Proceedings of the International conference on

Advanced Materials for Clean Energy and Health Applications

March 27 & 28, 2025

AMCEHA - 2025

University of Jaffna, Sri Lanka

Organizers

University of Jaffna
Sri Lanka

Western Norway
University of
Applied Sciences

Partners

Coimbatore Institute of Technology

Alagappa University

PSG College of Technology

University of Bergen

University of Oslo

Eastern University of Sri Lanka

National Institute of Fundamental Studies

Low-Cost Gel Electrolyte Prepared Using Silica Extracted from Rice Husk for Dye-Sensitized Solar Cells

Terans Rahapsksha[1], Gamini Rajapaksha[1,2], G. R. A. Kumara[3], K. D. M. S. P. K. Kumarasinghe[1]

[1] *Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka*
[2] *Department of Chemistry, Faculty of Science, University of Peradeniya, Peradeniya , Sri Lanka.*
[3] *National Institute of Fundamental Studies, Hantana Road, Kandy , Sri Lanka*
teransrajapaksha91@gmail.com

Dye-sensitized solar cells (DSSCs) consist of three main components: the photoelectrode, electrolyte, and counter electrode. The photoelectrode, composed of a TiO_2 layer sensitized with dye (N719), facilitates light absorption and electron injection. The electrolyte, containing a redox couple, enables charge transport, while the counter electrode aids in electron regeneration. Liquid electrolytes in DSSCs suffer from leakage and volatility, whereas gel electrolytes enhance stability but often exhibit lower ionic conductivity. This study investigates the effect of silica derived from rice husk (RH) as an additive to improve the ionic conductivity and efficiency of gel electrolytes. The gel electrolyte was formulated using polyethylene oxide (PEO) as the polymer matrix, with varying amounts (0.1 g - 0.75 g) of fused silica. Lithium iodide and iodine were used as the redox couple. Performance was evaluated under simulated sunlight using an SPD SS-25 LED Solar Simulator (AM 1.5, 100 mW/cm²) and a VK-PA-300 K PV power analyzer. The electrolyte solution without silica, exhibited an efficiency of 5.3%, while the optimized electrolyte with 0.25 g silica achieved 6.9%, marking a 30.2% improvement. Electrochemical impedance spectroscopy (EIS) analysis from an Auto lab system revealed that the ionic conductivity increased from 4.51 S/m (without silica) to 5.81 S/m (0.25 g silica), an enhancement of 28.8%. These findings highlight RH-derived silica as a cost-effective material for improving DSSC performance.

Keywords: Dye-sensitized solar cell, Gel electrolyte, Silica, Rice husk, Ionic conductivity