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Fabrication and characterization of new bio-based electrode polyurethane: diverse conducting materials impacts such as graphene oxide, gold, and carbon nanotube

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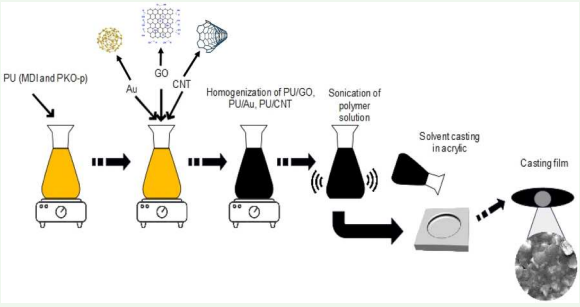
ABSTRACT

Novel bio-based electrode polyurethane (PU) fabricated using various conducting materials such as graphene oxide (GO), gold (Au), and carbon nanotube (CNT) as the primary source of a charge carrier. Initially, PU/GO, PU/Au, and PU/CNT polymers were synthesized using a pre-polymerization approach. Therefore, the application of conductive materials modifies and increases the conductivity of PU. The connection between PU and the conductive materials (GO, Au, and CNT) was identified using Fourier transform infrared (FTIR), whereby some important functional groups obtained in this spectrum investigation, such as the presence of amide (-NH) and carbonyl urethane(-C = O), following the absence of diisocyanate groups (-NCO) revealed the synthesis was satisfactory. The glass transition temperatures (T_g) of PU/GO, PU/Au, and PU/CNT were analyzed using differential scanning calorimetry (DSC). In contrast, the mass loss during the heat treatment was observed using thermogravimetric analysis (TGA). Furthermore, thermal studies have proven that PU/GO has higher thermal stability compared to PU/Au and PU/CNT. The field emission scanning electron microscopy (FESEM) presents satisfactory results between PU composites and pure PU. The conductivity of PU and PU composites was examined using electrochemical impedance spectroscopy (EIS) and showed that PU/GO has a better electrical conductivity (σ) at 3.68×10^{-3} S cm^{-1}.



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Carbon nanotube; electrode; gold; graphene oxide; polyurethane

1. Introduction

Among polymers employed in the industry (electrochemical devices, batteries, coating, biomedical, etc.), polyurethanes (PUs) are among the most appealing polymers. PUs have better resistance, biocompatibility, and mechanical properties than other polymers (1). Furthermore, applying PUs in numerous materials is well-established (2). The characteristics of PU allow for the tailoring of a broad range of particular properties, yet owing to the weak conductivity of PU, several drawbacks occur during PU performance. However, the weakness of PU can be modified by augmenting the conductive substances, namely, metal nanoparticles and carbon-based materials (3).

Researchers have made numerous attempts to increase the thermal and mechanical strength and chemical

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