



*Conduction behavior and carriers generation of
amorphous films due to photon irradiation*

A Thesis

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Sally Abdoul-Aziz El-Adly

Abstract

Abstract

Synthesis of CdSe and ZnSe nanoparticles were performed using the modified chemical recipe. The structural nature and optical properties of the as-synthesized nanoparticles were characterized by using: X-ray diffraction (XRD), energy dispersive X-rays analysis (EDX), transmission electron microscopy (TEM), and Fourier transform infrared (FT-IR). The crystal structure of the CdSe quantum dots was solved and refined from X-ray powder diffraction data by full-profile Rietveld method. The structure is wurtzite hexagonal, space group P63mc, $a = 4.2569(3)$, $c = 7.0022(5)$ Å, with Cd at (1/3, 2/3,0) and Se at (1/3, 2/3, 0.37904(36)). High-resolution TEM (HRTEM) was employed to characterize the particle size, shape and morphology of the CdSe nanocrystals. HRTEM showed monodispersed spherical nanocrystalline CdSe with diameters of less than 8 nm, and lattice fringe measurements corresponded to d-space values of planes within the hexagonal wurtzite CdSe that consistent with the value in the standard card ([JCPDS: 77-2307]. The UV-Vis absorption and PL spectra showed the well-dispersed CdSe nanocrystals in toluene were recorded at room temperature (RT). It can be seen that the line width of the luminescence spectrum was symmetric and narrow, which obviously revealed that the as-prepared CdSe QDs were nearly monodisperse and homogenous with peak position at 566.36 nm, (2.19 eV) and full width at half maximum (FWHM), 33.26 ± 1 nm.

A saturated solution of QD- Cd₄₆Se₅₄ and QD- Zn₄₉Se₅₁ has been prepared in a toluene solvent. The thin film coated on a pre-cleaned glass substrates using a spin coater unit rotated by 1000 RPM, with rate of dropping 14 drop/10 sec, then waited for 15 s and re-dropping in the same

Abstract

rate. This process rebated for several times (3~5) until obtaining the required thickness.

Transmittance and reflectance data of the as-deposited QD- $\text{Cd}_{46}\text{Se}_{54}$ and QD- $\text{Zn}_{49}\text{Se}_{51}$ thin films with different thicknesses in the range (102 nm 119 nm) and (155 nm 183 nm) are used to calculate the optical constants refractive index (n), absorption index (k) and the absorption coefficient (α). The dependence of the absorption coefficient on the photon energy at the absorption edge is well described by Tauc relation with a direct optical gap equal 2.26 eV, 2.37 eV for QD- $\text{Cd}_{46}\text{Se}_{54}$ of thickness ($d_1=119$ nm, $d_2=102$ nm) and 2.58 eV, 2.62 eV for QD- $\text{Zn}_{49}\text{Se}_{51}$ of thickness ($d_1=183$ nm, $d_2=155$ nm) respectively. A detailed study of as-deposited QD- $\text{Cd}_{46}\text{Se}_{54}$, irradiated by 2, 4, 6, and 8 KGy on the optical properties.

Keywords

Amorphous semiconductors, nanostructure, QD-CdSe, QD-ZnSe, γ -irradiation and Optical properties.

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***THEORETICAL BACKGROUND
AND LITERATURE REVIEW***

Chapter 1

Chapter 1

Theoretical background and literature review

1.1 Introduction

Our entire industrial civilization depends upon materials. More than 40 years ago, Nobel Prize-winning physicist Richard Feynman [1] mused that when scientists have learned how to control the arrangement of matter on a very small scale, they would see materials take on an enormously richer variety of properties. In the past few years, materials scientists have begun to gain that kind of exquisite control [2]. It is now clear that amorphous materials will be the basis of the next great advance in microelectronics. We have long used noncrystalline solids in the form of glasses for their passive properties, such as their inertness, transparency and in everyday use as containers. They are artifacts of an ancient time not only on earth but in the heavens on the moon, glassy materials are widespread [3]. When a semiconducting material such as silicon or germanium was made in crystalline form and its periodicity was not hampered by defects or unintentional impurities, then deliberately, that is dopants, could be introduced and the electronic current could be controlled. The three most important area for applications of amorphous materials are energy, information and materials. These three areas are the bedrock of the post-industrial revolution, and all the three are currently in crisis. Amorphous materials can now provide the solutions [3]. While the two pillars of the future in terms of science, technology and commercial importance are information and energy (they are becoming the two largest industries in the world), both are built on the foundations materials technology. The ages of humankind have always been identified with materials, for example, the Stone Age, the Iron Age, and the Bronze Age. The world has lived and prospered under the