Junior Science Communications
Faculty of Applied Sciences, UiTM Shah Alam
https://journal.uitm.edu.my/ojs/index.php/JSC

E-ISSN 2637-0689
Vol 31 2024

Colloquium on Applied Sciences 2023
17-18 July 2023, Faculty of Applied Sciences, UiTM Shah Alam, Malaysia

Enhancing the Electrical Properties and Durability Performance of PANI/ZnO Coated Cotton Fabric via Pretreatment Processes

Nur Syamimi Mohamad Yusup[a], Mohd Iqbal Misnon[ac*],Mohamad Muzamir Mahat[b]

Structured Abstract

Background: The electrical characteristics of conductive textiles offer opportunities for developing smart textile fabrics by treating conductive fabrics with conductive elements. This study explored the incorporation of conductive polymers and nanoparticles, specifically PANI, ZnO and glutaraldehyde. The loss of conductivity that occurs because of dust and dirt is unavoidable for fabrics. Therefore, to improve the electrical properties and durability performance of PANI/ZnO coated cotton fabric, removing those impurities from fabric's surface is required. This study aims to measure the electrical conductivity and treatment durability performances of PANI/ZnO-coated pretreated cotton fabric.

Methods: PANI/ZnO and PANI/ZnO with glutaraldehyde cotton fabrics were prepared using an immersion technique. The PANI was synthesised using the chemical oxidative polymerisation method with aniline monomer. Subsequently, ZnO nanoparticles were incorporated into the PANI with glutaraldehyde as the crosslinking agent. The cotton fabric was washed, scoured, and bleached before being treated with PANI/ZnO and PANI/ZnO with glutaraldehyde. Perspiration testing was conducted to evaluate the durability performance of fabric towards sweat. After treatment, SEM, FTIR, and XRD characterisation were utilised and the electrical conductivity was evaluated using EIS.

Results: EIS results showed higher electrical conductivity in PANI/ZnO with glutaraldehyde cotton fabrics which is 6.90×10^{-3}, S/m compared to 6.26×10^{-3} S/m for PANI/ZnO cotton fabrics, attributed to glutaraldehyde crosslinking. The glutaraldehyde is bound to PANI/ZnO chains, acting in the increase of electrical conductivity. The perspiration testing results indicate decreased electrical conductivity for PANI/ZnO and PANI/ZnO with glutaraldehyde cotton fabrics which is 1.71×10^{-3} S/m and 1.96×10^{-3} S/m, respectively.

Conclusion: The bleaching process proved to be the most effective pretreatment process for cotton fabric with the value of 6.90 x 10-3 S/m thereby enhancing the electrical properties and durability performance which is 1.96 x 10-3 S/m for PANI/ZnO with glutaraldehyde samples. SEM, FTIR, and XRD analyses confirmed the improvements achieved through bleaching and glutaraldehyde crosslinking.

Keywords: PANI, Textile Pretreatment, Durability Performance, Electrical Properties

*Correspondence: texiqbal@uitm.edu.my

[a]School of Industrial Technology, Faculty of Applied Sciences, Universiti Teknologi MARA, Shah Alam, Malaysia

[b]School of Physics and Materials Studies, Faculty of Applied Sciences, Universiti Teknologi MARA, Shah Alam, Malaysia

[c]Textile Research Group, Faculty of Applied Sciences, Universiti Teknologi MARA, Shah Alam, Malaysia