Ain Shams University
University College for Women for Arts, Science, and Education

STUDIES ON

SPECTROSCOPIC STUDIES ON SOME NOBLE METALS NANOCOMPOSITES MATERIALS FOR DIFFERENT APPLICATIONS

THESIS

Submitted for Ph.D. Degree of Science in Physics

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Abstract

Well-dispersed silver nanoparticles (Ag NPs) were prepared via different pathways as PVA /Ag, PVA/Cs/Ag PVA/ PVP/Ag with UV-Irradiated and PVA/Ag with Gamma Irradiated induce the growth of the Ag NPs. TEM study shape and size, X-ray diffraction (XRD) confirm the crystallinity nature of the as-prepared Ag NPs. UV-visible spectra show a narrow and intense absorption surface Plasmon resonance (SPR) which implies a monodispersed Ag NPs were obtained via these methods. Mechanisms of gamma, PVA, CS and PVP in the preparation process were discussed through the FTIR of the reaction system

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Summary

In this work, we prepared a series of Ag/PVA, PVA/CS/Ag, PVA/PVP/Ag with UV-Irradiated and Ag/PVA with Gamma-Irradiated nanocomposites was prepared successfully using a modern and new method. Our synthetic route did not need complicated apparatus or additional reducing agents.

The present work contains five chapters in addition to the list of figures, tables and references. The first two chapters are concerned with the introduction – reviews of previous studies and theoretical.

Chapter three describes the experimental setup and techniques used in the preparation of PVA, PVA/Ag, PVA/PVP, PVA/PVP/Ag and PVA/CS/Ag composites processing, irradiation and analysis. Several techniques were used to detect the structural changes due to irradiation and blending processing, these are: UV-Visible spectroscopy, X-ray diffraction, transmission electron microscopy (TEM) and Fourier transformer infrared spectroscopy (FTIR).

Chapter 4 includes the obtained results and their discussions:

Part I: Characterization of UV-Irradiated PVA/Ag Nanocomposite Film

Transmission electron microscope images illustrated that the average diameter of the Ag nanoparticles is indicated as the peak position of the Gaussian curves of the histogram to be from 10-23 nm with UV-irradiation time

was increased from 0.0 to 4 h. The particle shapes are mostly spherical, which is isotropic. Particles less than 10 nm are perfectly spherical, and the shapes of particles above 10 nm are distorted from spherical shape.

The XRD pattern of irradiated Ag/PVA nanocomposite samples show three new diffraction peaks which reveal that the Ag nanoparticles are formed in the PVA matrix and their crystal structure is face center cubic (fcc) structure. The irradiation time increases from 0.0 to 4 h, the intensity of the Ag lines increases and intensifies gradually in accordance with their growing grain sizes and no characteristic peaks were observed for the other impurities.

In this study the plasmon band of the Ag nanoparticles was noted at 448 nm. The spontaneous formation of silver nanoparticles can be attributed to the direct redox between PVA and Ag+ because there is no other reducing agent in the system. Moreover, the increased intensity as well as the red shift of the SPR band may be attributed to considerable increase in the amount of reduced silver and growth of silver nanoparticles.

FTIR spectrum of the obtained PVA/Ag nanocomposites The IR band at 1710 of PVA was intensified markedly and was shifted to 1725 cm^{-1} as a result of Ag nanoparticles formation. In addition, it is also observed that intensity of the band at 1085 cm^{-1} decayed after formation of the Ag nanoparticles, which is attributed to the stretch vibration of –C–O. Hence, it is suggested that the alcohol group (–C–OH) should be converted to the carbonyl group (–C=O) during the reduction with the silver