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Book of Abstracts

THEME:

Innovative scientific research: A tool for socioeconomic development and environmental sustainability

Federal University of Technology Minna,
Niger State, Nigeria

THEME OF THE CONFERENCE

Innovative scientific research: A tool for socioeconomic development and environmental sustainability.

SUB-THEMES OF THE CONFERENCE

- Advancement in Materials Science and Technology for Sustainable Development
- Modeling, Theory and Applications
- Climate Sustainability and Sustainable Development Goals
- Science, Technology and Innovation, and the Journey to a Net Zero Energy Future for Africa

PRE-CONFERENCE WORKSHOP TITLE

Publication in Impact Factor Journal: Challenge and Breakthrough

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Performance metrics and impedance spectroscopy of a surface-modified stainless-steel mesh and carbon-felt electrodes in a terrestrial microbial fuel cell for micro-power production

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Abstract
Terrestrial Microbial Fuel Cells (MFCs) represent a promising avenue for sustainable energy production, leveraging microbial metabolism to convert organic matter in the soil into electricity. Crucial to MFC performance is the selection of electrode materials, which directly interface with electroactive microbes for electron transfer. This study conducts a comparative analysis of surface-modified stainless-steel mesh (SMS) and carbon felt (CF) electrodes in terrestrial MFCs, evaluating their performance metrics and impedance spectroscopy. The SMS electrode which was fabricated using the pasting and reinforcement process demonstrated superior performance with maximum power of 859 µW compared 234 µW power of the commercially available CF electrode. This better performance of the SMS electrode was attributed to its pseudocapacitive behavior, enhancing internal charge storage capacity and overall MFC efficiency. Electrochemical impedance spectroscopy revealed a substantially higher charge transfer resistance (R_{ct}) in the CF electrode, impeding electron transfer processes. Conversely, the SMS electrode exhibited lower charge R_{ct} and improved diffusion characteristics, facilitating efficient electron transfer and mass transport. Notably, the R_{ct} of the CF electrode was over 40 times higher, while its diffusion coefficient was approximately 6 times greater compared to the SMS electrode. These findings underscore the significance of tailored electrode materials in optimizing MFC performance and emphasize the utility of impedance spectroscopy in elucidating complex electrochemical processes within MFC systems, thus guiding future advancements in sustainable power production in terrestrial MFCs.
Keywords: Impedance, microbial fuel cell, modified stainless-steel mesh, electrode, carbon-felt, performance

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Prediction of Compaction Parameters of Lateritic Soil Stabilized with Fly Ash and Limestone Powder Subjected to Three Energy Levels

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Abstract
This study adopted the multi-variate linear regression modelling technique to derive equations for compaction parameters (MDD and OMC) for lateritic soil stabilized with fly ash at varying percentages (3%, 6%, 9%, 12%, and 15%) and limestone powder at a constant percentage of 6%. Soil mixture containing 6% Limestone content was the control for the experiment. Three energy levels: British Standard Heavy (BSH), West Africa Standard (WAS), and British Standard Light (BSL) were adopted in this study. Regression modeling tools in MATLAB software was deployed to derive the equations for Maximum Dry Density (MDD) and Optimum Moisture Content (OMC). . The MDD and OMC equations were modeled on admixture content and compactive effort. The model for MDD had an R 2 value of 0.899 and a p-value of 6.24e-07. The model for OMC had an R2 value of 0.766 and a p-value of 0.000108. Based on the Analysis of Variance (ANOVA) results of laboratory and model data of