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DIELECTRIC BEHAVIOUR OF CYANOETHYLATED CELLULOSE-HYDROXYAPATITE NANOCOMPOSITES

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Nanofillers exhibit high dielectric constant, but they have poor flexibility and breakdown strength. Polymers have excellent flexibility, low dielectric loss and high breakdown strength but have much lower dielectric constants. Thus, the incorporation of nanoparticles into a polymer has a greater potential to enhance the dielectric behaviour of the overall composite. During this study, hydroxyapatite nanoparticles (HA Nps) were synthesized using wet chemical precipitation, and different weight fractions of nanoparticles, 5%, 10% and 15% in cyanoethylated polymer (CRS), were prepared. Powder X-ray diffraction patterns confirmed the presence of HA Nps and CRS polymer. Scanning electron microscopy was used to analyze the morphology of the synthesized HA Nps and to measure the thicknesses of nanocomposite films. Fourier transform infrared spectroscopy was used to study bonding interactions of synthesized compounds. Capacitance values were measured in the frequency range from 1 kHz to 1 MHz, and all nanocomposite films showed higher dielectric constants at lower frequencies than CRS bare polymer (21). The dielectric constants of composites at 1 kHz were 32, 44, 67 for 5%, 10% and 15% weights, respectively. All nanocomposites showed a lower leakage current when increasing the voltage. The dielectric constant of nanocomposites has increased with increasing the loading of HA Nps, which may be due to the formation of large volumes of interfacial regions. It can be thought that nanoparticles in 15% HA composite have agglomerated at higher loading, thus showing the most significant decrease in dielectric constant when increasing the frequency. At lower frequencies, all types of polarization mechanisms are involved, which leads to an increased dielectric constant. When the frequency increases, relaxation processes occur. Therefore, the dielectric constant decreases with increasing frequency as all polarization mechanisms do not contribute. Significant attention is not given to investigating the dielectric properties of CRS-based nanocomposites in the literature. These results suggest that CRS-HA polymer nanocomposite is a potential candidate for applications in the dielectric material of capacitors.

Keywords: Cyanoethylated cellulose, Dielectric constant, Hydroxyapatite, Nanocomposites, Nanoparticles