UNIVERSITI TEKNOLOGI MARA

THE CHARACTERIZATION OF PHYTIC ACID-DOPED POLYANILINE EMBEDDED IN FABRICS FOR ANTIBACTERIAL APPLICATIONS

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

This thesis reports the synthesis, characterisation as well as antibacterial activity of polyaniline (PANI) embedded in polyester fabric (PES) and cotton fabric (COT). The objective of this study is to determine the chemical, morphological, and electrical properties of phytic acid doped PANI fabric by using Fourier Transform Infrared (FTIR), X-ray Fluorescence (XRF), Field Emission Scanning Electron Microscope (FESEM), and Electrical Impedance Spectroscopy (EIS), respectively, and to evaluate the antibacterial activity of PANI fabric. PANI was successfully synthesised by a chemical oxidation method where three reactants were employed: aniline, hydrochloric acid (HCl), and ammonium persulphate. The synthesis PANI was then doped with phytic acid, which acted as a doping agent to induce conductivity. The concentration of phytic acid was varied between 10v/v%, 20 v/v/%, and 30 v/v/% to investigate the effect on conductivity activity of different doping levels of phytic acid. The fabricated fabrics were produced via immersion technique with 30 minutes and 24 hours of different immersion times. PANI fabrics were successfully embedded and characterised through FTIR, XRF, FESEM and EIS. The FTIR study affirmed that PANI was successfully synthesised, doped, and fabricated on fabrics with the present functional group of C-N observed in both fabrics. XRF determined the level of doping of phytic acid in PANI. This analysis proved that PANI was successfully doped with phytic acid in the presence of element phosphate (P_2O_5). The percentage composition of element P_2O_5 that was identified was increased as the percentage of phytic acid that was used was increased. The morphology study of PANI fabric showed that all the PANI fabric was evenly deposited with PANI particles. The coating presents flaky and globular morphology. The conductivity of PANI fabrics was determined by using EIS. From this study, PANI PES fabric with 30-minute time immersion showed the highest conductivity value with $2.15 \times 10^{-2} \pm 3.87 \times 10^{-3}$ Sm^{-1}. The optimum concentration of phytic acid was 30v/v% with 30 minutes of optimum time immersion. The PES fabric was the best candidate as a substrate compared to the COT fabric. The agar disc diffusion method was used against six bacteria strains, which were *Klebsiella pneumoniae* (K.*pneumoniae*), *Staphylococcus aureus* (S.*aureus*), *Escherichia coli* (E.*coli*), *Serratia marcescens* (S.*marcescens*), *Bacillus cereus* (B.*cereus*) and *Bacillus subtilis* (B.*subtilis*). This study showed inhibition zones around PANI fabrics, which proved that PANI fabrics were competent against bacteria strains. The most significant inhibition zone for PANI fabric against the bacterial strain is 10.3 ± 0.5 mm, which occurred when PANI coated onto PES fabric at a concentration of 30 v/v% against K.*pneumaniae* with 30 minutes of immersion. Lastly, PANI fabrics were tested for their stability in the base environment by immersion in tap water for 30 minutes and 24 hours. The results showed that both fabrics did not change their colour, proving that this PANI fabric doped with phytic acid can retain its conductivity state, emeraldine salt state. It can be concluded from this study that PANI has proven potent conductive and antibacterial properties by doping it with phytic acid. Phytic acid is the best candidate for doping agent as this acid is stable enough to prevent the charge carrier of PANI from leaching out when exposed to an alkaline environment. The PANI fabric is conductive when exposed to alkaline, specifically tap water; hence, this fabric can be used in bio-inspired applications operating at high pH and can be cleaned and washed.

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