

Abstract:

Despite the success of antibacterial agents against infection-causing bacteria, bacterial infectious diseases continue to pose a threat to both mankind and animals. A major concern is that certain bacteria have developed resistance to antimicrobial agents as a result of their overuse, leading to the emergence of superbugs. Silver (Ag) nanoparticles are widely used for antibacterial purposes and are known as the “next generation of antibiotics”. Several methods can be used to generate these antibacterial nanoparticles, one of which is electrospinning. Composite Ag-loaded electrospun nanofibers have gained more attention in the recent era because they are synthesized by a simple and eco-friendly electrospinning technique. This research presents the development of Ag-TiO₂ electrospun composite nanofibers by sol-gel and electrospinning method. Physiochemical structural properties of the heat-treated Ag-TiO₂ nanofibers improved by metal loading such as fiber diameter, porosity and photocatalytic activity. The morphology, chemical composition, structure and optical properties of synthesized nanofibers were characterized by FESEM, EDX, XRD, Raman spectroscopy and UV-visible analysis. These electrospun nanofibers were observed to have a fibrous structure with successful incorporation of silver metal, estimated by field emission scanning electron microscopy and EDX results. The Uv-vis analysis confirms the band-gap shift of silver-loaded sample in visible light region, with enhanced photocatalytic properties. The performance of these electrospun nanofibers was assessed by antibacterial studies, against Escherichia coli bacteria. The antibacterial activity of these synthesized nanofibers assessed by three different methods that give mechanistic insights of nanofibers and bacterial interaction. The well plate method, plate counting method and Laser confocal microscopy was employed for antibacterial studies. The clear zones of inhibition confirm the Ag ions interaction with bacterial cell. The plate counting method give viable cell count, no. of colonies decreases with increase in Ag concentration. This indicates the antibacterial activity is related to concentration of loaded metal. These results confirm that the antibacterial activities of TiO₂ electrospun nanofibers are enhanced by silver loading. The change in morphology and fluorescence behavior of bacteria was studied by confocal microscopy. These results further reinforce the findings obtained through other tests. Hence, these surface modified electrospun nanofibers with large surface area to volume ratio efficient bactericide and can be used in wide practical applications.