Faculty of Science
Ain Shams University

Radiation-induced synthesis and characterization of some nanocomposites and their applications

A Thesis

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(Organic Chemistry)

By

Rehab Sokary Sayed Mostafa El-Sokary
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A Thesis Title

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Researcher Name:

Rehab Sokary Sayed Mostafa El-Sokary

Supervisors

Ass. Prof. Dr. / Gamal Abdel Aziz Meligi
Ass. Prof. of Organic Chemistry, Chemistry Department, Faculty of Science, Ain Shams University

Prof. Dr./ Zakaria Ismaiel Ali

Prof. and Head of Radiation Chemistry, National Center for Radiation Research and Technology, Atomic Energy Authority

Ass. Prof. Dr./ Hoda Hanafi Saleh

Ass. Prof. of Radiation Chemistry, National Center for Radiation Research and Technology, Atomic Energy Authority.

Ass. Prof. Dr. / Wael Mohamed Hosam El-din Eisa

Ass. Prof. of Spectroscopy, National Center for Research

Prof. Dr. Ebrahim Hosani Ali Badr

Head of Chemistry Department

Referees

Faculty of Science
Ain Shams University

Approval sheet

Title of Ph. D thesis

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Researcher Name:

Rehab Sokary Sayed Mostafa El-Sokary

Supervisors **signature**

Ass. Prof. Dr. / Gamal Abdel Aziz Meligi
Ass. Prof. of Organic Chemistry,
Chemistry Department, Faculty of Science, Ain Shams University

Prof. Dr./ Zakaria Ismaiel Ali
Prof. and Head of Radiation Chemistry, National Center for Radiation Research and Technology, Atomic Energy Authority

Ass. Prof. Dr./ Hoda Hanafi Saleh
Ass. Prof. of Radiation Chemistry, National Center for Radiation Research and Technology, Atomic Energy Authority.

Ass. Prof. Dr/ Wael Mohamed Hosam El-din Eisa
Ass. Prof. of Spectroscopy, National Center for Research

Prof. Dr. Ebrahim Hosani Ali Badr

Head of Chemistry Department

Faculty of Science
Ain Shams University

Name: ***Rehab Sokary Sayed Mostafa El-Sokary***

Scientific degree: *Ph. D* Degree in science (chemistry),

Organic Chemistry

Department: Chemistry Department

Faculty: Faculty of Science

University: Ain Shams University

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Candidate

Rehab El-Sokary

Abstract

Metal / polymer nanocomposites have attracted considerable interest in recent years due to their size-dependent properties and great potential for many applications such as nonlinear optics, photo electrochemical cells, heterogeneous photo catalysis, optical switching, and single electron transistors.

Gold nanoparticles were in situ synthesized via irradiation process, using (poly vinyl alcohal) PVA, (PVA: Chitosan (Cs)), and (PVA: poly acrylamide (PAM)) as host polymeric matrices.

The prepared gold nanoparticles (AuNPs) have spherical nanoparticles shape with different size ranging from 10 -35 nm, which were characterized by ultraviolet-visible (UV-VIS) spectroscopy, Fourior transform infrared spectroscopy (FTIR) X-ray spectroscopy and transmission electron microscopy. The synthesized gold nanoparticles have been successfully applied as a catalyst in the degradation of methyl orange and methylene blue.

Also, aniline monomer and polyvinyl alcohol composite film have been successfully synthesized using 50 kGy gamma radiation dose. The as-prepared (PVA/Ani) film has been utilized as adsorbent for the removal of methylene blue, (MB) from aqueous solution.

In addition, polyaniline (PANI) nanofibers and PANI/ PVA nanocomposite films were synthesized by the oxidative polymerization of aniline and ammonium peroxodisulfate (APS), as an oxidizing agent. The PANI/PVA nanocomposite films were exposed to γ-ray after the oxidative polymerization. Synthesized polyaniline (PANI) nanofibers and PANI/PVA nanocomposite films were characterized using various analytical techniques.

Aim of the work

In recent years, nanophase materials have gained more attention because of special physical and chemical features. Gold nanoparticles (Au NPs) attract a great deal of interest due to its well-known medical, catalytic activity, optical properties and chemical functionability. It can catalyze many reduction reactions.

In this study, the radialytic synthesis of Au NPs with controllable size and shape using water soluble poly (vinyl alcohol), Chitosan and poly (acryl amide) as a stabilizer was carried out by choice polymer type, polymer combination, polymer content, and irradiation dose.

The effective of Au nanoparticles as catalyst in the degradation of methylene blue and methyl orange was studied. The catalytic activity of AuNPs-PVA was investigated using the degradation reactions of these two dyes.

In this study, we have developed a novel approach to synthesize PVA/Ani composite film as an adsorbent for dye from water. The role of aniline monomer, initial dye concentration, and PVA/Ani film weight were investigated.

Polyaniline (PANI) is one of the most extensively studied conducting polymers due to its low cost, good environmental stability, high conductivity and interesting redox properties associated with nitrogen heteroatoms. So, the chemical and radiation - induced synthesised PANI NPs and PANI/PVA nanocomposites by oxidative polymerization of aniline using Ammonium per Sulphate (APS) as an oxidizing agent in an aqueous medium were aimed in this work.

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List of Schemes

List of Abbreviations

Abbreviation	Scientific name
Ani	Aniline
APS	Ammonium per sulfate
ATR-FTIR	Attenuated total reflectance Fourier transform infrared spectrometers
Au NPs	Gold nanoparticles
CB	Conduction band
Cs	Chitosan
E_g	Band gap energy
eV	Electron volt
HOMO	Highest occupied molecular orbitals
HRSEM	High resolution scanning electron microscopy
HRTEM	High resolution transmission electron microscopy
kGy	Kilo gray
LSPR	Localized surface plasmon resonance
LUMO	Lowest unoccupied molecular orbitals
MB	Methylene blue
MO	Methyl orange
nm	Nanometer