

Evaluation of the Addition of O-Toluidine and Nano-Ag on The Optical and Electrical Properties of PEDOT-PSS Polymer

Nadhim A. Abdullah, Abdullah A. Hussein*,
Ghufran M. Shabeeb, and Haider Abdulelah

Department of Materials Science, Polymer Research Centre, University of Basrah, Iraq

*Corresponding author details: Abdullah A. Hussein; Abdullah.hussein@uobasrah.edu.iq

ABSTRACT

In this work, we investigate the optical and electrical properties of PEDOT-PSS:PVA:POT and PEDOT-PSS:PVA:POT:AgNPs thin films, by adding different concentrations of POT (1, 5, and 9 v%). The thin films were deposited using the spin coating method. UV-Vis spectroscopy was used to inspect the structure of the created tests. Transmittance estimations were conducted within the wavelength range of 200-900 nm to calculate the optical energy gap. The results showed that the absorption and energy bandgap decreased with the addition of Ag and different ratios of POT, while the electrical conductivity decreased in the presence of Ag. The electrical conductivity values were $(2.28 \times 10^{-9}$, 2.57×10^{-9} , and 2.99×10^{-8}) S.cm⁻¹ for PEDOT-PSS:PVA:POT and $(2.9 \times 10^{-7}$, 1.04×10^{-6} , and 4×10^{-7}) S.cm⁻¹ for PEDOT-PSS:PVA:POT:AgNPs.

Keywords: O-toluidine; PEDOT-PSS; PVA; POT; Silver Nanoparticle.

INTRODUCTION

PEDOT:PSS encompasses a complex structure due to the combination of two polyelectrolytes. The chemical structures of PEDOT:PSS and to balance the charge of the carriers in conjugation with the conjugated poly(3,4-ethylene dioxythiophene) (PEDOT) and the poly(styrene sulfonate) (PSS) have appeared in Figure 1.[1] Based on the picture, we can say that. 1b, the -OH groups in the PSS structure separated to release H⁺ in water, and then the H⁺ specifically reacted with the double bond in the PEDOT's thiophene, resulting in the creation of hydrogen bonding. At the same time, the electrons in the C-O electron pairs were pulled towards O because O has a stronger pull on these electrons.

In simpler terms, according to the information shown in the diagram. In simple words; The -OH groups in the PSS structure separated and released H⁺ in water. Then, the H⁺ specifically attacked the double bond in the PEDOT's thiophene, resulting in the creation of hydrogen bonding. At the same time, the electrons of the C-O shared pairs were pulled towards O because it is more electronegative. This situation happened because the C in the C-O bond had turned into a positive charge. An ionic bond formed when the positively charged C⁺ and negatively charged O⁻ of the PSS structures came together.[2] Also, the arrangement of atoms in PEDOT:PSS can be seen in the picture shown in figure The substance 1c, when mixed with water, forms small gel particles. These particles create films with different sections: some are blue and rich in PEDOT: PSS, while others are grey and rich in PSS.

Tiny parts of PEDOT are touching the PSS bundles when they are mixed together in a liquid form.

Furthermore, we can analyze the chemical structure of PEDOT:PSS by comparing it with the morphological model shown in Figure 1c. This text basically says that when 1c is mixed with water, it forms tiny gel particles. These particles create films that have two types of structures: blue areas with a lot of PEDOT: PSS and grey areas with a lot of PSS. Tiny pieces of PEDOT come into contact with the PSS bundles when they are mixed together in a liquid. This observation causes the creation of a mixture of gel particles in water. This happens because the two components have different weights and this makes one of them have a larger density. The typical weight of one molecule of PEDOT is around 1000 grams per mole, while the weight of one molecule of PSS is around 400,000 grams per mole [3].

This observation causes gel particles to form a colloid in water. This happens because the two parts have different weights and this causes them to have different densities. The average weight of PEDOT is about 1000 grams per mole, and the weight of PSS is about 400,000 grams per mole. In this situation, the Ag NPs helped to cover the conducting polymer. This improved the electrical performance by combining the metal core with the conductor polymer shell. The way electricity passes through something showed that bigger particles made it easier for electricity to flow. Two ideas can possibly explain the outcome. First, when silver particles were formed, they prevented PEDOT from combining with PSS, causing