*Faculty of Science*
*Ani Shams University*

# Radiation induced synthesis of conducting polymer nanocomposite

A Thesis
*Submitted for ph.D. Degree of Science in Chemistry*
*(Physical Chemistry)*
***By***

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# *Acknowledgment*

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*Tamer Abdel Aal Mohammed Sayed* *March 2013*

# ***Aim of the work***

## Aim of the work

Nanocomposites are of great interest in recent years because they are considered to be novel functional materials with a wide range of potential applications in bio and chemical sensors, electronics, catalysis and optics. A number of production techniques have been reported for preparation of metallic colloids using metal salts as starting materials, such as chemical, photochemical, electrochemical, radiolytic, and sonochemical reduction. Due to its unique advantages, the irradiation-based strategy, as a wrathful tool, has been extensively used to prepare nanoscale particles and materials.

In this thesis, we have developed a novel approach to synthesize Ag/PVA nanocomposite hybrid material which is based on the seeded growth of Ag nanoparticles within PVA matrix. In this synthetic strategy, we use gamma-irradiation, to utilize the reorganized seed points, or nucleation sites, to initiate the growth of Ag nanoparticles directly on the polymer backbone. Gamma irradiation of Ag/PVA nanocomposite can reduce metal ions to zero valent metal particles, avoiding the use of additional reducing agents and the consequent side reactions. Furthermore, the amount of zero valent nuclei can be controlled by varying the irradiation dose. Homogeneous formation of AgNPs is favorable as it results in uniformly dispersed nanoparticles. Through this process we are assured of successful producing a PVA polymer filled by high monodispersed AgNPs. Polyvinyl alcohol (PVA), which is a water soluble polymer, has important advantages of good mechanical and acoustic optical properties, where this parameter determines the photo induced response in the newly suggested composite. So in our experiment, PVA was used as a polymer-capping reagent, utilizing the interactions of silver ions with hydroxyl groups in the PVA molecules.

Ag/polyaniline nanocomposites combine the electrical characteristics of silver and the mechanical and processing properties of polyaniline, the synergetic effects between silver nanoparticles and polyaniline may result in good electrical and thermal conductivities, and catalytic properties. In this work, Ag/PANI nanocomposite have been prepared by using aniline as stabilizer and via the chemical-radiation method, Ag/polyaniline nanocomposites were synthesized with ammonium persulfate (APS) as oxidizing agents and γ-irradiation as a reducing agent for a reduction of $Ag^{+}$ to AgNPs.

# *Contents*

# Contents

# ***List of Abbreviations***

## *List of Abbreviations*

| Abbreviation | Scientific name |
|---|---|
| °K | Absolute temperature |
| $E_a$ | Activation energy, Kcal/mol. |
| eV | Electron volt |
| kGy | Kilo gray |
| nm | Nanometer |
| LSPR | Localized surface plasmon resonance |
| NPs | Nanoparticles |
| AgNPs | Silver nanoparticles |
| VB | The valence band |
| CB | The conduction band |
| HOMO | The highest occupied molecular orbitals |
| LUMO | The lowest unoccupied molecular orbitals |
| $E_g$ | The band gap energy |
| PANI | Polyaniline |
| PVA | Poly vinyl alcohol |
| XRD | X-ray diffraction |
| TEM | Transmission electron microscopy |
| HRTEM | High performance transmission electron microscopy |
| UV/VIS | Ultraviolet/Visible spectroscopy |
| TGA | Thermogravimetric analysis |
| FTIR | Fourier transform infrared |
| APS | Ammonium persulphate |