THE EFFECT OF ACTIVATION AND RECRYSTALLIZATION ON THE SYSTEM CDS – CDO

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The report shows the parameters' changes after activation and recrystallization of the thin layers from CdS, taking part in the construction of thin-layer solar sells as n-layer. The layers were obtained through three methods: vacuum evaporation, sintering and spray pirolysis. After carrying out of activation and recrystallization, the layers electro optical parameters changed toward equalization (approaching) independently from the method of obtaining. The layers obtained by spray pirolysis change their parameters in largest range, which allows their use when producing thin-layer solar cells.

Keywords: CdS, CdO, Spray Pirolysis, Solar Cells

1. INTRODUCTION

The polycrystalline layers from CdS, as a component of the thin-layer solar sells were put to thermal treatment in fixed medium independently from the method of their obtaining. The influence of the intercrystal barriers was reduced as a result of this technological operation, the phase CdO appeared with conductivity of the order of $10^{-5}\ \Omega^{-1}cm^{-1}$. The method of activation and recrystallization as well as the medium composition respectively the powder matrix are significant for the layer parameters. Three methods were chosen through which were obtained layers according to [1, 2, 3], significantly different regarding their structure**,** photosensitivity, conductivity e t. c. The characteristic photosensitivity of the sintered layers is of the order of 10^{3} – 10^{4}, 10^{1} – $10^{2}$of the evaporated layers and it is absent with the layers obtained through spray pirolysis. The changes of the electric parameters of the layers were studied after activation and recrystallization in a quasi - closed volume, distant from the powder matrix which contains the alloying components.

2. EXPERIMENTAL PROCEDURE

Vacuum thermal evaporation of CdS with a purity of 99.999 mass% (Merck) was performed in the vacuum chamber of a B 30.2 equipment at a pressure of 10^{-3} Pa, on a glass substrate heated to 240 °C. The CdS thin Films were prepared by a conventional pneumatic spray deposition technique on glass substrates. The deposition parameters were: nitrogen flow rate (5÷81/min), solution flow rate (20ml/min), nozzle ¼ JAU (Spraying Systems Co) and nozzle – substrate distance (30cm). Details of the growth process have been described in previous work [4]. The deposition of CdS layers through sintering was carried out according to [5], on a glass

substrate with temperature of 900 °C. The activation and recrystallization of the layers is carried out in an air medium at 450 °C, with duration of interval up to 60 min with composition of the powder matrix 89,28 mass % CdS, 8,93 mass % $CdCl_2$, 1,19 mass % CuCl и 0,6 mass % LiCl. The principle diagram of the method of activation and recrystallization carried out in a quartz reactor of SDO – 125/3 – 12.0 l with slow cooling conditions is given on fig. 1.

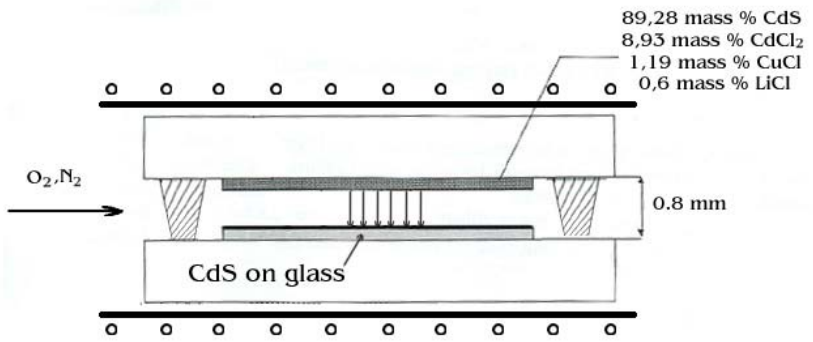

Fig. 1 Diagram of the method of CdS thin layers activation and recrystallization

The thickness of the films measured using a Talystep (Taylor Hobson) was 900 ± 10 nm. The samples were evaluated before and after post thermal treatment by X ray diffraction XRD with DRON – 2, using Co anode, the surface studying of the sample is performed through Philyps 515 with probe EDAX and software SW 9100. Direct - current conductivity was measured at room temperature by means of a standard four-point probe apparatus. The areas meant for contact are at distance 1.06 mm, received according to [6] and the total length of the photoconductive curve was 10 mm.

III. RESULTS AND DISCUSSION

a **b** **c**

Fig. 2 CdS layer - sintered(a), CdS layer -vacuum evaporated (b), CdS layer- through spray pirolysis(c).

The photos of the layers' surfaces obtained by vacuum thermal evaporation, sintering and spray pirolysis are given on fig.2.

Particles from the charge were not found on the layers' surfaces as a result of the distance between the charge and the layers. A photo of the CdS layer surface,

obtained by means of spray pirolysis, activated in a powder matrix through immersion is given on fig. 3. Particles were found on the surface, which were mechanically included from the powder matrix.

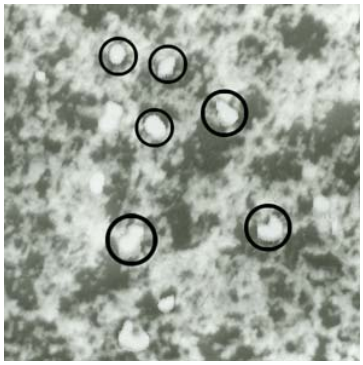

Fig. 3 CdS obtained by means of spray pirolysis, activated in the powder matrix through immersion.

XRD studies show that the dominating orientation is (002) for the layers obtained by the three methods but after activation and recrystallization. The phase CdO appeared at activation and recrystallization temperature 500 °C in 2θ – 33.16, 38.42 and 55.26. the orientation (110) appeared for the three methods when activating and recrystallizating with duration more than 20 min by 450 °C. The results from the photosensitivity measurements when activating and recrystallizating with 450 °C are given in table 1.

t, min / $\mathbf{R_D/R_{ph}}$	0	10	20	30	40	50	60
Sintered	10^4	5.10^4	10^5	5.10^5	10^6	10^4	2.10^2
Vacuum evaporated	10	10^2	3.10^2	5.10^2	5.10^5	10^4	10^2
Spray deposit	1	5.10^3	10^4	5.10^4	5.10^5	10^3	10^2

Table 1. Photosensitivity R_D/R_{ph} of the layers depending on the activation and recrystallization duration.

The max values of the layers' photosensitivity when carrying out activation and recrystallization in the medium of oxygen, nitrogen and vacuum are given in table 2.

medium / $\mathbf{R_D/R_{ph}}$	O_2	N_2	vacuum
Sintered	5.10^6	10^4	10^3
Vacuum evaporated	5.10^5	10^3	10^2
Spray deposit	7.10^5	3.10^2	10

Table 2. Photosensitivity R_D/R_{ph} of the layers depending on the activation and recrystallization medium.

The largest change in the photosensitivity values is characteristic for the layers obtained through spray pirolysis. The photosensitivity max value was achieved by additional thermal treatment in an oxygen medium.

4. CONCLUSIONS

The results from the experiments and studies show that the composition of the powder matrix and the method of activation and recrystallization can be successfully applied for directed properties change of the layers from **CdS,** obtained through different methods. The activation and recrystallization system suggested in this report protects the surface from pollutions. A large parameters change was found for the layers obtained by spray pirolysis which gives larger technological opportunities.

5. REFERENCES

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