Design of Polymer Blends Based on Chitosan:POZ with Improved Dielectric Constant for Application in Polymer Electrolytes and Flexible Electronics

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There is a considerable demand for the development and application of polymer materials in the flexible electronic- and polymer-based electrolyte technologies. Chitosan (CS) and poly(2-ethyl-2-oxazoline) (POZ) materials were blended with different ratios to obtain CS:POZ blend films using a straightforward solution cast technique. The work was involved a range of characteristic techniques, such as impedance spectroscopy, X-ray diffraction (XRD), and optical microscopy. From the XRD spectra, an enhancement in the amorphous nature in CS:POZ blend films was revealed when compared to the pure state of CS. The enhancement was verified from the peak broadening in CS:POZ blend films in relative to the one in crystalline peaks of the CS polymer. The optical micrograph study was used to designate the amorphous and crystalline regions by assigning dark and brilliant phases, respectively. Upon increasing POZ concentration, the dielectric constant was found to increase up to \( \varepsilon' = 6.48 \) (at 1 MHz) at 15 wt.% of POZ, and then a drop was observed beyond this amount. The relatively high dielectric constant and dielectric loss were found at elevated temperatures. The increase of POZ concentration up to 45 wt.% made the loss tangent to shift to the lower frequency side, which is related to increasing resistivity. The increases of dielectric constant and dielectric loss with temperature were attributed to the increase of polarisation. The loss tangent peaks were found to shift to the higher frequency side as temperature elevated. Obvious relaxation peaks were observed in the imaginary part of electric modulus, and no peaks were found in the dielectric loss spectra. The concentration dependent of \( M'' \) peaks was found to follow the same trend of loss tangent peaks versus POZ content. The relaxation process was studied in terms of electric modulus parameters.

1. Introduction

Chitosan (CS) is a linear polysaccharide, bioderivative of the second most abundant natural chitin polymer after cellulose [1], which is obtained mainly from shells of crustaceans, jellyfish, or corals. The advantage of CS over the other polysaccharides is based on its biocompatibility and a variety of interesting properties, such as anti-inflammatory, antimicrobial, antitumor, and immunity-enhancement properties. It serves as a multifunctional compound that can be used in biomedical purposes [2]. Another important property of CS is the nontoxicity and natural biodegradability. However, the pure state of CS shows a relatively low ionic conductivity. Natural polymers usually have normal inclination to decay in comparison to the indestructible synthetic polymer [3]. There are two organic functional groups, known as amine (-NH\(_2\)) and hydroxyl (-OH), on the CS backbone structure, which are responsible in complex