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FINAL YEAR PROJECT 2 - RESEARCH PROJECT**

**THE PHYSICOCHEMICAL STUDIES ON LITHIUM
SALT-DOPED POLYANILINE / NITRILE BUTADIENE RUBBER
(PANI/NBR) ELECTROLYTES**

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DOPED POLYANILINE /NITRILE BUTADIENE RUBBER
(PANI/NBR) ELECTROLYTES**

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ABSTRACT

THE PHYSICO-CHEMICAL STUDIES ON LITHIUM SALT- DOPED POLYANILINE / NITRILE BUTADIENE RUBBER (PANI/NBR) ELECTROLYTES

Conducting polymers (CP), particularly polyaniline (PANI), have become a promising solution to harmful liquid electrolytes. However, in its undoped state, PANI exhibits very low conductivity ($\sim 10^{-6}$ S/cm) due to a lack of mobile charge carriers. Additionally, undoped PANI forms brittle, non-uniform films with poor electrode-electrolyte contact, all of which hinder its overall conductivity and performance in electrochemical applications. To overcome the brittleness issues, this study aims to blend PANI with NBR at different ratio (0:100, 10:90, 20:80, 30:70, 40:60, 50:50, 60:40, 70:30, 90:10, and 100:0) using solution casting techniques. Then, the structural, morphological, electrical, and mechanical properties of the systems were studied to determine the best ratio. Then, different wt.% of LiTFSI salt was added to improve the conductivity of the highest conducting PANI/NBR blend supported by the evaluation of the structural, electrical, and morphological properties. In this study, flexible and free-standing film of PANI/NBR blend was successfully prepared up until 50:50 PANI/NBR ratio (PANI50). The FTIR study confirms the interaction between PANI-NBR via hydrogen bonding. PANI/NBR blends also show the improvement in term of flexibility by increasing tensile strain, if compared to PANI. The conductivity of the PANI/NBR blend increased with increasing amount of PANI up until $\sim 10^{-4}$ S cm^{-1} due to the formation of a percolation network, where PANI particles begin to form interconnected conductive network as observed in the SEM image of PANI50. PANI50 was chosen as optimum ratio to be doped by salt due to its balanced mechanical and conductivity, hence proving the synergistic effect of the polymer blend at this ratio. The highest conducting salt-doped sample was obtained with addition of 20 wt.% of LiTFSI (PANI50-20Li) contributed by the strong plasticizing effect of the TFSI⁻ anions, which was further supported by its gel-like structure as observed via SEM analysis. This phenomenon reduces strong electrostatic contacts and dynamic crosslinking within the blend matrix, increase free volume and facilitate polymer chain mobility, thereby improving the conductivity. As the materials used in this study are safer for the environment, the CP that was produced will support both the 12th Shared Prosperity Vision 2030 (KEGA12) and Sustainable Development Goal 7 (SDG7).

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