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Abstract

Characterization of Electromechanical Performance of Chitosan Films †

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The investigation of piezoelectricity in polysaccharides constitutes an important field of research in the last decades due to the increasing interest in green electronics and wearable biomedical applications. Chitosan is recognized as a functional material due to its intrinsic properties, such as non-toxicity and antibacterial activity, biocompatibility, and capacity to degrade in nature. There have been different results measured in chitosan structures, making it challenging to identify whether the piezoelectric effect is due to electrostrictive behavior, surface charges or dipole alignment. Additionally, shear piezoelectricity has been reported for this biopolymer. As it is noted, their electrical properties are still under investigation to understand its electromechanical performance. In this work, chitosan films have been fabricated with two standard acidic solutions (acetic vs. lactic acids). Some of them were neutralized to evaluate the effect of the functional OH groups in the surface. A systematic characterization of the chitosan-based films was done. The microstructure and physical characterization were realized using the X-Ray diffraction and FTIR techniques. The microstructure measurements are correlated with piezoelectric-response force microscopy (PFM) and Kelvin probe force microscopy (KPFM) to identify the contribution of distinct mechanisms at the microscale in chitosan-based films. In addition, the effect of different acidic media and the neutralization procedure is also analyzed. The apparent piezoresponse given by the PFM signal may arise by different mechanisms; therefore, the analysis of the second harmonic is approached to identify them. Microstructure characterization suggests that films made with acetic acid tend to be more crystalline, presenting a more defined characteristic peak of chitosan around $2\theta = 20^{\circ}$. Furthermore, films fabricated with acetic acid are less hydrophilic, which confirms a relation between crystallinity and water absorption properties. The second harmonic signal is higher than the first harmonic signal, which suggest that the PFM signal is dominated by electrostriction, electrostatics, or charge injection phenomena.

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