Mechanism of electrical conductivity in PEDOT: PSS film enhanced with colloidal silver nanoparticles

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Abstract

This study explores the enhancement of electrical conductivity in poly(3,4-ethylenedioxythiophene): poly(styrene sulfonate) (PEDOT: PSS) films through the incorporation of colloidal silver nanoparticles (AgNPs) into the PEDOT:PSS solution and fabricated via solvent casting technique. The morphological, structural, and electrical properties of the resulting films were characterized using scanning electron microscopy (SEM), Fourier-transform infrared spectroscopy (FTIR), and four-point probe measurements. SEM analysis revealed the morphological changes induced by AgNPs incorporation, showing improved film homogeneity and surface roughness. XRD analysis provided insights into the structural changes within the films, suggesting potential interactions between PEDOT: PSS and AgNPs. FTIR spectroscopy elucidated the chemical interactions between PEDOT: PSS and AgNPs, highlighting the formation of specific bonding motifs. The electrical properties of

the films were evaluated using four-point probe measurements, demonstrating a significant enhancement in conductivity with increasing AgNPs concentration. UV-Vis spectroscopy revealed alterations in the optical properties of the films, indicating potential changes in bandgap energies. The comprehensive characterization approach employed in this study offers valuable insights into the mechanisms governing the conductivity enhancement in PEDOT: PSS films upon AgNPs integration. This investigation provides a detailed understanding of the synergistic effects between PEDOT: PSS and AgNPs, shedding light on the fundamental processes underlying the conductivity enhancement in polymer-based nanocomposites. These findings contribute to the advancement of wearable electronics and optoelectronic devices, offering new opportunities for the development of high-performance materials and devices.

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