INVESTIGATION OF THE OPTICAL PROPERTIES OF THE ZN DOPED CDS THIN FILM DEPOSITION AND CHARACTERIZATION

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ABSTRACT

For the present work we employ Chemical Bath deposition Technique. Initially the bathtub parameters like temperature, pH of the precursors, polarity of the solutions, deposition time was optimized for synthesis of CDS thin films. Using above optimized parameters, we prepare CDS thin films for the study of effect of Zn concentration on various properties of the films. The structural, Morphological, and optical characterization were investigated. The XRD spectra of the CDS films exhibit the hexagonal crystal structure

Keywords: CDS Thin films, Optical Properties, Chemical Bath Deposition Method , ZN

Introduction

The solar power hasthe greatest potential of all the sources of renewable energy. Various types of thin film solar cells exists today; the major contributors be crystalline silicon, amorphous crystalline galliumarsenide, poly-crystalline copper-indium gallium di-sellenide (Cu IGS) and poly crystalline cadmium tellurium (CDE) [1]. In olden days II-IV semiconductors thin films have attracted considerable attention. In the architecture of photo voltaic devices, the greenockite (CDS) was mostly used as a window layer[2,3]. Addition of Zn to the foremost widely used CDS buffer layer material enhances the electronic, electrical, optical properties of devices. It has been widely used as a wide band gap window material in hetro-junction solar cells, and photo conductive devices[4,5]. This study is used to contributed to synthesis, of Cd1-xZnxS thin films and study the structural, Morphological, and optical properties. Several techniques are available for preparation of Cd1- xZnxS thin films. With the help of Chemical bath deposition technique which is extremely economic, simple, invasive less time consume ales chemical wastage and required less instrumentation. In recently years, sulfide (CDS) is a crucial Ⅱ e Ⅵ semiconductor and has been paid much attention thanks to its potential application in many fields, like light-emitting diodes (LEDs) in flat panel displays [1], transistors [2], electrochemiluminescence [3] and photo catalytic [4,5], etc., which attributed to its wide and direct band gap (about 2.42 eV at room temperature), high refractive index [6], a small exciton, Bohr radius of 2.5 nm, excellent transport properties and excellent chemical and thermal stability.

Moreover, it is one of the best candidates as an n-type window material for hetero junction solar cells, such as a cadmium tellurium (CDT) [7], copper indium gallium diselenide (CuInGaSe) [8], and copper zinc tin sulfide (CZTS) [9] solar cell.And high efficiency hetero junction solar cells require a thin film window layer with good transmittance to increase the blue response. But, pure CDS thin film has a band gap about 2.42 eV, which means that visible light wavelength less than 512 nm will be absorbed by the CDS window layer [10]. 1 Therefore, low transmission of CDS thin film hinders absorption of the absorbing layer of solar cell. The elements doped CDS thin films is one of the simplest techniques for the alteration of electrical conductivity, and the energy band gap. More elements, like Ga [11], Cu [12], B [13], In [14], Sn [15], and Zn [5,16e18], are doped or alloyed into CDS to demonstrate tun able optical and electrical properties. Among various types of doped CDS thin films, Zn do pant is considered as a technical approach that could modify the optical and electrical properties of CDS crystals through replacing Cd element to form CdxZn1xS thin film [19]. It is important for solar cell that the high band gap makes more visible light transparent, which leads to a decrease in the window absorption losses and increases in the short circuit current [20].

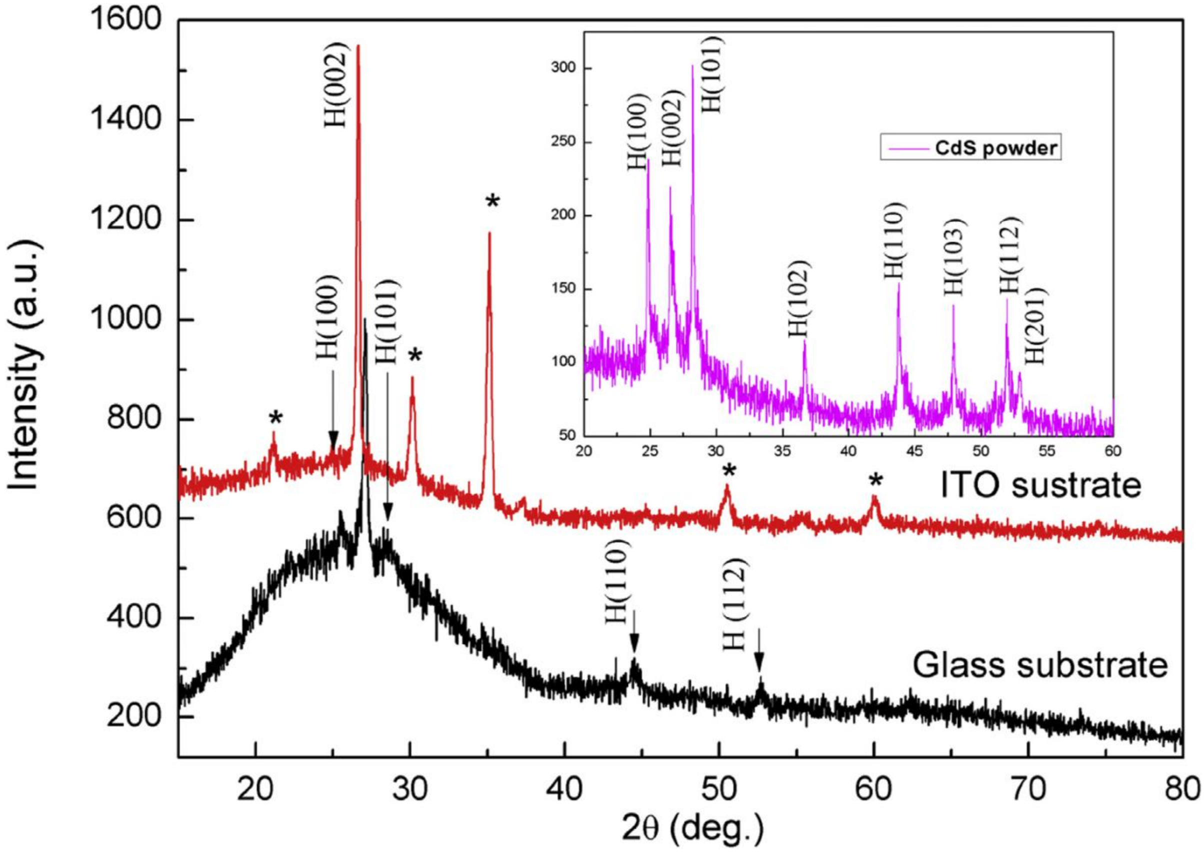
EXPERIMENTAL DETAILS

The pure CDS and CDS:Zn thin films were fabricated on glass (soda-lime glass) and ITO substrate using CBD method. The substrates were ultrasonically cleaned using acetone and rinsed in deionized water, respectively. All substrates were kept vertically in the solutions with the help of quartz holders. At first, the pH of liquid chemical solution, which contained 0.002 M (cadmium acetate, Cd(CH3COO)2) and 0.03 M (ammonium acetate, CH3COONH4), was adjusted to 10.5 at room temperature using ammonia (NH3H2O). Followed by the answer heated to 80 C with stirring under constant speed, 0.004 M Thoreau (CS(NH2)2) was put into as an S source. The bath temperature was kept constant for the deposition time of 30 minutes. During the whole process, NH3H2O was used as a completing agent, and CH3COONH4 was used as NH3 buffer. For the preparation of CDS:Zn thin films, Zinc acetate (Zn(CH3COO)2) with different concentrations was added to the aqueous solution when the temperature reached 80 C.

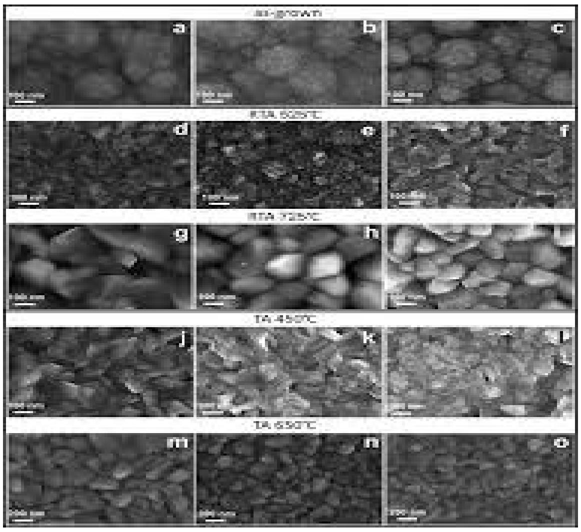
Conclusion

With help of XRD, CDS thin films have poly crystalline structure. The resistivity of Zn doped CDS thin film increased firstly then decreased, which attributed to trace metal Zn precipitates and deposit on ITO substrate with the rise of Zn concentration in the process of preparation.

LIST OF FIGURES



Intensity (a.u.)
2θ (deg.)
ITO sustrate
Glass substrate
H(002)
H(100)
H(101)
H(110)
H (112)
*
CdS powder
H(100)
H(002)
H(101)
H(102)
H(110)
H(103)
H(112)
H(201)


as-grown
a
b
c
RTA 525°C
d
e
f
RTA 725°C
g
h
TA 450°C
j
k
l
TA 650°C
m
n
o

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