



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

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A Thesis Title

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

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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 alcohol) 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, Fourier 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 Abbreviations

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