



Pharos University in Alexandria

Faculty of Engineering

Department of Petrochemical Engineering

**Preparation of Polymer Nanocomposite with A Low Dielectric
Constant Using In-Situ Interfacial Poly Condensation**

*A thesis submitted in partial fulfillment of the requirement for the degree of
Master of Science*

In

Petrochemical Engineering

Submitted by

Lina Moataz Khamis EL-Bayar

**B. Sc. in Petrochemical Engineering Faculty of Engineering Pharos
University, 2019**

2023

ACKNOWLEDGMENT

In the Name of Allah, the Most Gracious, the Most Merciful

First and foremost; all praise is to Allah, the Almighty, on whom ultimately, we depend for sustenance and guidance. It is because of His blessing that we were finally able to finish this project with great enthusiasm and determination. We thank Allah for bestowing wellness, persistence and knowledge upon us to accomplish this project.

Special appreciation goes to Prof. Dr. Shaaban Nosier, Prof. Dr. Abbas Anwar Ezzat, Dr. Fathy Shokry and Dr. Mahmoud Abdelaty for their supervision on this project. Their constructive comments and suggestions have contributed to the success of this work. Thank them for their encouragement, For a great working relationship, the grasp of broad concepts attention to detail.

Acknowledgement is due to the Dean of the Faculty of Engineering, Prof. Dr. Mahmoud Mohammed Al-Maliji and to the Head of Department of Petrochemicals Engineering, Prof. Dr. Abbas Anwar Ezzat

Most importantly, words cannot convey our sincere appreciation and deepest gratitude to my beloved parents for their emotional and moral support and Also for their love, patience, encouragement, and endless prayers. I am very fortunate and blessed to have parents who are constantly helpful and supportive. Am praying for the mercy and forgiveness of my father, Dr. Moataz El-Bayar.

Abstract

Nowadays, dielectric materials with excellent mechanical and thermal properties are desired for use in integrated circuits (ICs). For this reason, low dielectric constant Poly (m-phenylene isophthalamide)/fluorographene (PMIA/FG) composite films were prepared via in-situ interfacial polycondensation method. Isophthaloyl chloride and m-phenylene diamine were reacted in a two-phase media in the presence of FG nanoparticles. suggesting that the mechanical, electrical and thermal properties were significantly enhanced in the presence of FG. With addition of 1.25 wt% FG, the tensile strength and elongation at break were increased by 110% and 20 % respectively when compared with pure PI film. Furthermore, composite films exhibit 465 °C of initial degradation temperature indicating a high thermal stability. Especially, the PMIA/FG film with 0.75 wt% of FG possessing a low dielectric constant of 2.15 compared to 3.44 dielectric constant for pure PMIA. Therefore, by their excellent performance, PMIA/FG composite films represent suitable with applications in the microelectronics and aerospace industries.