International Journal of Advanced Research in Physical Science (IJARPS)
Volume 6, Issue 1, 2019, PP 1-6
ISSN No. (Online) 2349-7882
www.arcjournals.org

The Spectroscopic Studies of CdS Nanofibers Synthesized via Dc-Sputtering Technique

P. K. Ghosh

Department of Physics, Abhedananda Mahavidyalaya, Sainthia, Birbhum, W.B, India

Corresponding Author: *P. K. Ghosh, *Department of Physics, Abhedananda Mahavidyalaya, Sainthia.*

Abstract: *The field emission property of transparent CdS nanofibers, grown by direct current-sputtering technique on Si and glass substrates, has been studied without using any catalyst or matrix. X-ray diffraction patterns and selected area electron diffraction patterns confirmed the cubic CdS phase formation in the thin films although the initial target material was hexagonal CdS powder. TEM micrographs have confirmed the nanofiber formation with diameters in the range 2 - 4.3 nm and length a few microns. XRD patterns showed the crystal size increased with the increase of deposition time. The Fowler-Nordhiem plots of the emission current from the nano-CdS thin films are almost straight line. The turn-on fields of the grown nano-CdS thin films are found to be in the range 3.6 - 6.6 V/µm. Only bulk-CdS thin film grown on Si substrates have not showed field emission property under the same conditions.*

Keywords: *CdS nanofibres; dc-sputtering; nanostructural; optical, field emission*

1. Introduction

The unconventional properties of nanostructured materials have recently attracted tremendous interest because of their potential uses in both mesoscopic research and the development of nanodevices [1]. The electron field emission exhibited by nanometer-sized materials is one of the most attractive properties for practical applications [2]. It is known that the macroscopically flat surfaces emit electrons at macroscopic field values considerably less than the local field at which cold electron emission normally takes place [3]. This phenomenon of low-macroscopic-field emission [4] is of great technological interest in vacuum microelectronics and field emission displays.

Recently, various research groups are working on many new kind of materials which are appropriate for field emitters for possible application in near future. However, semiconductor nanocrystals have attracted much interest during the last decade because of their interesting properties. Transparent nanostructured CdS thin films have received much attention for several practical applications [5]. The field emission properties of many transparent semiconductors like ZnO [6], $CuAlO_2$ [7] etc. have been studied widely. Jia et al [8] and Chen et al [9] have also reported the field emission from In_2O_3 and Cu_2S respectively. Previously, the field emission from CdS/SiO_2 nanocomposites and nano-CdS modified porous silicon have been reported by Jiao et al [10] and Ling et al [11] respectively. In this Paper, we have reported the detailed studies of effect electrode distance on field emission properties of cadmium sulphide nanofibers, grown by direct current-sputtering technique on Si substrates, has been studied without using any catalyst or matrix.

2. Experimental

2.1. Synthesis

Target of cadmium sulfide (CdS) was fabricated by taking a suitable aluminium holder (5 cm dia.) and compacting the CdS polycrystalline powder (Aldrich, purity 99.99%) by applying suitable hydrostatic pressure (~ 100 kg / cm^2). The fabricated CdS target was placed in the dc-sputtering chamber for the deposition of nanocrystalline thin films on various substrates.

The films were synthesized at room temperature and the substrates used were glass and Si. The glass substrates were cleaned at first by a mild soap solution, then in boiling water and in an ultrasonic cleaner and finally degreased in alcohol vapor. For Si substrates, to remove the surface oxide layer, they were etched in HF (~20%) for 5 minutes and finally cleaned in an ultrasonic cleaner. The chamber was evacuated by conventional rotary and diffusion pump combination to a base pressure of

Scanned by CamScanner

THE STUDIES OF FIELD EMISSION PROPERTIES FROM CDS NANOFIBERS SYNTHESIZED VIA DC-SPUTTERING TECHNIQUE

P. K. Ghosh
Department of Physics, Abhedananda Mahavidyalaya, Sainthia, Birbhum, W.B, India

Abstract

The field emission property of transparent CdS nanofibers, grown by direct current-sputtering technique on Si and glass substrates, has been studied without using any catalyst or matrix. X-ray diffraction patterns and selected area electron diffraction patterns confirmed the cubic CdS phase formation in the thin films although the initial target material was hexagonal CdS powder. TEM micrographs have confirmed the nanofiber formation with diameters in the range 2 - 4.3 nm and length a few microns. XRD patterns showed the crystal size increased with the increase of deposition time. The Fowler-Nordhiem plots of the emission current from the nano-CdS thin films are almost straight line. The turn-on fields of the grown nano-CdS thin films are found to be in the range 3.6 - 6.6 V/μm. Only bulk-CdS thin film grown on Si substrates have not showed field emission property under the same conditions.

Keywords: CdS nanofibres; dc-sputtering; nanostructural; optical, field emission

1. Introduction:

The unconventional properties of nanostructured materials have recently attracted tremendous interest because of their potential uses in both mesoscopic research and the development of nanodevices [1]. The electron field emission exhibited by nanometer-sized materials is one of the most attractive properties for practical applications [2]. It is known that the macroscopically flat surfaces emit electrons at macroscopic field values considerably less than the local field at which cold electron emission normally takes place [3]. This phenomenon of low-macroscopic-field emission [4] is of great technological interest in vacuum microelectronics and field emission displays.

Recently, various research groups are working on many new kind of materials which are appropriate for field emitters for possible application in near future. However, semiconductor nanocrystals have attracted much interest during the last decade because of their interesting properties. Transparent nanostructured CdS thin films have received much attention for several practical applications [5]. The field emission properties of many transparent semiconductors like ZnO [6], $CuAlO_2$ [7] etc. have been studied widely. Jia et al [8] and Chen et al [9] have also reported the field emission from In_2O_3 and Cu_2S respectively. Previously, the field emission from CdS/SiO_2 nanocomposites and nano-CdS modified porous silicon have been reported by Jiao et al [10] and Ling et al [11] respectively. In this Paper, we have reported the detailed

Scanned by CamScanner

Spectroscopic Studies of Cds Nanoparticles Synthesized by RF-Magnetron Sputtering Technique

P. K. Ghosh
Dept of Physics
Abhedananda Mahavidyalaya, Sainthia, Birbhum, W.B, India

Abstract- Nanoparticles of CdS have been produced by rf-sputtering method. X-ray diffraction patterns and selected area electron diffraction patterns confirmed the nanocrystalline cubic CdS phase formation. TEM measurements of the CdS thin film prepared on carbon coated copper grid show that the particle size lies in the range 2 - 5 nm and the optical transmittance measurement shows above 85 % transparency in the wavelength range 500 - 800 nm. Effects of electrodes distance variation on the optical properties of the nanoparticles were studied. The direct optical bandgap value of the films initially decreased with lowering of electrode distance then increased. The direct optical bandgap lies in the range 3.09 eV to 3.67 eV and indirect bandgap 1.74 eV to 3.18 eV for electrode distance variation 2 cm to 4 cm.

Keywords- nanoparticles, rf-sputtering, electrode distance, optical properties

I. INTRODUCTION

Nanostructured materials have gained special interest in recent years due to their new properties providing the theoretical concepts [1-3] in physics associated with it. Quantum confinement effects are observed in nanoparticles because of large surface to volume ratio, resulting in high density of surface states. Preparation and study of nanoparticles[4,5], nanobelts [6,7], nanofibres and nanowires [8,9] have been reported by different groups with different routes. One-dimensional nanostructured materials have gained immense importance in the assembly of nanodevices [10,12]. Nanometer-scale electronics have opened the new area of application in device technology[13]. One-dimensional nanoscale materials may be utilized in various nanodevices including nanologic circuits, nanolasers, nanosensers, nanothermometers[14], etc. Quantum wires of semiconductors [15] and metallic alloys [16] have found to exhibit interesting magnetic and electrical properties.

Quantum confinement effect modifies the electronic structure of nanocrystals when the sizes of the nanoparticles are comparable to that of Bohr excitonic radius of those materials. Hence depending upon the sizes of the materials, the nanoscale semiconductors show interesting properties, and great efforts have been imposed on controlling their sizes. Starting from the zero-dimensional nanoparticles, various structures, such as nanowires, nanorods, nanotubes and nanobelts have been produced from different materials [17-20], among them CdS is one of the widely studied materials. Previously, CdS nanowires have been reported via chemical bath deposition process by Zhang et al [21]. CdS nanoparticles have been prepared via sol-gel method by Mathieu et al [22]. Murray et al[23] and Counio et al[24] have synthesized CdS nanoparticles by pyrolysis of organometalic reagents and controlling precipitation of nanocrystals in inverted micelles respectively. CdS nanoparticles embedded in silicon dioxide matrix have also been reported via magnetron rf-sputtering technique by Rolo et al[25] and Vasileviskiy et al. Recently, CdS nanoparticles have been grown within the self-organized pores of a polymer matrix via chemical bath deposition by us [26]. As the nanoscale semiconductors show interesting properties [27-30], different properties of CdS thin films studied by different groups [31-32]. In this paper we have reported the synthesis and characterizations of CdS nanoparticles by rf-magnetron sputtering without any capping agents or matrix.

II. EXPERIMENTAL

2.1 Target preparation for sputtering

Cadmium sulphide (CdS) target was fabricated by taking a suitable aluminium holder (2 inch dia) and compacting the hexagonal CdS polycrystalline powder by applying suitable hydrostatic pressure (~ 100 kg / cm^2). The fabricated CdS target was placed in the radio frequency magnetron-sputtering chamber for the deposition of nanocrystalline thin films on various substrates such as glass and Si.

2.2 Film synthesis

The films were synthesized at room temperature and the substrate used was glass and Si. The glass substrates were cleaned at first by a mild soap solution, then in boiling water and ultrasonic cleaner and finally degreased in alcohol vapor.

Scanned by CamScanner

Environmental Effects of the Ozone Layer Depletion and possible protective measures by nanostructure materials

P. K. Ghosh

Department of Physics, Abhedananda Mahavidyalaya, Sainthia, Birbhum-731234, West Bengal,India.

Abstract

Reductions in stratospheric ozone levels will lead to higher levels of ultra violet ray reaching the Earth's surface. The emission of ultra violet ray from the sun almost same; rather, less ozone means less protection, and hence more UV reaches the Earth. Most of the cases human activities play the significant roll on the environment. Ozone layer damage is one of them. Different types of offensive ordered in the atmosphere such as CO_2, different oxides of sulpher and nitrogen, chlorofluorocarbon etc are the potential ozone depletors. Due to decrease of ozone layer, increase in the amounts of ultraviolet radiation received at the earth surface and it affects the living part of the environment. Though the possibility of ozone hole recovery remain uncertain, still there may be a little prospect of ozone recovery by developing nanostructure titanium oxide (TiO_2) materials that can cause photo driven remediation reaction to control the offensive order in the atmosphere and recover the ozone layer to make the environment clean. The main objective of this paper is to review the origin and effects of ozone layer depletion as well as the possible protective measures of this layer.

Keywords: Ozone Layer Depletion, Offensive orders, Protection

1. Introduction

The standard practices of running the economy of the industrialized nations all over the world have caused catastrophic results to our environment such as Acid Rain, Ozone layer depletion, and Global Warming. These three main topics have raised an international debate on what to do about it. Among them, Ozone layer depletion is one of the great concerns when it comes to its impacts to the natural world and the future generations.

1.1. Ozone layer

Ozone layer in lower portion of the stratosphere is extended from approximately 10-50 km from the earth surface. Though its density is low, its importance is enormous. It absorbs 93-99% of Sun's high frequency ultra violet (UV) rays which is potentially devastating to life on earth [1] and protects the living part of the earth from its dangerous effect [2-8]. The ozone layer was discovered in 1913 by the French physicists Charles Fabry and Henri Buisson. Its properties were studied in detail by the British meteorologist G. M. B. Dobson. A recent study of Ozone

Scanned by CamScanner

IJRDET
International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435(Online) Volume 7, Issue 5, May 2018)

Dielectric Properties of Transparent CdS Nanofibers Synthesized Via Dc-Sputtering Technique

Pradip Kumar Ghosh

Department of Physics, Abhedananda Mahavidyalaya, Sainthia, Birbhum, W.B, India

***Abstract*— CdS nanofibers have been prepared by direct current-sputtering technique without using any catalyst or matrix. X-ray diffraction patterns and selected area electron diffraction patterns confirmed the cubic CdS phase formation in the thin films although; the initial target material was hexagonal CdS powder. TEM micrographs have confirmed the nanofiber formation with diameters in the range 2 - 4.3 nm and length a few microns. XRD patterns showed the crystal size increased with the increase of deposition time. UV-Vis spectra of the films have showed nearly 90 % transparency in the visible range and bandgap is higher compared to that of the bulk material. The direct bandgap increased from 3.06 eV to 3.56 eV with decrease of deposition time 20 to 7 min. The crystallite sizes have also been determined from the shift of direct bandgap with that of bulk CdS and they lie in the range 2.82 - 3.65 nm. The dielectric constant for thin films of CdS nanofibers have been measured under vacuum by using an L-C-R meter and the value of it lies in the range 55 to 73 at higher frequencies.**

***Keywords*— CdS nanofibres; dc-sputtering; nanostructural; optical, dielectric properties.**

I. INTRODUCTION

Nanocrystalline semiconductors, which can be grown efficiently in different form such as nanoparticles, nanorods, nanobelts, nanowire etc, have attracted much attention due to their novel properties and promising applications. Various nanodevices including nanologic circuits, nanolasers, nanosensers, nanothermometers [1], etc. have been assembled using one-dimensional nanoscale materials. Transparent quantum dots and quantum wires of II-VI sulfide semiconductors such as CdS and ZnS have gained renewed interest due to their enhanced luminescence property and size dependent optical properties. Depending on the sizes of the particles, the nanoscale semiconductors show interesting properties [2-5], and great efforts have been imposed upon controlling their sizes. Starting from the zero-dimensional nanoparticles, various structures such as nanowires, nanorods, nanotubes and nanobelts have been produced from different materials in different routes.

It is well known that CdS is a II-VI semiconductor having a direct bandgap 2.42 eV. It has many commercial applications such as in photoelectric devices and in solar cells. Previously, different properties of CdS thin films studied by different groups [6-7] deposited by various routes such as pulsed laser deposition (PLD), vacuum evaporation, rf sputtering, chemical bath deposition (CBD) etc. Dielectric properties of CdS was also studied by different groups [8-13]. But the report on CdS nanostructure formation via dc-sputtering is scanty. In this letter we have reported the synthesis of CdS nanofibres by dc-sputtering without using any catalyst, and studied their structural and optical properties with varying deposition time. Sputtering is a well-known technique for the deposition of thin films. For polycrystalline film synthesis by sputtering, in general the sputtering pressure is kept low < 10^{-1} mbar. This would allow the adatoms on the substrate enough mobility for growing bigger crystallites. In this work we have studied the dielectric properties of CdS nanofibres prepared at high pressure dc-sputtering technique.

II. EXPERIMENTAL

Target of cadmium sulfide (CdS) was fabricated by taking a suitable aluminium holder (5 cm dia.) and compacting the CdS polycrystalline powder (Aldrich, purity 99.99%) by applying suitable hydrostatic pressure (~ 100 kg / cm^2). The fabricated CdS target was placed in the dc-sputtering chamber for the deposition of nanocrystalline thin films on various substrates.

The films were synthesized at room temperature and the substrates used were glass and Si. The glass substrates were cleaned at first by a mild soap solution, then in boiling water and in an ultrasonic cleaner and finally degreased in alcohol vapor. For Si substrates, to remove the surface oxide layer, they were etched in HF (~20%) for 5 minutes and finally cleaned in an ultrasonic cleaner. The chamber was evacuated by conventional rotary and diffusion pump combination to a base pressure of 10^{-6} mbar. Before starting the actual deposition the target was pre-sputtered and the substrates were covered by a movable shutter. The working pressure of the evacuated chamber was maintained at ~ 0.5 mbar by sending argon gas during deposition of the film.

Scanned by CamScanner

American Journal of Optics and Photonics
2017; 5(2): 19-23
http://www.sciencepublishinggroup.com/j/ajop
doi: 10.11648/j.ajop.20170502.12
ISSN: 2330-8486 (Print); ISSN: 2330-8494 (Online)

Influence of Annealed Temperature on Optical Properties of Nanostructured CdO Thin Films

Pradip Kumar Ghosh

Department of Physics, Abhedananda Mahavidyalaya, Sainthia, Birbhum, West Bengal, India

Email address:

pradipghosh2002@gmail.com, pkg_ju@yahoo.co.in

To cite this article:

Pradip Kumar Ghosh. Influence of Annealed Temperature on Optical Properties of Nanostructured CdO Thin Films. *American Journal of Optics and Photonics.* Vol. 5, No. 2, 2017, pp. 19-23. doi: 10.11648/j.ajop.20170502.12

Received: November 19, 2016; **Accepted**: January 12, 2017; **Published**: October 13, 2017

Abstract: Nanostructures of cadmium oxide (CdO) thin films were deposited by sol-gel dip coating technique on glass and Si substrates. X-ray diffraction patterns and selected area electron diffraction patterns confirmed the nanocrystalline cubic CdO phase formation. Transmission Electron Micrograph (TEM) of the film revealed the manifestation of nano CdO phase with average particle size lies in the range 1.6 nm to 9.3 nm. From the measurements of transmittance spectra of the films the direct allowed bandgap values have been calculated and they lie in the range 2.85 eV to 3.69 eV with high transparency (~ 75% in the wavelength range 500 - 800 nm) of the film. Particle size have also been calculated from the shift of bandgap from that of bulk value for those films for which the particles are compearable to Bohr exitonic radius.

Keywords: CdO Thin Films, Sol-gel, TEM, XRD, Optical Properties

1. Introduction

Nanocrystalline semiconductors have attracted much attention due to their novel properties and varaities of promising potentials in extensive applications [1, 2]. Numerous technical advancements in the field of nanostructured materials have stimulated the wide range of research interest in recent years because of various new properties exhibited by them. Recently, nanostructured semiconductor are widely used to design a rich varieties of device for microelectronics. One-dimensional nanostructured materials have gained special interest in the assembly of nanodevices [1-3]. Nanometer-scale electronics have been predicted to play an important role in device technology [4, 5]. Quantum wires of semiconductors [6] and metallic alloys [7] have found to exhibit interesting magnetic and electrical properties. The nanostructure transparent conducting oxides have also gained trememdous importance due to their size dependent optical properties and possible applications in near future.

Recently, various research groups around the world are working on the synthesis of several II-VI n-type transparent semiconducing oxide thin films in different process [8-18]. Previously, thin films of CdO have been synthesized by various techniques, including activated reactive evaporation [8], spray pyrolysis [9, 10], solution growth [11], MOCVD [12], PLD [13], rf sputtering [14] etc. Recently, F doped CdO thin film have been reported by us [15] via sol-gel process. The preperation of ZnO quantum dots by Mahamuni et al [16], nanowires and nanoribbons byYao et. al [17], nanorods by Liu et. al [18] and Guo et. al [19] etchave been studied wiedly. The nanostructure of CdO have been prepared by Ashrafi et. al [20] via metalorganic molecular-beam epitaxy and nanobelts have also been prepared by Pan et. al [21] via thermal evaporation method. In this paper I report successful synthesis of nanostructured cadmium oxide thin film via a very simple sol-gel route. The sol-gel dip-coating method is chosen because of its many advantages such as easier composition control, better homogeneity, low processing temperature, lower cost, easier fabrication of large area films, possibility of using high purity starting materials and having an easy coating process of large and complex shaped substrates. In this paper, the temperature dependent of nanostructural and optical properties of cadmium oxide thin films has been studied.

2. Experimental

2.1. Preparation of Films by Sol-gel

The thin films of CdO have been deposited on glass and Si

Scanned by CamScanner

Effect of particle size on dielectric and photoluminescence spectroscopy of ZnS nanoparticles

P.K. GHOSH

Department of Physics, Abhedananda Mahavidyalaya, Sainthia, Birbhum-731234, W.B, India.

*Corresponding author: E-mail: pradipghosh2002@gmail.com

Keywords: ZnS Nanoparticles, Photoluminescence, Dielectric

Abstract. Nanoparticles of ZnS in thin film form have been synthesized by radio frequency magnetron sputtering technique on glass and Si substrates at substrate temperature 300 K. X-ray diffraction and selected area electron diffraction studies confirmed the formation of nanocrystalline cubic phase of ZnS in the films. TEM micrographs of the thin films revealed the manifestation of ZnS nanoparticles with sizes lying in the range 3.00 – 5.83 nm. The room temperature photoluminescence spectra of the films showed two peaks centered around 315 nm and 450 nm. We assigned the first peak due to bandgap transitions while the latter due to sulfur vacancy in the films. The composition analysis by energy dispersive X-rays also supported the existence of sulfur deficiency in the films. The dielectric property study showed high dielectric permittivity (85-100) at a higher frequency (>5 KHz).

Introduction

The creation of nanostructure materials opens up the opportunity of observing the evolution of physical properties of the materials with sizes [1-2]. Nanosized particles of semi conducting compounds in particular display grain size dependent optoelectronic properties, due to the size quantization effects [3-4]. The materials in nanostructure form exhibit high transparency, high dielectric constant, low field electron emission, etc. Almost all these properties could be well utilized to save the energy to produce environmental friendly atmosphere [5-7]. If the solar cell with such transparent materials be made, it could be used as transparent photovoltaic which might be used as architectural windows that permits the visible light through the window and generate the electricity from UV part of it. Also high dielectric materials are utilized as source of energy, because dipole oscillation radiates energy.

Experimental

Zinc sulfide (ZnS) target was fabricated by taking a suitable aluminium holder (5 cm dia.) and compacting the ZnS polycrystalline powder (99.99 %, Aldrich) by applying suitable hydrostatic pressure (~ 100 kg / cm^2). The fabricated ZnS target was placed in the radio frequency magnetron-sputtering chamber (13.56 MHz) for the deposition of nanocrystalline thin films on various substrates such as glass and Si. The deposited films were characterized by studying mainly nanostructural, compositional, luminescence and dielectric properties. The nanostructures and diffraction patterns of the films were studied by a transmission electron microscope (TEM, Hitachi-H600). The thicknesses of the films have been measured by an ellipsometer (Nano-view SM HG 1000) and lie in the range 260 nm to 530 nm. Compositional analysis was done by energy dispersive X-ray analysis (EDX, GEOL JSM 6300 Oxford-ISIS). The photoluminescence (PL) spectra of the nanocrystalline ZnS thin films have been measured by a fluorimeter (FL 4500). The dielectric properties of the films were also studied with varying frequency by using an L-C-R meter (HP - 4284 A) at room temperature under vacuum (~10^{-3} mbar).

Copyright © 2016 by the authors
Published under license by Materials Research Forum LLC.

Scanned by CamScanner