

**COMBINED OF COMPLEX NONLINEAR LEAST SQUARES (CNLS) &
DISTRIBUTION OF RELAXATION TIMES (DRT) STUDY OF LSCF
CATHODE THIN FILM WITH PCFC ELECTROLYTE**

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ABSTRACT

Combined of Complex Nonlinear Least Squares (CNLS) & Distribution of Relaxation Times (DRT) Study of LSCF Cathode Thin Film with PCFC Electrolyte

This research investigated the temperature dependent performance of Lanthanum Strontium Cobalt Ferrite (LSCF) cathode on Barium Cerium Zirconate Yttrium (BCZY) electrolyte for protonic ceramic fuel cells (PCFC). The measurements of electrochemical impedance spectroscopy were obtained at 700°C, 750°C and 800°C, and data were analyzed using CNLS fitting and DRT methods. The material exhibited relatively high resistances ($R_s=10.7 \text{ } \Omega\text{cm}^2$, $R_p=140 \text{ } \Omega\text{cm}^2$) and moderate conductivity (0.489 S/m) at 700°C, and DRT indicated broad peaks indicating slower processes. Performance was much improved at 750°C, where resistances decreased ($R_s=8.0 \text{ } \Omega\text{cm}^2$, $R_p=0.55 \text{ } \Omega\text{cm}^2$) and conductivity was 0.654 S/m, with sharper DRT peaks showing faster reactions. Optimum performance was at 800°C, with lowest resistances ($R_s=7.75 \text{ } \Omega\text{cm}^2$, $R_p=0.54 \text{ } \Omega\text{cm}^2$), highest conductivity (0.675 S/m) and sharper DRT peaks confirming faster reaction kinetics. These results clearly demonstrate that higher temperatures enhance the electrochemical activity of the material by reducing resistances and enhancing proton conductivity. The study validates LSCF as an optimum cathode material for intermediate temperature fuel cell application, with the integrated CNLS-DRT analysis offering comprehensive insight into the temperature dependent behavior of the symmetrical cell.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	Page
ABSTRACT	iii
ABSTRAK	iv
TABLE OF CONTENTS	v
LIST OF TABLES	vi
LIST OF FIGURES	viii
LIST OF ABBREVIATIONS	ix
CHAPTER 1 INTRODUCTION	xi
1.1 Background of Study	13
1.2 Problem Statement	13
1.3 Research Questions	16
1.4 Objectives	17
1.5 Significance of the Study	17
CHAPTER 2 LITERATURE REVIEW	19
2.1 Solid Oxide Fuel Cell (SOFC)	19
2.2 Proton Ceramic Fuel Cell (PCFC)	21
2.3 Lanthanum Strontium Cobalt Ferrite (LSCF)	25
2.4 Symmetrical cell of LSCF BCZY LSCF	27
2.4.1 Electrical performance of Symmetrical cell	28
2.5 Electrochemical Impedance Spectroscopy (EIS)	31
2.6 Distribution Relaxation Time (DRT)	36
CHAPTER 3 METHODOLOGY	39
3.1 Cathode slurry	39
3.2 Symmetrical cell of LSCF BCZY LSCF	40
3.3 Electrochemical Impedance Spectroscopy (EIS)	42
3.4 Distribution Relaxation Time (DRT)	43
3.5 Flowchart	46
CHAPTER 4 RESULTS AND DISCUSSION	47
4.1 Introduction	47
4.2 Electrochemical Impedance Spectroscopy (EIS)	47
4.2.1 CNLS Analysis of LSCF Impedance Spectra	47
4.3 Distribution Relaxation Time (DRT) analysis	53
CHAPTER 5 CONCLUSION AND RECOMMENDATION	59
5.1 Introduction	59
5.2 Conclusion	59
5.3 Recommendation	61

REFERENCES	62
APPENDICES	66
CURUCULUM VITAE	73