

Ain Shams University
Faculty of Women for Art,
Science and Education
Physics Department

**"Study of the Effect of Low and High Linear Energy
Transfer Radiation on Some Polymeric Materials"**

A thesis presented by:

Basma Ali El-Badry

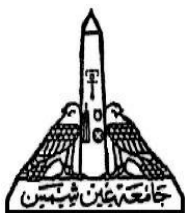
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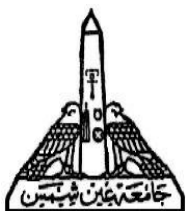
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A Thesis for Ph.D. in Science - Radiation Physics

BASMA ALI EL-BADRY

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

﴿ فَأَمَّا الزَّبَدُ فَيَذْهَبُ جُفَاءً وَأَمَّا مَا يَنْفَعُ

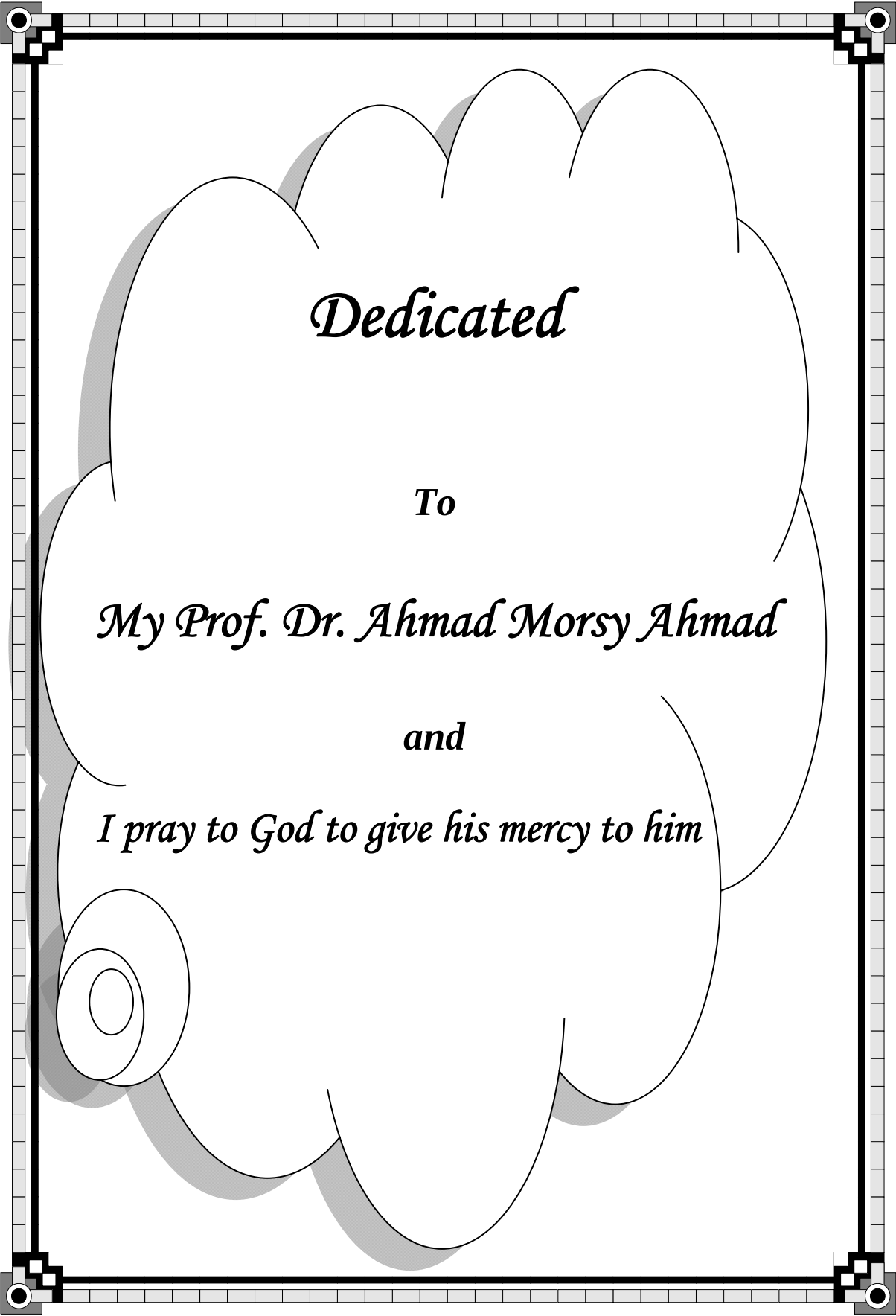
النَّاسَ فَيَمْكُثُ فِي الْأَرْضِ كَذَلِكَ يَضْرِبُ

اللَّهُ الْأَمْثَالَ

صدق الله العظيم

[الرعد : 17]





Dedicated

To

My Prof. Dr. Ahmad Morsy Ahmad

and

I pray to God to give his mercy to him



Application of polymer in various industrial areas is of immense importance. It is being characterized by solubility, strength, high modulus, corrosion resistance, electronic properties, as well as low cost. These advantages enabled its employment in a wide range of applications ranging from the daily usage to the very high technology, engineering, and medicine. In many of these applications, it becomes necessary to enhance the surface and bulk properties of polymers. Various irradiation techniques with a variety of radiation types such as gamma, ultraviolet, and ion implantation have been found to dramatically modify the composition and structure of the polymer, due to disruption of original chemical bonding causing many complex effects.

So, this thesis aims to select some polymeric materials that have potential interest in both the nuclear track detection and industrial applications and also to study of the effect of high (e.g. ion beam) and low (e.g. γ -rays) linear energy transfer (LET) radiation on structural destruction of polymer target along with its manifestation in physical properties. The effect of electronic energy loss (S_e) and nuclear energy loss (S_n) of different ions on polymer modification is also investigated by SRIM program.

The polymers namely Poly-Allyl-Diglycol-Carbonate (CR-39) and Makrofol (MK-DE) were selected and irradiated with different doses of gamma rays and ion beams. Different properties will be studied after irradiation of the selected polymers. Among these, the optical properties, chemical structural properties, electrical or dielectric properties, mechanical properties and some surface properties such as wettability and roughness of the surface after irradiation with ion beam.

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*(**B.A.El-Badry**)*



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List of Abbreviations

ABBREVIATION	WORD
LET	Linear energy transfer
LED	Light-emitting diode
SSNTD	Solid state nuclear track detector
CR-39	Columbia resin -39
PADC	Poly allyl diglycol carbonate
PM	Pershore mouldings
MK-DE	Makrofol-DE
DP	Degree of polymerisation
UV/Vis	Ultraviolet and visible
PL	Photoluminescence
FTIR	Fourier transform infra red
XRD	X-ray diffraction
HV	Vickers Hardness
DSC	Differential scanning calorimetry
θ	Contact angle
R_a	Roughness
E_g	Optical band gap energy
E_u	Urbach energy
E_b	Binding energies
β	Band structure energy
γ	Gamma rays
δ	Delta rays
E_d	Displacements energy
F	Frequency
R	Range
AC	Alternating current
DC	Direct current
FWHM	Full width at half maxima
MeV	Mega electron volt
GeV	Giga electron volt
keV	Kilo electron volt per angstrom
eV/Å	Electron volt per angstrom

ABBREVIATION	WORD
MeV/u	Million electron volt per nucleon
Gy	Gray
kGy	Kilo Gray
Rad	Radiation absorbed dose
amu	Atomic mass unit
dpa	Displacements per atom
V_B	Bohr velocity
ϵ_0	Permittivity
h	Planck constant
PC	Polycarbonate
S_e	Electronic energy loss
SHI	Swift heavy ion
S_n	Nuclear energy loss
SRIM	Stopping range of ions in matter
TRIM	Transport of ions in matter
T_g	Glass transition temperature
T_m	Melting temperature
T_c	Crystallization temperature
MTS	Membrane touch switches
FIM	Film insert molding
PET	polyethylene terephthalate
PTFE	Polytetrafluoroethylene

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