

**Studies the Structural and Optical Properties of (CdO:Ag₂O)
Thin Films**

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**Ziad.T. Khodyar, Nedhal A. Mahmood, Suhama A. Hamed,
Muhammad H. Abdullah**

Department of chemistry, College of Science, University of Diyala,
Ministry of education

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Abstract

(CdO: Ag₂O)thin films have been prepared using Chemical Spray pyrolysis technique on glass substrates. We have studied the Structural and optical parameters such as reflectance, refractive index, extinction coefficient and real and imaginary part of dielectric constant have been studied.

XRD measurements revealed that the thin films were polycrystalline shows a preferred orientation along (111) ,(220) planes.

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Introduction

Transparent conducting oxide thin films have been widely in solar cell applications. In spite of being a transparent conductor metal oxide, Cdo has not usually been employed as a transparent electrode in solar cell Technology due to it's relatively small band gap when it is compared to other materials [1].

Cadmium oxide is an oxygen deficient n- type conducting due to oxygen vacancies [2] and has Nacl structure [3]. Silver oxide reacts easily with ligand precursors such as 1,3 - disubstituted imidazolium or benzimidazolium salts to generate the corresponding N-heterocyclic carbene complexes. These silver complexes are useful as carbene-transfer agents, easily displacing labile ligands such as cyclooctadiene or acetonitrile. This is a common way of synthesizing transition metal carbene complexes[4].

It's nearly metallic conductivity and is caused by a large native defect concentration [5], and have a high Transparency in the visible region of the electromagnetic spectrum [4], there have been a number of studies on the semiconductor aspects of pure Cdo, but the formation and effect of imparities has received little attention . we try to study the(CdO: Ag₂O)thin films as a dopants on the Structural and optical properties .

Experimental

The method of chemical spray pyrolysis utilized in this paper to prepare thin films of (CdO: Ag₂O). The subsequent reaction on the heated substrates produces the (CdO: Ag₂O)thin films plus volatile products.

The preparation technique and other details have been described else where [6] .It has been found that the following deposition parameters give good stoichiometric films with good transparency and uniform surface:

- 1- Substrate Temperature of about (450 °C).
- 2- Spray rate 10 cm³/min.
- 3- Distance between sprayer nozzle and substrate of 30+1 cm

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The glass substrates are placed on the hot plate fan about 30 min before spraying process, so the glass substrates are nearly at the same temperature as the hot plate. Each spraying period lasts for about 15s followed by about 5 min waiting period to avoid excessive cooling of the hot substrates due to the spraying. The thickness of the sprayed samples were in the range of $(2500 \pm 20) \text{Å}$.

The films were clear, transparent, brown colored having very good adhesive properties and are of smooth surface free from pinholes.

Optical and transition spectra were recorded by double beam (UV/VIS) (Shimadzu Corporation Japan) in the wavelength range (300 -900) nm.

Results and discussions

the XRD pattern of the films shows that the films is polycrystalline .It is confirmed by comparing the peak positions (2 θ) of the XRD patterns of the films with the standard X-ray powder diffraction data file (card no. 5-0640,43-0997). Figure (1) represents the XRD patterns of (CdO: Ag₂O)thin films ,this films show the most preferred plane [111] in addition to [220] reflections. No other peak beside these is observed which establishes the single phase cubic structure of the films.

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Fig. (1) show the X-ray diffraction pattern of (CdO: Ag₂O)thin films.

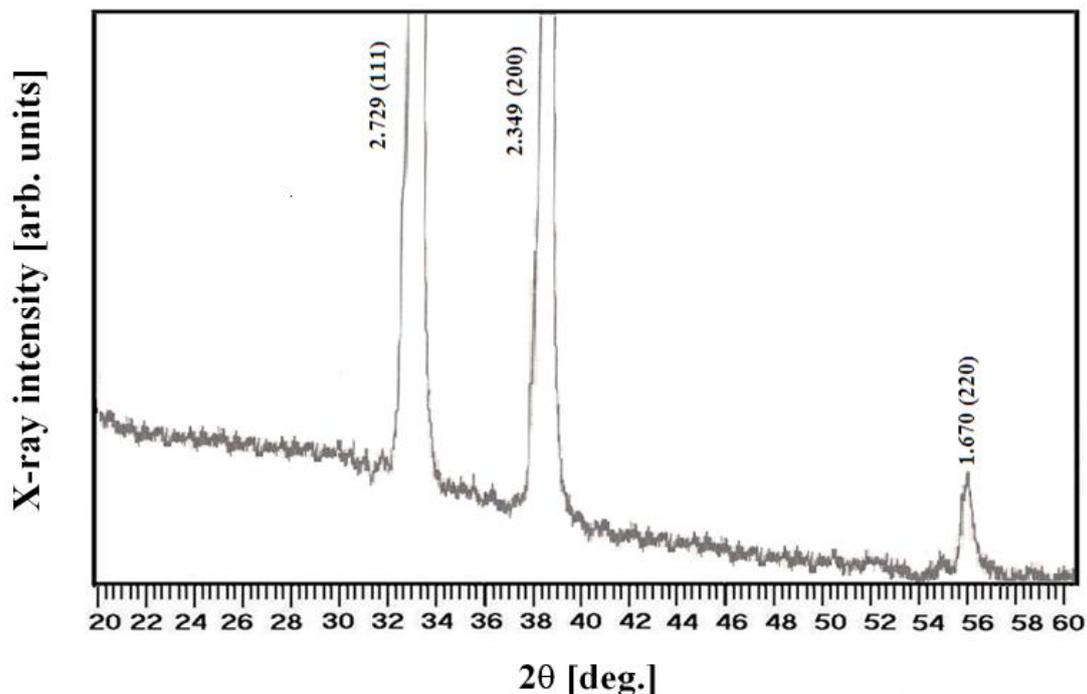


Figure (1) XRD pattern of the (CdO :Ag₂O)films.

Fig (2) shows the reflectance spectrum of as prepared (CdO: Ag₂O)films in the region of (300-900) nm. the reflectance is given by[7]: $R=A-T-1$ (1)

Where (A) is the absorptance and (T) is the transmittance.

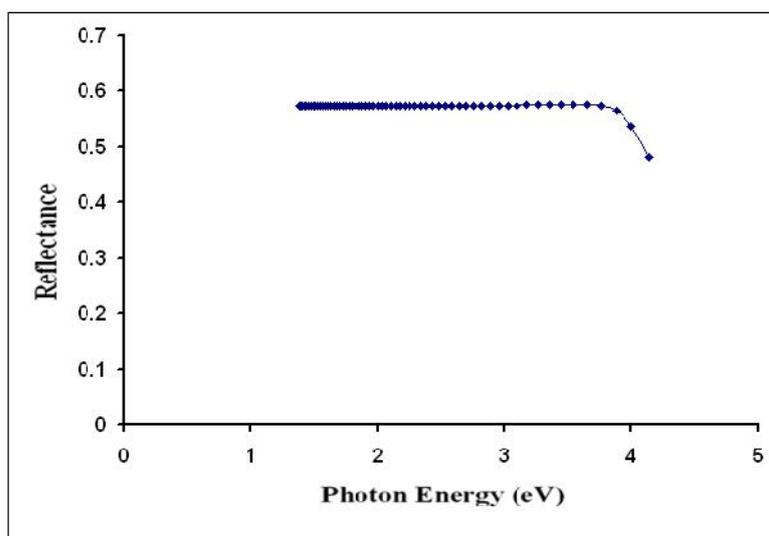


Figure (2) Reflectance as a function of Photon energy of (CdO: Ag₂O)thin films

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Figure (3) shows the variation of refractive index with photon energy, by using the relation[8]:

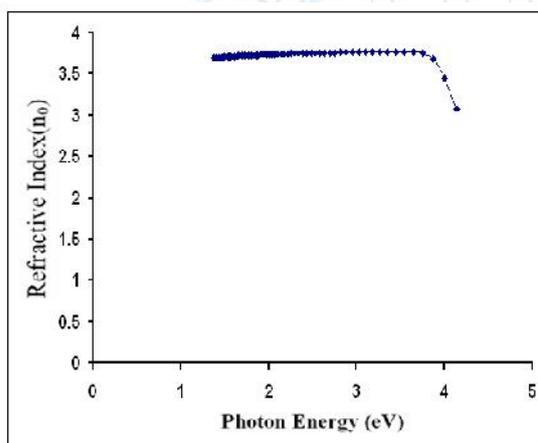
$$n = \left(\left[\frac{4R}{(R-1)^2} - K \right]^{1/2} - \frac{R+1}{R-1} \right) \dots\dots\dots(2)$$

Where(R) is the reflectance and (k) is the extinction coefficient, the behavior of (n₀) is corresponding to the reflectance.

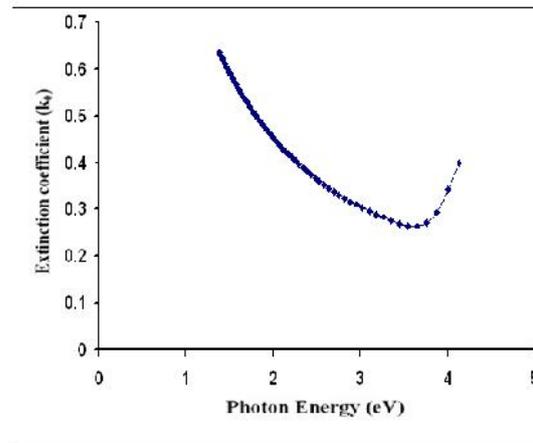
Figure (4) shows the extinction coefficient (k₀) as a function of Photon Energy. (k₀) decreases with increases of Photon Energy until (3.6eV) and increases after this value.

The extinction coefficient (k) is directly proportional to the absorption coefficient as see in relation [9]:

$$k = \frac{\alpha \lambda}{4 \pi} \dots\dots\dots(3)$$



Figure(3) Refractive Index vs. Photon energy.



Figure(4) Extinction coefficient vs. Photon energy.

The dielectric constants consists of real part (r) and imaginary part (i),the variations of them with photon energy were determined and shown in figure (5)and(6).

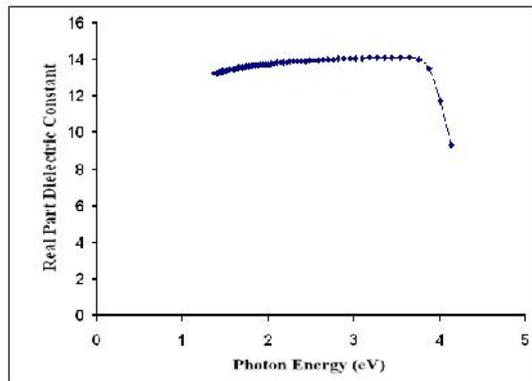
The real (r) and imaginary (i) parts of the dielectric constant related to the (n) and (k) values. The (r) and (i) values were calculated using the form [10]:

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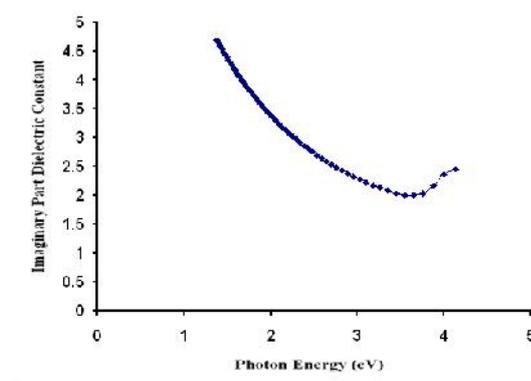
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$$\epsilon_r = n^2 - k^2 \quad \dots\dots\dots(4)$$

$$\epsilon_i = 2nk \quad \dots\dots\dots(5)$$



Figure(5) ϵ_r vs. Photon energy.



Figure(6) ϵ_i vs. Photon energy.

Conclusions

- 1-the (CdO: Ag₂O)thin films have been prepared successfully by chemical spray pyrolysis technique.
- 2-the thin films were polycrystalline shows a preferred orientation along (111) ,(220) planes.
- 3- n_0 has similar trend to the variation of R.
- 4- r has similar trend to the variation of refractive index and i values are related to the variation of k_0 .

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