ASURS 2025

Applied Sciences Undergraduate Research Sessions

ABSTRACTS

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ASURS 2025

04th June 2025

Faculty of Applied Sciences

Rajarata University of Sri Lanka

SYNTHESIS, OPTIMIZATION AND CHARACTERIZATION OF MUSHROOM (*Pleurotus ostreatus*) STEMS DERIVED CHITOSAN BASED GEL POLYMER ELECTROLYTES FOR MAGNESIUM ION BATTERY APPLICATION

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Energy storage devices like batteries rely on electrolytes to transport ions between electrodes, enabling electrochemical reactions. Traditional liquid electrolytes have great high ionic conductivity but present safety concerns such as leakage, flammability, and chemical reactivity. Solid electrolytes improve safety and stability but are limited by their low conductivity at room temperature and mechanical brittleness. Gel polymer electrolytes (GPEs) combine the advantages of both by providing high ionic conductivity while also improving mechanical and thermal stability, making them a promising alternative for next-generation, safer, and more sustainable battery technologies. GPEs based on synthetic polymers are widely utilized in energy storage applications such as batteries. However, they pose significant environmental concerns due to their non-biodegradability (because they are petroleum-based polymers), high production costs, and potential toxicity. To address these challenges, biopolymer derived electrolytes have gained interest as sustainable alternatives. Among various biopolymers, chitosan is well known for its natural abundance, film-forming ability, and potential as a polymer host in GPEs. Commercially, chitosan is primarily extracted from crustacean shells, making it cost-effective but raises environmental concerns related to seafood waste disposal and the use of harsh chemicals in the extraction process. As an alternative this study explores the extraction of chitosan from *Pleurotus ostreatus* (oyster mushroom) stems, a renewable and plant-based source. Demineralization and deproteination were used to extract chitin, followed by deacetylation of the extracted chitin to yield chitosan. The extracted chitosan was characterized using FTIR spectra, which showed characteristic peaks at 1635 cm^{-1} (amide) and 3269 cm^{-1} (hydroxyl). The extracted mushroom stems derived chitosan was used to develop an eco-friendly GPE. Chitosan was dissolved in acetic acid along with magnesium triflate (MgTf) salt to form the polymer electrolyte matrix. A series of GPEs were prepared by varying the concentrations of MgTf (chitosan: MgTf 10,15, 20, 25, 30, and 40 wt%). The highest ionic conductivity of 2.3×10^{-4} S/cm was achieved at 25 wt% MgTf. The optimized chitosan MgTf electrolyte was further enhanced with titanium dioxide (TiO_2) nanofillers with different amounts (chitosan: TiO_2 2, 4, 6, 8 wt%). To further improve the mechanical properties of the electrolyte, Titanium dioxide nanoparticles (TiO_2) were added to the optimized system as a nanofiller. The ionic conductivity of the electrolyte was improved as 3.79×10^{-4} S/cm for 6 wt% TiO_2 added system. The synthesized GPEs were characterized using Fourier-transform infrared spectroscopy (FTIR) to analyze polymer-salt interactions, Electrochemical Impedance Spectroscopy (EIS) to evaluate ionic conductivity measurements, and DC polarization measurement to calculate the electronic transference numbers.

Keywords: *Gel polymer electrolytes, Chitosan, Magnesium triflate, Ionic conductivity*

Acknowledgments: Authors are grateful to Professor T.M.W.J Bandara, Department of Physics, Faculty of Science, University of Peradeniya, Peradeniya for electrochemical impedance analysis.