Green synthesis of inorganic nanoparticles as anti-bacterial agents

Thesis

Submitted By

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Abstract

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Nehad Hamdi Ali Abd El Hameed, Green Synthesis of Inorganic Nanoparticles as Antibacterial Agents.

In this thesis, studies on the utilization of different inorganic nanoparticles as antibacterial agents were performed in two parts: first, synthesis and antibacterial activity evaluation of different nano-structured copper, zinc and magnesium oxides were carried out. Second; silver metal, copper, zinc and magnesium oxides were prepared and supported on bleached cotton fabrics. The loaded fabrics were then evaluated as antibacterial textiles. Reduction, wet method, sol gel and precipitation methods were used in the preparation of the antibacterial nanoparticles (NPs). The preparation of the antibacterial-loaded cotton was carried out in-situ and ex-situ by pad dry methods.

Several techniques were used to characterize all the prepared samples. Type, purity and crystal properties of the prepared metal and metal oxides were tested using x-ray diffraction (XRD). The shape and particle sizes were investigated using High Resolution Transmission Electron Microscopy studies (HRTEM). Formation of the supported nanoparticles was confirmed using Field Emission Scanning Electron Microscopy (FESEM) and Energy dispersive x-ray (EDX). Surface characteristics of the prepared metal oxides were also studied. The results indicated that, all the metal and metal oxides were in nanometer range and in the desired shapes.

The antibacterial studies on the prepared metal oxides were conducted on Gram positive (*Bacillus subtilis and Staphylococcus aureus*) and Gram negative (*Escherichia coli*) bacteria by agar diffusion method. Overall, both copper and zinc oxides showed high antibacterial activities. However, the antibacterial performance of magnesium oxide was

significantly low. The physicochemical characteristics (shape, particle size, surface area, etc.) of copper and zinc oxides nanoparticles significantly affected their antibacterial performance. On the contrary, the antibacterial activity of MgO has not been significantly affected by the criteria of the prepared nanoparticles. It seemed that the ability of MgO to launch the antibacterial process was quite low so the impact of their physical properties could not be detected. Further, results indicated that the antibacterial performances of the metal oxides are also remarkably influenced by the shape and size of the investigated bacteria as well as the antibacterial test method.

On the other hand, under the given experimental conditions, the maximum inactivation performances of each loaded inorganic agent was investigated. The loaded fabrics showed the following antibacterial performance order against *Bacillus subtilis,* Ag=CuO>ZnO>MgO. While their activity order was CuO>Ag>ZnO=MgO *against S.aureus and E. coli*. The inactivation performances depend on the type, purity and the amount of antibacterial nanoparticles on the textile surfaces.

Aim of the work