract: Zinc oxide is an important material with numerous applications due to its unique properties. Due to their thermal and chemical stability are used in wide applications such as LEDs, sensors, catalysts, and photodetectors. Different chemical, physical, and biological methods have been adopted to achieve the intended result, as enumerated in many pieces of literature. Therefore, selecting an efficient synthesis process is essential, which is a key factor that significantly influences the efficacy of the synthesized nanocrystalline materials. The chemical synthesis of nanoparticles (NPs) via hydrothermal, solvothermal, and sol-gel routes is considered effective as high-quality crystalline structures are produced. Control of parameters of processes yields excellent morphological features of the synthesized samples. This review explored the different parameters of processes and their effect on the morphology of ZnO nanostructures via hydrothermal, solvothermal, and sol-gel techniques. Finally, some ZnO nanocomposites molecules are reviewed as per the dopant used and its effect on the sample compound synthesized.

Keywords: synthesis methods; nanostructures; nanomaterials; nanoparticles; zinc oxide; morphology.

1. Introduction

Zinc oxide is one example of transition metal oxides that exhibit unique electrical, optical and mechanical properties. Due to their unique properties, they have numerous applications in fields such as pharmaceuticals, electronics, consumer goods, optical and electrical devices, and environmental remediation [1-5]. The morphology of ZnO nanostructures has a significant role in their applications, according to Jin and Jin 2019 [6]. For instance, rod-like, sheet-like, and belt-like nanostructures are suitable for solar cells, light-emitting diodes, gas sensors, and biological probes. Interestingly, researchers focus on the morphology of nano ZnO to achieve their intended purpose in its applications. Controlling the size and shape of these nanostructures during synthesis is the major focus of the researcher.

Different synthesis techniques have been developed to be grouped into physical, chemical, and biogenic (green route). Physical techniques include pulsed laser deposition, magnetron sputtering, electrodeposition, and electron beam evaporation [7-11]. The chemical synthesis route comprises hydrothermal, solvothermal, sol-gel, chemical bath deposition, wet chemical process, spray pyrolysis, microemulsion, and precipitation methods [12-18]. Green