COMPLEX NONLINEAR LEAST SQUARES (CNLS) AND DISTRIBUTION OF RELAXATION TIME (DRT) ANALYSIS OF MODIFIED $La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_{3-\delta}$ (LSCF) SYMMETRICAL CELL IN COMBINATION

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This Final Year Project entitled "**Complex Nonlinear Least Squares (CNLS) and Distribution of Relaxation Time (DRT) Analysis of Modified $La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_{3-\delta}$ (LSCF) Symmetrical Cell In Combination**" was submitted by Alya Nazifa Binti Zulkifli in partial fulfilment of the requirements for the Degree of Bachelor of Science (Hons.) in Physics, in the Faculty of Applied Science, was approved by

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ABSTRACT

COMPLEX NONLINEAR LEAST SQUARES (CNLS) AND DISTRIBUTION OF RELAXATION TIME (DRT) ANALYSIS OF MODIFIED $La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_{3-\delta}$ (LSCF) SYMMETRICAL CELL IN COMBINATION

This study explores the enhancement of proton-conducting fuel cells (PCFC) through the modification of lanthanum strontium cobalt ferrite (LSCF) cathodes of a symmetrical cell using zirconium chloride ($ZrCl_4$), to overcome the limitations arises such as strontium (Sr) segregation at scorching temperatures that slows down the performance. The objectives of this research are: (1) to determine the polarization resistance (R_p) of modified LSCF via surface modification through complex non-linear least squares (CNLS) and distribution of relaxation time (DRT) analysis, and (2) to analyze the variation in relaxation time constants and their corresponding DRT profiles for the modified LSCF symmetrical cell. The methodology involved synthesizing BCZY electrolytes and preparing symmetrical LSCF | BCZY | LSCF cell with modified and unmodified symmetrical cell to be used as control sample. For modified sample, LSCF thin films were dipped into $ZrCl_4$ solution to modify the surface. The effects of the modification were analyzed using electrochemical impedance spectroscopy (EIS) and DRT analysis. With a higher level of resolution than conventional CNLS analysis, the DRT approach successfully identified overlapping electrochemical processes. The results of CNLS and DRT analysis showed that both area-specific resistance (ASR) and R_p significantly improved with increasing temperature, Overall, the study concludes that $ZrCl_4$ surface modification greatly improves PCFCs' electrochemical performance, with DRT analysis proving to be more reliable method for assessing impedance.

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