

بسم الله الرحمن الرحيم





شبكة المعلومات الجامعية التوثيق الالكتروني والميكروفيلم



جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات



يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار





بعض الوثائق الأصلية تالفة





بالرسالة صفحات
لم ترد بالأصل





Dosimetric Studies on Some Chemical Materials and Its Possible Use as Radiation Monitors

A Thesis

Submitted for the Fulfilment of the Degree of Ph.D.in Chemistry

By: El-Saied Ramadan El-Shwafy

M.Sc., (Chemistry), (2015)

National Center for Radiation Research and Technology, NCRRT
Egyptian Atomic Energy Authority, EAEA

Thesis Supervisors

**Prof. Dr. Saad Abdel-Wahab
Mohammed**

*Prof. of physical chemistry
Faculty of Science
Ain Shams University*

**Prof. Dr. Mahmoud Abdel-Wahed
Ibrahim**

*Prof. of Applied radiation Physics,
National Centre for Radiation
Research and Technology (NCRRT),
Egyptian Atomic Energy Authority
(EAEA).*

**Prof. Dr. Moushera Abdel-Kader
Al Kelany**

*Prof. of Applied radiation chemistry
National Centre for Radiation
Research and Technology (NCRRT),
Egyptian Atomic Energy Authority
(EAEA).*

**Ass. Prof. Dr. Sameh Mohammed
Gafar**

*Ass.Prof. of Applied radiation
chemistry, National Centre for
Radiation Research and Technology
(NCRRT), Egyptian Atomic Energy
Authority (EAEA).*

2020



Dosimetric Studies on Some Chemical Materials and Its Possible Use as Radiation Monitors

Thesis Supervisors

Approved

Prof. Dr. Saad Abdel-Wahab Mohammed

Prof. of physical chemistry, Faculty of Science
Ain Shams University

.....

Prof. Dr. Mahmoud Abdel-Wahed Ibrahim

Prof. of Applied radiation Physics,
National Centre for Radiation Research and Technology
(EAEA). (NCRRT), Egyptian Atomic Energy Authority

.....

Prof. Dr. Moushera Abdel-Kader Al Kelany

Prof. of Applied radiation chemistry
National Centre for Radiation Research and Technology
(NCRRT), Egyptian Atomic Energy Authority (EAEA).

.....

Ass. Prof. Dr. Sameh Mohammed Gafar

Ass. Prof of Applied radiation chemistry

National Centre for Radiation Research and Technology (NCRRT),
Egyptian Atomic Energy Authority (EAEA).

.....

Head of Chemistry Department
Prof. Dr. Ayman Ayoub Abdel-Shafi

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ
مِنْ أَفْرِغْ كَيْسَكَ فِيهَا مِنْ حَبِّ الْبَصْلِ
فِي جِلْدَةِ الزَّجَاجِ كَمَا كَانَ كَبِيرِي بِقِيَامِي
شَحْرَافِي كَرِيمَتِي وَشَرَفِي وَخَيْرِي
صِي وَفِي كَرِيمَتِي نَارُ نَوْزِهَايَ
مِنْ شَأْنِ وَخَيْرِي بِدَارِ الْمَنَافِقِ اللَّهُ بِكَ شَيْءٍ عَلَيْهِ

Acknowledgement

I am deeply grateful to **Prof. Dr. Saad Abdel-Wahab Mohammed** Prof. of physical chemistry, Faculty of Science, Ain Shams University, for his supervision, continuous guidance and helpful discussion throughout this work.

I would like to express my profound gratitude to **Prof. Dr. Mahmoud Abdel-Wahed Ibrahim**. NCRRT for suggesting the point of research, valuable advice, and interesting discussion, continuous guidance and for his continuous supervision during all the stages of the development of the work.

The author wishes to express his highest appreciation and profound gratitude to **Prof.Dr.Moushera Abdel-Kader Al Kelany** Chairman of of Radiation Protection and Dosimetry Dept., NCRRT for her kind supervision and planning the point of research and excellent direction during all the stages of the development of the work.

I am deeply grateful to **Ass. Prof.Dr.Sameh Mohamed Gafar**, lecturer of radiation chemistry for his supervision, continuous support and valuable advice.

My deep appreciation is extended to lastly, but not least in gratitude,I thank **all members of Radiation Protection and Dosimetry Department (NCRRT)**.

El-Saied Ramadan El-Shwadfy

2020

Dedication

I dedicate my thesis to My Parents have been a major influence in all my successes. I would like to say a big thank you to them for the values and principles they have taught me, and in fact I dedicate this thesis to them; nay to my family for continuous support and to sweat heart all my love **my wife and my daughter "Asmaa"**.

Contents

Subject	page
Abbreviations.....	I
List of tables	II
List of figures.....	III
Aim of work.....	X

Chapter I

Introduction and Literature Survey

<u>I-Introduction</u>	
I.1 Gamma and Electron Beam Radiation Processing.....	1
I.2 Industrial irradiators for radiation processing	2
I.3 Radiation Dosimetry.....	4
I.3.1 Dosimetry systems.....	4
I.3.2 Dosimetry and Quality Assurance	5
I.3.3 Classification of dosimeters.....	6
I.4 Principles of EPR	8
I.4.1 EPR Theory.....	9
I.4.2 EPR - Applications	10
1.4.2.1 EPR – Applications in Chemistry Science.	10
1.4.2.2 EPR – Applications in physics.....	11

1.4.2.3EPR – Applications in Biology Science...	11
1.4.2.4 EPR – Applications in Medicine Science	11
<u>γ-Literature Survey</u>	
2.1. Film dosimeter.....	12
2.2. EPR dosimeter.....	18
2.3. Complexes of Cr	22
2.4. Gel dosimeter.....	28
2.5. Liquid dosimeter	35

Chapter II

Experimental

II.1 Reagents:	40
II.2 Apparatus.....	42
II.2.1 Irradiation sources (Gamma Irradiation).....	42
II.2.2 UV/VIS spectrophotometer.....	43
II.2.3 Electrical conductivity meter.....	43
II.2.4 Thickness gauge.	43
II.2.5 EPR Spectrometer	44
II.3 Preparation of dosimetry systems.....	46
II.3.1.Preparation of dosimetry systems contains complexes.	46
II.3.1.1.Preparation of DPC/Cr-complex liquid dosimeter.....	46
II.3.1.2. Preparation of DPC/Cr-complex gel samples.....	46

II.3.1.3 Preparation of Ferroin liquid dosimeter.....	46
II.3.2. Preparation of gel dosimetry systems.....	47
II.3.2.1. Preparation of TBTB gel dosimetry systems.....	47
II.3.2.1.1- Preparation of TBTB stock solution.....	47
II.3.2.1.2- Preparation of TBTB - gelatin gel dosimeter.....	47
II.3.2.2. Preparation of Ethyl violet (EV) gel dosimetry system.....	47
II.3.2.2.1- Preparation of stock solution of Ethyl violet (EV).	47
II.3.2.2.2- Preparation of (EV-gelatin)gel dosimeter.....	47
II.3.2.3. Preparation of Bromothymol blue (BTB) gel dosimetry system.....	48
II.3.2.3.1- Preparation of stock solution of Bromothymol blue (BTB).....	48
II.3.2.3.2- Preparation of (BTB-gelatin) gel dosimeter.....	48
II.3.2.4. Preparation of Eosin gel dosimetry system.....	48
II.3.2.4.1- Preparation of stock solution of Eosin.....	48
II.3.2.4.2-Preparation of Eosin - gelatin gel dosimeter.....	48
II.3.3. Preparation of Dithizone dosimetry systems.....	49
II.3.3.1- Preparation of stock solution of Dithizone (DTH)...	49
II.3.3.2-Preparation of DTH/PVA film dosimeter.....	49
II.3.3.3-Preparation of DTH liquid dosimeter.....	49
II.3.3.4. Preparation of (DTH-gelatin) gel dosimeter.....	49

II.3.4. Preparation of RB dosimeters.....	50
II.3.4.1. Preparation of RB EPR dosimeter.....	50
II.3.4.2. Preparation of RB-gelatin gel dosimeter	50
II.4. Irradiation procedure (Gamma irradiation).....	51
II.5. Absorption spectra measurements.....	51
II.6 Relative humidity during irradiation procedure	52

Chapter III

Results and Discussion

III.1 Study the spectrophotometric Properties of Azo Dye Metal Complex and Its Possible Use as radiation dosimeter.....	55
III.1.1 Absorption spectra.....	55
III.1.2 Radiation dose response curves.....	58
III.1.3 Stability of liquid and gel dosimeters before and after irradiation.....	60
III.1.4 Electrical conductivity measurements.....	61
III .1.5. Reproducibility of gel and liquid Cr/DPC-complex dosimeter.....	62
III.1.6 Conclusion and applications	63
III.2. Study of Ferroin liquid.....	64
III.2.1 Absorption spectra.....	64
III.2.2 Response curves.....	65
III.2.3 Radiation chemical yield (G-Value).....	67
III.2.4 Pre-irradiation stability.....	67
III.2.5 Post irradiation stability.....	68
III.2.6 Conclusion and applications.....	69
III.3. Radiation-Induced color of tetrazolium-Derivative for radiation dosimetry applications.....	71
III.3.1 Absorption spectra.....	71

III.3.2 Response curves.....	71
III.3.3.Radiation chemical yield (G-Value).....	74
III.3.4.Pre-irradiation Stability.....	74
III.3.5.Post -irradiation Stability.....	75
III.3.6.Conclusion.....	76
III.4.Spectrophotometric analysis of Ethyl violet gel for low-dose dosimetric applications.....	77
III.4.1Absorption Spectra.....	77
III.4.2.Dose Response.....	78
III.4.3.Pre-Irradiation Stability.....	80
III.4.4.Post -Irradiation Stability.....	81
III.4.5.Conclusion.....	82
III.5.Eosin – gelatin gel dosimeters.....	83
III.5.1Absorption spectra.....	83
III.5.2.Response curves.....	84
III.5.3.Radiation chemical yield (G-Value).....	85
III.5.4.Pre-irradiation stability.....	86
III.5.5.Post -irradiation Stability.....	87
III.6.Bromothymol blue (BTB) – gelatin gel.....	89
III.6.1. Absorption spectra.....	89
III.6.2. Response curves.....	90
III.6.3. Radiation chemical yield (G-Value).....	92
III.6.4. Pre-irradiation Stability.....	92
III.6.5.Post -irradiation Stability.....	93
III.7. Study of DTH dyed Poly (vinyl alcohol) film.....	96
III.7.1. Absorption spectra.....	96
III.7.2. Response curves.....	97
III.7.3.Radiation Chemical Yield (G-Value).....	98
III.7.4.Pre-irradiation stability.....	99
III.7.5.Post irradiation stability.....	100
III.8.Study of DTH dyed liquid.....	102