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Relation between Electrical Properties and Application of Chitosan Nanocomposites

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Abstract : The polysaccharide chitosan (CS) is an attractive biopolymer for the stabilization of several nanoparticles in acidic aqueous media. This is due in part to the presence of abundant primary NH2 and OH groups which may lead to steric or chemical stabilization. Applications of most CS nanocomposites are based upon the interaction of high surface area nanoparticles (NPs) with different substance. Therefore, agglomeration of NPs leads to decreasing effective surface area such that it may decrease the efficiency of nanocomposites. The aim of this work is to measure nanocomposite's electrical conductivity phenomena that will allow one to formulate optimal concentrations of conductivity NPs in CS-based nanocomposites. Additionally, by comparing the efficiency of such nanocomposites, one can guide applications in the biomedical (antibacterial properties and tissue regeneration) and sensor fields (detection of copper and nitrate ions in aqueous solutions). It was shown that the best antibacterial (CS-AgNPs, CS-AgNPs-carbon nanotubes) and would healing properties (CS-AuNPs) are observed in nanocomposites with concentrations of NPs near the percolation threshold. In this regard, the best detection limit in potentiometric and impedimetric sensors for detection of copper ions (using CS-AuNPs membrane) and nitrate ions (using CS-clay membrane) in aqueous solutions have been observed for membranes with concentrations of NPs near percolation threshold. It is well known that at the percolation concentration of NPs an abrupt increasing of conductivity is observed due to the presence of physical contacts between NPs; above this concentration, agglomeration of NPs takes place such that a decrease in the effective surface and performance of nanocomposite appear. The obtained relationship between electrical percolation threshold and performance of polymer nanocomposites with conductivity NPs is important for the design and optimization of polymer-based nanocomposites for different applications.

Keywords : chitosan, conductivity nanoparticles, percolation threshold, polymer nanocomposites
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