EFFECT OF POTASSIUM IODIDE (KI) SALT ADDITION ON POLYSACCHARIDE BASED NATURAL SOLID POLYMER ELECTROLYTE.

NURUL SYAMIMI BINTI SOHAIMI

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Dr Nabilah Akemal Muhd Zailani
Supervisor
B.Sc. (Hons.) Applied Chemistry
Faculty of Applied Sciences
University Teknologi MARA
02600 Arau
Perlis

_____

Dr Khuzaimah binti Nazir
Co-Supervisor
B.Sc. (Hons.) Applied Chemistry
Faculty of Applied Sciences
Universiti Teknologi MARA
02600 Arau
Perlis

_____

Dr. Siti Nurlia binti Ali
Project Coordinator
B.Sc (Hons.) Applied Chemistry
Faculty of Applied Sciences
Universiti Teknologi MARA
02600 Arau
Perlis

_____

Dr.Nur Nasulhah Kasim
Head of Programme
B.Sc. (Hons.) Applied Chemistry
Faculty of Applied Sciences
Universiti Teknologi MARA
02600 Arau
Perlis

Date: _____

ABSTRACT

EFFECT OF POTASSIUM IODIDE (KI) SALT ADDITION ON POLYSACCHARIDE BASED NATURAL SOLID POLYMER ELECTROLYTE

Energy storage devices often use highly conducting liquid electrolytes (LEs), which have poor safety and electrochemical stability. Alternatively, solid polymer electrolytes (SPEs) are gaining interest due to their safety and wider electrochemical stability. Natural polymers, such as polysaccharides, are preferred as polymer host as they contain oxygen that are suitable as coordinating site. In this study, flexible and free-standing SPE films were prepared by doping different wt.% of potassium iodide (KI) in the polysaccharide system using solution casting technique. The study investigated the effect of different amount of KI on the structural, electrical, and morphological properties of the polysaccharide-based electrolyte films using Fourier Transform Infrared Spectroscopy (FTIR), Electrochemical Impedance Spectroscopy (EIS), and Optical Microscopy (OM), respectively. The study successfully produced solid, flexible, and free-standing films of polysaccharide-based polymer electrolytes by doping up to 20 wt% of KI into the polysaccharide matrix via the solution casting technique. Flexible films were produced by minimizing hydrogen bonding between polysaccharide chains. This was achieved by the interaction of oxygen in the OH group of the polysaccharides with Li^+ from the salt, as confirmed by FTIR analysis. However, adding >20 wt% of KI resulted in brittle films due to formation of ionic aggregates at high salt concentration. The FTIR analysis confirms complexation between hydroxyl and carbonyl groups of polysaccharides with K^+ of the salt. This is shown by the shift in wavenumber or change in peak intensities for O-H stretching, C=O stretching, and C-O bending peaks after adding KI. Adding up to 20 wt% of KI increased ionic conductivity to 1.40×10^{-8} S cm^{-1}, which is two orders of magnitude higher than the pure polysaccharide system. This was due to the increased charge carrier and improved amorphous phase caused by polymer-salt interaction, as proven in FTIR analysis. Additionally, the hydrogen bonds causing the brittle structure of polysaccharide have been reduced as OH stretching of polysaccharide interacts with the Li^+ of the salt. This is confirmed by OM studies that show the presence of a polymer-salt network in K1 and K2 optical micrographs. The ionic conductivity decreases when 30 wt% of KI is added due to ion aggregate formation, confirmed by the disappearance of the polymer-salt network in the surface morphology of K3. The preparation of KI-doped polysaccharide-based PE in this study align with the Sustainable Development Goals 7 (SDG7) on affordable and clean energy and the 12th Shared Prosperity Vision 2030 (KEGA12) on the green economy.

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