CdO THIN FILMS DEPOSITED BY SPRAY PYROLYSIS

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CdO thin films were prepared by a conventional pneumatic spray deposition technique on glass substrates from a solution of cadmium acetate diluted with methanol and water. During post thermal treatment CdO exhibits low spreading resistance of 15 Ω per square for 350 nm films. Four point dc – conductivities measured from samples prepared by varyind the post thermal treatment. Optical measurements show that the films are highly transparent, above 90% transmission, for wavelengths ≥ 600 nm.

1. INTRODUCTION

During the last few years thin films of cadmium oxide (CdO) has revealed itself as a very promising material for use in the photovoltaic industry. Because of its high electrical conductivity high optical transparency in the spectral region of sun radiation, a refractive CdTe and a good match with the CdTe lattice, it may be used as a substitute of CdS, In_2O_3 and SnO_2 in photovoltaic hetero structure. In a previous paper we reported the improvement of the electro-optical properties of CdO thin films deposited after laser treatment.

Various techniques have been employed to prepare CdO thin films such as sputtering solution growth, activated reactive evaporation pulsed laser sputtering , sol-gel method and direct laser treatment on CdS layers [1,2,3] . In this paper CdO thin films was prepared by spray pyrolysis technique and post thermal treatment.

In this article we present characterization properties CdO films such as the structural, optical and electrical properties. The influence of annealing temperature on the films characteristic properties is investigated.

2. EXPERIMENTAL

The CdO thin films were prepared by a conventional pneumatic spray deposition technique on glass substrates. A 0,1M solution of cadmium acetate diluted with methanol and water was used. The deposition parameters were: nitrogen flow rate (5÷8l/min), solution flow rate (20ml/min), nozzle ¼ JAU (*) and nozzle – substrate distance (30cm).

Thin films were spray system described elsewhere.

Five deposition temperatures (200, 210, 220, 230, 240^{0}C) were selected for this study.

The as-grown films were annealed at 280, 290, 300^0C for 1h in air.

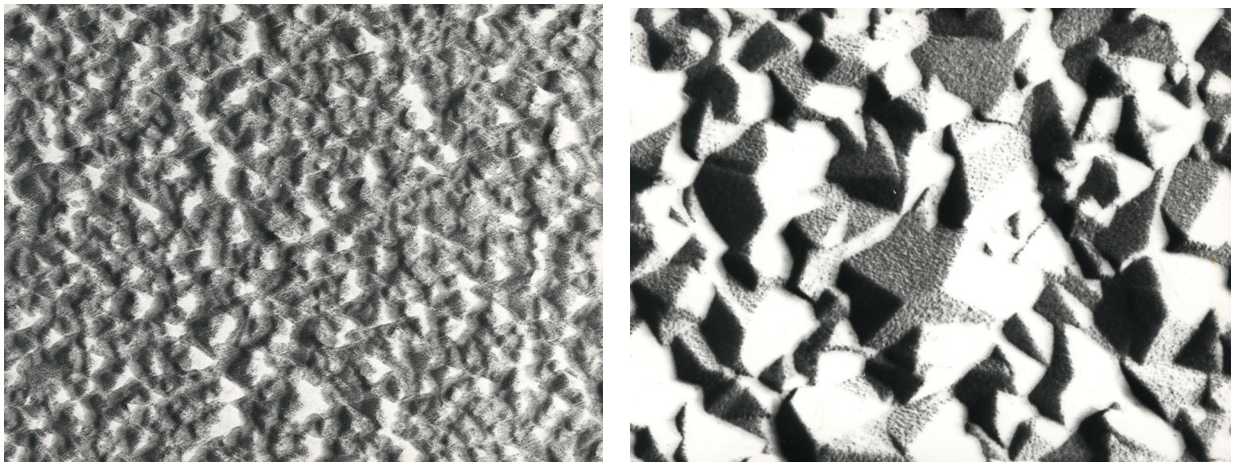
Sample were evaluated before and after post thermal treatment by X ray diffraction XRD with DRON-2, using Co anode, the inves tigation of the surface of the sample is performed with BS-350 SEM, the transmittance and reflectance spectra were measured by CF-46 spectrometer in 400 ÷1200 nm range. Films of 400 ± 20 nm. thicknesses as measured with a step profiler were selected for the study.

Replacing of separate layers in depth was done by use of solution including CH_3COOH.

Direct-current conductivity was measured at room temperature using a standard four-point probe apparatus and a constant current source (50 mA).

3. RESULTS AND DISCUSSION

Films with good adherence and homogeneity were obtained. Fig 1 a.b shows the CdO films before and after treatment



a b

Fig.1 CdO films before (a) and after (b) treatment

Direct-current conductivity was measured at room temperature. The carrier density values corresponding to different deposition temperatures can be seen in table 1.

T[°C]	220	225	230	235	240
$N_s[10^{26}m^{-3}]$	6,3	7,80	8,17	7,10	7,0

Table 1. Carrier concentration for samples deposited at different deposition temperatures

The carrier density values ofter treatment can be seen in table 2.

T°C deposition T°C treatment	220	225	230	235	240
280	5,8	6,8	6,9	7,8	7,0
290	4,6	6,9	6,8	8,0	7,4
300	4,8	7,2	6,4	7,8	7,2

Table 2. Carrier concentracion [x.$10^{26}$$m^{-3}$] for samples after treatment

XRD spectra of CdO films can be seen in fig.2.

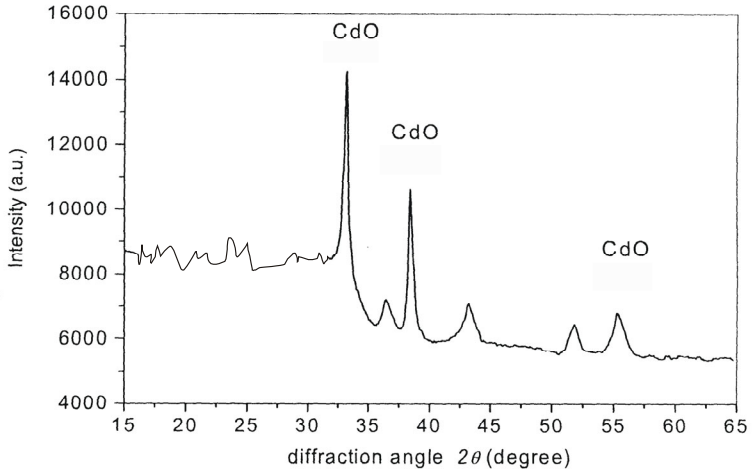


Fig.2 XRD spectrum of CdO films

Fig. 3 show the transmittiance spectra corresponding to samples deposited at 220, 225, 230, 235 and 240^{0}C.

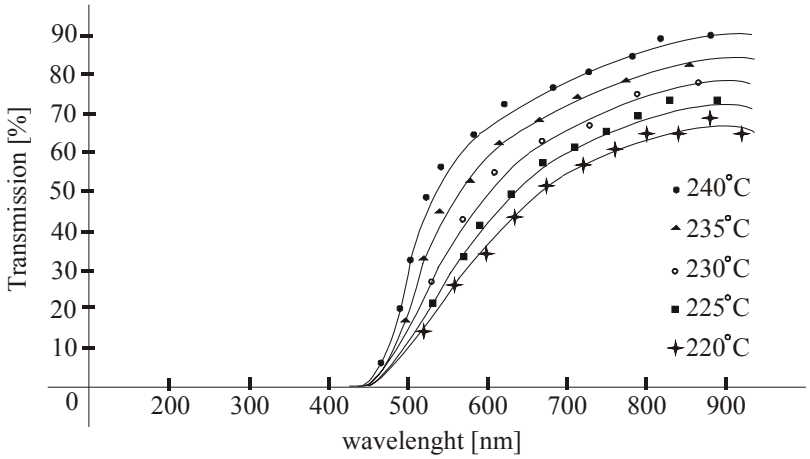


Fig.3 Transmittiance spectra for samples deposited at five different temperatures

CdO films have a cubic structure. At growth temperature below 220^0 the films are weakly crystallized with grains randomly oriented on the glass substrate. At temperatures above 220^0, the CdO films are strongly crystallized with a preferred (200) orientation.

Films with good adherence and homogeneity were obtained. Films characterization showed that at an optimum temperature range of $220 \div 280^0$, CdO exhibits low spreading resistance of 15 Ω per square for 350nm films compared with 10 Ω per square for CdO deposited, after laser treatment on CdS[4,5] layers, high transmittance between 600÷900nm, up to 85%.

4. CONCLUSIONS

Structural and optical analysis show that spray pyrolysis technique is useful method for the deposition of CdO thin films. Post-thermal annealing improves the crystallinity of all samples. Results show that as the film deposition temperature increases up the optimum temperature range, the transmission of the film also increases.

5. REFERENCES

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