World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:10, No:08, 2016

Green Synthesis of Nanosilver-Loaded Hydrogel Nanocomposites for Antibacterial Application

Authors : D. Berdous, H. Ferfera-Harrar

Abstract : Superabsorbent polymers (SAPs) or hydrogels with three-dimensional hydrophilic network structure are high-performance water absorbent and retention materials. The in situ synthesis of metal nanoparticles within polymeric network as antibacterial agents for bio-applications is an approach that takes advantage of the existing free-space into networks, which not only acts as a template for nucleation of nanoparticles, but also provides long term stability and reduces their toxicity by delaying their oxidation and release. In this work, SAP/nanosilver nanocomposites were successfully developed by a unique green process at room temperature, which involves in situ formation of silver nanoparticles (AgNPs) within hydrogels as a template. The aim of this study is to investigate whether these AgNPs-loaded hydrogels are potential candidates for antimicrobial applications. Firstly, the superabsorbents were prepared through radical copolymerization via grafting and crosslinking of acrylamide (AAm) onto chitosan backbone (Cs) using potassium persulfate as initiator and N,N’-methylenebisacrylamide as the crosslinker. Then, they were hydrolyzed to achieve superabsorbents with ampholytic properties and uppermost swelling capacity. Lastly, the AgNPs were biosynthesized and entrapped into hydrogels through a simple, eco-friendly and cost-effective method using aqueous silver nitrate as a silver precursor and curcuma longa tuber-powder extracts as both reducing and stabilizing agent. The formed superabsorbents nanocomposites (Cs-g-PAAm)/AgNPs were characterized by X-ray Diffraction (XRD), UV-visible Spectroscopy, Attenuated Total reflectance Fourier Transform Infrared Spectroscopy (ATR-FTIR), Inductively Coupled Plasma (ICP), and Thermogravimetric Analysis (TGA). Microscopic surface structure analyzed by Transmission Electron Microscopy (TEM) has showed spherical shapes of AgNPs with size in the range of 3-15 nm. The extent of nanosilver loading was decreased by increasing Cs content into network. The silver-loaded hydrogel was thermally more stable than the unloaded dry hydrogel counterpart. The swelling equilibrium degree (Q) and centrifuge retention capacity (CRC) in deionized water were affected by both contents of Cs and the entrapped AgNPs. The nanosilver-embedded hydrogels exhibited antibacterial activity against Escherichia coli and Staphylococcus aureus bacteria. These comprehensive results suggest that the elaborated AgNPs-loaded nanomaterials could be used to produce valuable wound dressing.

Keywords : antibacterial activity, nanocomposites, silver nanoparticles, superabsorbent Hydrogel
Conference Title : ICNST 2016 : International Conference on Nano Science and Technology
Conference Location : Kuala Lumpur, Malaysia
Conference Dates : August 18-19, 2016