Faculty of Engineering

Cairo University

MODELING CATHODE CARBON CORROSION IN PEM FUEL CELLS AND STUDY OF FAILURE MITIGATION TECHNIQUES USING NANOTECHNOLOGY

By

Mahmoud Faheem Shar Shar

A Thesis Submitted to the
Faculty of Engineering at Cairo University
In partial fulfillment of the
Requirements for the degree of

DOCTOR OF PHILOSOPHY
In
Mechanical Power Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
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Under the supervision of

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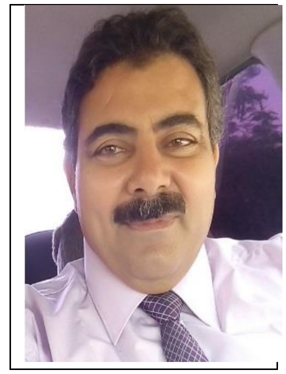

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Title of Thesis : **MODELING CATHODE CARBON CORROSION IN PEM FUEL CELLS AND STUDY OF FAILURE MITIGATION TECHNIQUES USING NANOTECHNOLOGY**

Key words: PEM FUEL CELLS, cathode carbon corrosion, computational model ,numerical simulation, COMSOL multiphysics

Summary : The study investigates numerically, cathode carbon corrosion in PEM fuel cells. This phenomenon is caused by exhausting of hydrogen in a part of the anode compartment and replaced by air (Oxygen), where the rest of the anode operates normally. This irregular situation sets up the entire cell in the mode of dual operation as generator (power source) drive an electrolyzer (power load) which creates reverse current increases cathode interfacial potential and promotes carbon corrosion. This failure mode of operation is referenced to normal mode of operation. Hence, it is convenient to first investigate normal mode of operation of PEM fuel cells which is completely exhibited in performance, participating physics and characteristic parameters. The performance is expressed in output voltages, the characteristic parameters are expressed in geometrical, kinetic, transport and operating parameters and participating physics are expressed in physical variables. Computational models have been developed in COMSOL multi-physics to study both normal mode and failure mode of operation. Failure mitigation is investigated employing alternative carbon materials using nanotechnology.

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Dedication

To all my family

Table of Contents

List of Tables

List of Figures