

THE FUNDAMENTAL OUTLIVING CONCEPT OF
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**THE FLUORESCENCE QUENCHING CONCEPT OF
POLY (1, 4-PHENYLENE-1, 2-DI (*p*-PHENOXYPHENYL) VINYLENE),
dpop -PPV AS CARBON DIOXIDE GAS SENSOR**

By

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**JABATAN SAINS KIMIA
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**PENGAKUAN DAN PENGESAHAN LAPORAN
PROJEK PENYELIDIKAN I DAN II**

Adalah ini diakui dan disahkan bahawa laporan penyelidikan bertajuk:

The fluorescence quenching concept of poly (1, 4-phenylene-1,2- di (p-phenoxy phenyl) vinylene , dpop-PPV as carbon dioxide gas sensor oleh Lee Ting Ting, No. Matrik UK 6599 telah diperiksa dan semua pembedaan yang disarankan telah dilakukan. Laporan ini dikemukakan kepada Jabatan Sains Kimia sebagai memenuhi sebahagian daripada keperluan memperoleh Ijazah Sarjana Muda Sains (Sains Kimia), Fakulti Sains dan Teknologi, Kolej Universiti Sains dan Teknologi Malaysia.

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TABLE OF CONTENT

APPROVAL SHEET	ii
ACKNOWLEDGEMENTS	iii
LIST OF CONTENT	iv
LIST OF TABLES	vi
LIST OF FIGURES	vii
LIST OF ABBREVIATIONS	ix
LIST OF APPENDICES	xi
ABSTRACT	xii
ABSTRAK	xiii
1.0 INTRODUCTION	1
1.1 Introduction	1
1.2 Background of study	3
1.3 Significance of study	3
1.4 Objectives	4
2.0 LITERATURE REVIEW	5
2.1 Poly (arylene vinylene), (PAV)	5
2.2 Sensor	7
2.3 The selection of sensor	8
2.4 Fluorimetry	9
2.5 Origin of fluorescence	11
2.6 Selection of solvent	15
2.7 Spectrochemical phenomena	17
2.8 Concept of fluorescence quenching	18
2.9 The theory of optical fibers	23
2.10 Fiber optic chemical sensor	23
2.11 Chemical sensor	26
2.12 Fluorescence and chemical structure	28
3.0 METHODOLOGY	29
3.1 Chemicals	29
3.2 Apparatus	30
3.3 Preparation of <i>dpop</i> -PPV solution	31
3.4 Characterization of polymer	
3.4.1 Fourier Transform Infrared Spectroscopy Analysis (FTIR)	31
3.4.2 UV-Visible Absorption Spectroscopy Analysis (UV-VIS)	32
3.4.3 Thermogravimetric Analysis (TGA)	32
3.4.4 Differential Scanning Calorimetric Analysis (DSC)	33
3.4.5 Fluorescence Spectroscopy	33

3.5	Characterization of sensing material in solution	
3.5.1	Fluorescence spectra	34
3.5.2	Regeneration process	35
3.5.3	Photostability test	35
3.5.4	Repeatability and reproducibility test	36
3.5.5	The steady state response toward CO ₂ gas	37
3.5.6	The effect of CO ₂ volume	37
4.0	RESULTS AND DISCUSSION	38
4.1	Polymer Characterization	
4.1.1	Fourier Transform Infrared Spectroscopy Analysis (FTIR)	38
4.1.2	UV- Visible Spectroscopy Analysis (UV-VIS)	40
4.1.3	Differential Scanning Calorimetric Analysis (DSC)	41
4.1.4	Thermogravimetric Analysis (TGA)	41
4.2	Characterization of sensing material in solution	
4.2.1	Fluorescence spectrum	44
4.2.2	Quenching effect	46
4.2.3	Photostability	49
4.2.4	Regeneration	51
4.2.5	Repeatability and Reproducibility of sensing tests	53
4.2.6	The steady-state response towards CO ₂ gas	55
4.2.7	The effect of the CO ₂ volume	57
5.0	CONCLUSION AND RECOMMENDATION	60
	REFERENCES	62
	APPENDICES	66
	CURRICULUM VITAE	70

LIST OF TABLES

Tables		Page
3.1	List of chemicals	29
3.2	Apparatus	30
3.3	List of equipment needed for experiment	30

LIST OF FIGURES

Figure		Page
2.1	Structure of <i>dpop</i> -PPV	7
2.2	Schematic diagram of UV/Visible fluorescence equipment with important component.	10
2.3	The Fluorescence Process	13
2.4	Jablonski diagram of processes leading to luminescence	14
2.5	Mechanism propose for fluorescence quenching of <i>dpop</i> -PPV by CO ₂ gas	22
2.6	Diagram of the instrumentation of an optical sensor	25
2.7	The structure of a chemical sensor	27
4.1	FTIR spectrums for <i>dpop</i> -PPV	39
4.2	The UV-Vis spectrum of <i>dpop</i> -PPV	40
4.3	The DSC thermogram of <i>dpop</i> -PPV	42
4.4	The TGA thermogram of <i>dpop</i> -PPV	43
4.5	The excitation and emission spectra of <i>dpop</i> -PPV (λ_{ex} : 420 nm, λ_{em} : 525 nm).	45
4.6	The fluorescence spectrum of <i>dpop</i> -PPV before (a) and after(b) quenching with CO ₂ gas.	47
4.7	The response of <i>dpop</i> -PPV when exposed to CO ₂ gas for 0 min(a), 5 min(b), 10 min(c) and 15 min(d).	48
4.8	Photostability graph for <i>dpop</i> -PPV reagent in DMF solvent that exposed to xenon lamp for eight hours	50
4.9	Typical response of <i>dpop</i> -PPV solution towards CO ₂ gas with the same concentration. The N ₂ gas was used to regenerate the polymer every after CO ₂ gas detection.	52
4.10	Repeatability and reproducibility of <i>dpop</i> -PPV as sensing reagent towards CO ₂ gas.	54

4.11	The effect of flow rate on the response time of <i>dpop</i> -PPV solution towards CO ₂ gas.	56
4.12	The effect of the CO ₂ volume towards the fluorescence intensity of reagent <i>dpop</i> -PPV in DMF.	58
4.13	The correlation between the I ₀ / I of <i>dpop</i> -PPV and volume of CO ₂ gas.	59

LIST OF ABBREVIATION AND SYMBOLS

Abbreviation / Symbol	Description
DMF	Dimethylformamide
PAV	Poly (arylene)vinylene
PPV	Poly (phenylene diphenyl) vinylene
UV	Ultraviolet
FTIR	Fourier Transform Infrared Spectroscopy
DSC	Differential Scanning Calorimetry
TGA	Thermogravimetry Analysis
CO ₂	Carbon dioxide gas
N ₂	Nitrogen gas
O ₂	Oxygen gas
HOMO	Highest Occupied Molecular Orbital
LUMO	Lowest Unoccupied Molecular Orbital
σ	Sigma
π	Pi
LED	Light emitting diode
S ₀	Ground-state energy
S ₁	First electronic singlet state
S ₂	Second electronic singlet state

Abbreviation / Symbol	Description
<i>o</i> -NTP	<i>o</i> -mononitrophenol
I_0	Absence of quencher
I	Presence of quencher
[Q]	Quencher concentration
K_{sv}	Stern-Volmer quenching constant
H^+	Hydrogen ion
NH_3	Ammonia
λ_{ex}	Wavelength for excitation
λ_{em}	Wavelength for emission
RSD	Relative Standard Deviation
ml /s	Milliliter per second
T_g	Glass Transition Temperature

LIST OF APPENDICES

Appendix		Page
1	Data for figure 4.10	66
2	Data for figure 4.11	67
3	Data for figure 4.12	68
4	Data for figure 4.13	69

ABSTRACT

The potential of *dpop*-PPV as sensing material for carbon dioxide (CO₂) gas detection have been conducted. The studied of sensing properties was based on fluorescence quenching concept. For the characterization of *dpop*-PPV, the properties of polymer have been carried out by using several instruments. It included Fourier Transform Infrared Spectroscopy (FTIR), Ultraviolet-Visible Absorption Spectroscopy (UV-VIS), Differential Scanning Calorimetric Analysis (DSC) and Thermogravimetric Analysis (TGA). Result obtained from the studied showed that properties of polymer had been successfully carried out. From TGA analysis, the polymer showed only 5% of weight loss at temperature 450 °C. The DSC analysis indicated that glass transition temperature, T_g was about 186 °C. The characteristic of this sensing polymer including fluorescence spectra, repeatability and reproducibility test, regeneration process, photostability test, response curve and flow rate of CO₂ gas were performed. Result obtained from the analysis showed that polymer solution were responsive to CO₂ gas as the fluorescence intensity decreased upon the exposure to CO₂ gas. The polymer was also found to be regenerated by flowing with nitrogen (N₂) gas. Repeatability and reproducibility was reported at the value of Relative Standard Deviation (RSD) of 1.83 % and 7.50 % respectively. It was discovered that *dpop*-PPV was no longer resist to photostability test as the polymer was photodegraded in the presence of xenon lamp.

KONSEP PELINDAPAN Pendarfluor dalam Poli (1, 4-Fenilena-1, 2-DI (*p*-Fenoksifenil) Vinilena), *dpop*-PPV untuk Penderiaan Gas Karbon Dioksida (CO₂)

ABSTRAK

Potensi polimer berkonjugat iaitu *dpop*-PPV sebagai bahan penderia untuk pengesanan gas karbon dioksida (CO₂) telah dikaji. Sifat-sifat bahan penderia dikaji berdasarkan konsep pelindapan pendarfluor. Untuk pencirian polimer, kajian telah dijalankan dengan menggunakan beberapa instrumens. Antaranya termasuk Spektroskopi Inframerah Fourier Transformasi (FTIR), Spektroskopi Ultralembayung-Nampak (UV-VIS), Kalorimeter Imbasan Pembezaan (DSC) dan juga Analisis Termogravimetri (TGA). Daripada keputusan analisis DSC, didapati bahawa suhu peralihan kaca, T_g adalah 186 °C manakala untuk analisis TGA, polimer menunjukkan kehilangan berat sebanyak 5 % pada suhu 450 °C. Ciri-ciri penderia polimer seperti kebolehulangan dan kebolehasilan semula, penjanaan semula, kestabilanfoto, masa rangsangan keadaan mantap dan juga kesan isipadu gas CO₂ telah dikaji. Hasil kajian menunjukkan bahawa larutan polimer adalah responsif kepada gas CO₂ akibat daripada pengurangan keamatan fluorezen apabila sampel polimer didedahkan kepada gas CO₂. Polimer didapati boleh dijanakan semula dengan menggunakan gas nitrogen (N₂). Kebolehulangan dan kebolehasilan semula dilaporkan pada nilai sisihan piawai relatif (RSD) masing-masing 1.83 % dan 7.50 %. Hasil kajian kestabilanfoto mendapati bahawa *dpop*-PPV adalah tidak stabil terhadap cahaya lampu xenon.