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COMPLEX PHOTOCONDUCTORS CHALCOGEN-POLYMER

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There was discovered a material with strong photoconduction effect. Langmuir-Blodgett film with barium stearate, and selenium carbazole has been prepared and tested for the change of conductivity (decrease) under the influence of UV-radiation. Change of resistance in a time scale of 0-400 seconds was evidenced. The UV radiation determines an increase of the electrical resistence and after switching off the illumination a slow decrease of the resistance occurs.

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1. Introduction

The Langmuir-Blodgett multilayers are good materials for preparing sensing elements for gases and liquids, as well as for the detection of biochemical substances.

Several papers discuss the preparation and sensitivity of sensors based on organic materials with single wall carbon nanotubes [1].

In our previous paper we have demonstrated the role of the mixture of barium stearate with carbon nanotubes for sensing of ammonium nitrate dissolved in water [2]. A patent based on Langmuir Blodgett films of alkylic layers with carbon nanotubes has been deposed [3].

In this note we report our results concerning the photoconduction effect of a material with barium stearate, carbon nanotubes and selenium carbazole to be used as UV sensor.

2. Experimental

2.1 Preparation of thin films

A sandwich of 5 layers of barium stearate has been deposited by Langmuir-Blodgett technique in a KSV double-trough (Model 5000-3) (see Fig. 1). The solution for deposition was prepared by mixing barium stearate and carbazole powder stirred in a ultrasonic unit for five minutes.

All the samples consist in 5 layers deposited from the complex solution consisting of a mixture of Barium Stearate with 0.05g, single-wall carbon nanotubes (SWCNT) 0.005g, dodecyl benzene sulfonate (SDB) 0.05g and $Se_{95}PVK_5$ (an alloy of Selenium with carbazole) in 16ml Benzene.

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The double trough model KSV-5000 is presented in Figure 1. The multilayer samples have been deposited from the complex material formed at the surface of one of the Langmuir-Blodgett trough by compressing it at a given surface pressure and transferring the layer from the trough on a glass slide support.

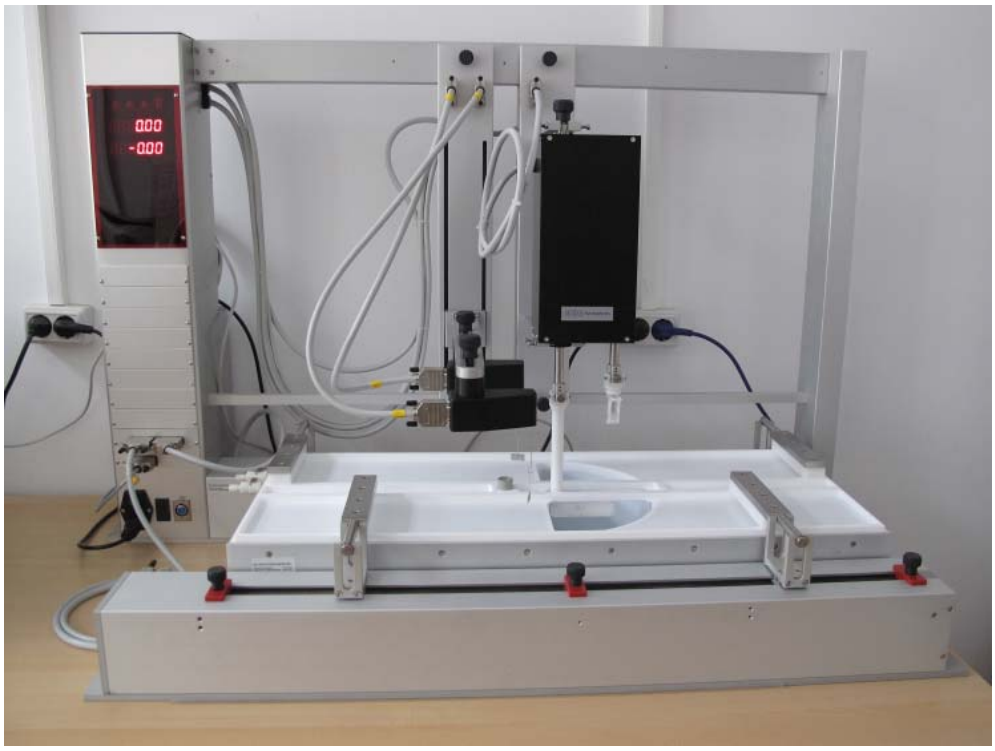

Fig. 1. The KSV device for LB deposition

2.2. Characterization of thin films

For the investigation of the photoconduction effect in the LB multilayer sample doped by a chalcogen-carbazole alloy we used a UV lamp, situated at a distance of 15 cm, at the room temperature of T= 26.6^{o}C (t_0) – 29.0 ^{o}C (t_f).

UV irradiation has been carried out with a medical UV lamp made by Electrotehnica-Bucharest, having the main emission lines in the range of 330-340 nm at the power density of 116 $\mu W/cm^2$.

The experiments with only selenium powder deposited on barium stearate from a solution of selenium with benzene have failed to show a photoconductive effect.

The influence of the carbazole ($Se_{95}PVK_5$) on the behavior of electrical resistance of the LB sensor has been investigated for a large time scale of irradiation (Fig. 2). The electrical resistence of the LB sample shows a strong increase during UV irradiation. The response to UV radiation is proportional with the time of radiation. No saturation of the effect of ultraviolet light on the LB material was observed.

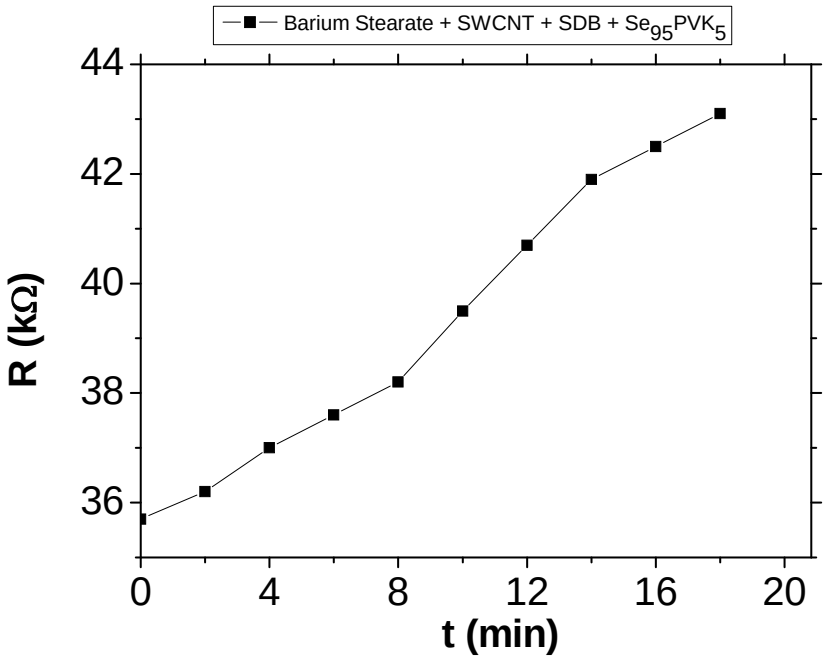

Fig. 2. Variation in time of the electrical resistance of the sample for the case of using at the surface a film of $Se_{95}PVK_5$ deposed from solution.

Figure 3 shows that the photoconductive phenomenon is partially reversible at a time scale of several minutes of switching off the UV beam.

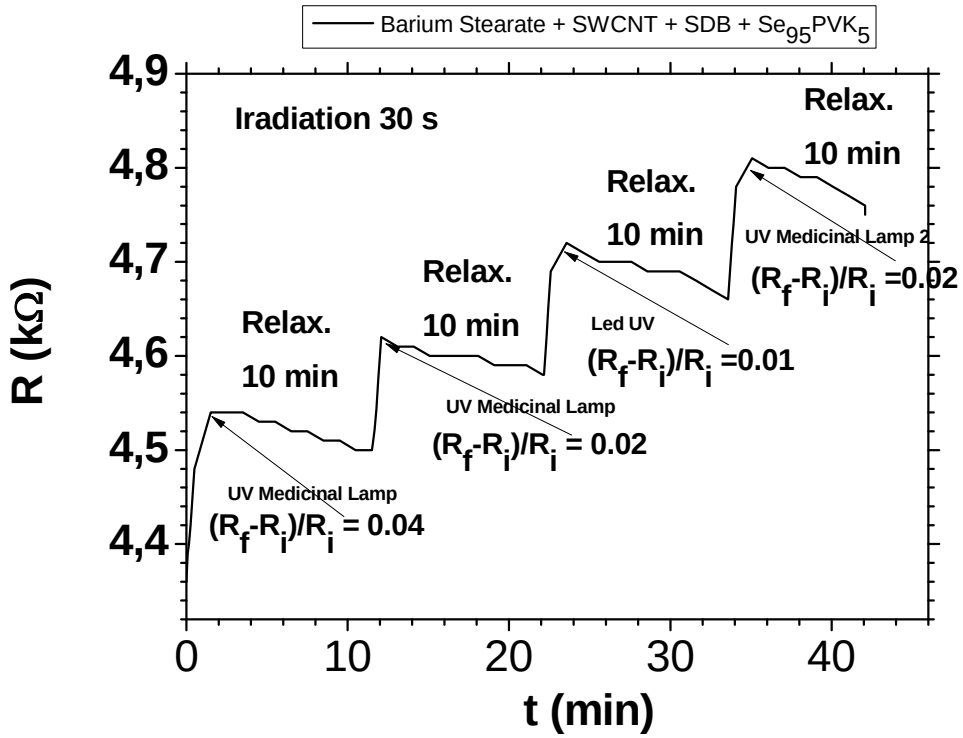

Fig. 3. The variation in time of the electrical resistance of the photoconductor during irradiation with UV radiation in 4 series of 30 s UV illumination followed by 10 minutes relaxation (absence of UV light). Different sources of radiation have been used : two UV lamps and one UV LED. The photoconductor consists in 5 layers of Barium stearate doped with single wall carbon nanotubes and SDB and above the layers was dropped a solution of $Se_{95}PVK_5$ in benzene.

3. Results and discussion

We have shown that the complex Langmuir-Blodgett films doped with carbon nanotubes and selenium carbazole exhibit significant change of electrical resistance phenomenon under the action of UV-light phenomenon. The sensitivity to UV grows when the selenium is introduced under the form of a compound with carbazole.

A partial reversibility in the absence of UV light is demonstrated at the scale of tens of minutes.

Work is in progress in order to improve the reversibility of the photoconductor.

4. Conclusions

The photoconduction effect is evidenced in a soft material based on barium stearate, single-wall carbon nanotubes and selenium carbazole. The reversibility of the phenomenon is only partial.

Acknowledgement

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