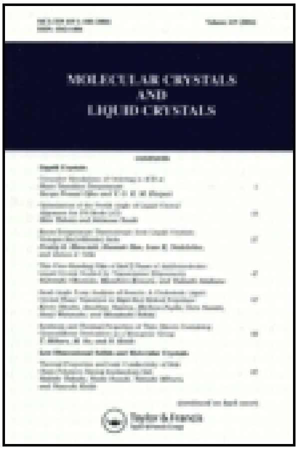

Molecular Crystals and Liquid Crystals
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/gmcl16

Thin Films Photovoltaic Cells From Undoped And Doped Polyacetylene.

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Version of record first published: 20 Apr 2011.

To cite this article: M. Cadene, M. Rolland, M. abd Lefdil, J. Bougnot, C. E.M, M.J.M. Abadie & L. E.M.P. (1985): Thin Films Photovoltaic Cells From Undoped And Doped Polyacetylene., Molecular Crystals and Liquid Crystals, 121:1-4, 297-300

To link to this article: http://dx.doi.org/10.1080/00268948508074878

Mol. Cryst. Liq. Cryst. 1985, Vol. 121, pp. 297-300
0026-8941/85/1214-0297/$10.00/0

THIN FILMS PHOTOVOLTAIC CELLS FROM UNDOPED AND DOPED POLYACETYLENE.

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Abstract We realised thin film photovoltaïc Cells by a direct polymerisation of $(CH)_x$ onto a sprayed CdS layer.
The dark intensity-voltage characteristics are obtained for different temperatures and the capacity-voltage curves at different frequencies.
The photovoltaïc behaviour is studied.
In spite of its low efficiency such junctions could lead,after improvment to very cheap photovoltaic cells.

INTRODUCTION

Devices using organic semiconductors are of great interest from the viewpoint of ease of fabrication and low cost.

In particular, semiconductive polyacetylene $(CH)_x$ have some advantages as high absorption coefficient ($\alpha > 10^5 cm^{-1}$) and the band gap energy of Trans $(CH)_x$ (ptype) is about 1.5 eV at wich the optimum solar energy conversion efficiency can be attained.

The formation of a variety of rectifying junctions involving $(CH)_x$ has been demonstrated : i)Schottky junctions using metallic (heavily doped) $(CH)_x$ [1]; ii) Schottky junctions using semiconducting $(CH)_x$ [2] ; iii) p-n heterojunctions[3]

Our goal is to built up very low cost solar cells. So that,we choose the "spray" polycristalline cadmium sulfide layers as n semiconductor in our cells with trans polyacetylene undoped and heavily doped sulfiric acid..

SAMPLES PREPARATION

The "spray" cadmium sulfide thin film (4μm-8μm) were obtained by Chamberlin method .

Generally, sprayed CdS film presents bowls at the surface (see figure 1)

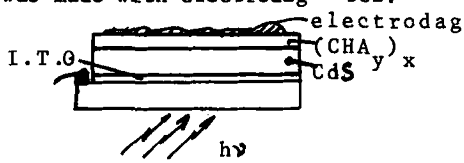
figure 1

0 5μm

A such effect is an disadvantage for polymerising homogeneous $(CH)_x$ thin film and can also produce short-circuit effects. We eliminate the bowls by an adequate polishing.

Cis-polyacetylene was directly polymerized on CdS by using Shirakawa's technique. The film was isomerized to the thermodynamically stable trans conformation by a heat treatment under dynamic pumping at 140°C during 10 minutes.

To reduce strongly the $(CH)_x$ electrical resistivity, the trans $(CH)_x$ were doped in liquid phase with H_2SO_4(6M) at 300°K, and washed with cyclohexene. The back ohmic contact to the $(CH)_x$ was made with electrodag + 502.



EXPERIMENTALS RESULTS

Dark studies

The characteristics $1/C^2$ versus reverse voltage at different frequencies for undoped trans $(CH)_x$-CdS "spray", always exhibit linear curves, corresponding to a diffusion voltage around 1.0 volt.

The density of CdS "spray" is around 1.5 $10^{17} cm^{-3}$. Values of N_A, C, W_n, W_p, are summarized in the table below.

F_{KHZ}	N_A cm^{-3}	C_{nF} cm^{-2}	W_n Å	W_p Å
3	2.05 10^{17}	65	540	410
5	1.13 10^{17}	55	640	480
8	1.17 10^{17}	50	710	540
12	1.10 10^{17}	48	740	550

The depletion width was localised in the two composants. We note that N_A obtained is similar to the value obtained by other autors.

The figure 2 exhibits log J versus the direct voltage at different temperatures for doped $(CH)_x$ cells.
We observe that the relation-ship $J=J_s \exp [a (V-R_sJ)]$ is verified, "a" is the slope of characteristics and it is independent of temperature.

Photovoltaic behaviour

After doping with H_2SO_4(6M), the (J,V) characteristics (figure 3) show a high amelioration of J_{cc} (18 μA/cm² before doping, 1,5mA/cm² after doping, under 1 sun). The low values of J_{sc} of undoped $(CH)_x$ are essentially due to high serie resistance.
At last, the figure 4 exhibits the spectral response of CdS-Trans $(CH)_x$ undoped and doped H_2SO_4. Although, the best response lies around the CdS gap we notice a strong widening at the lower energy side until a $(CH)_x$ band gap. We also notice an amelioration of spectral response after doping in the region of low energy.

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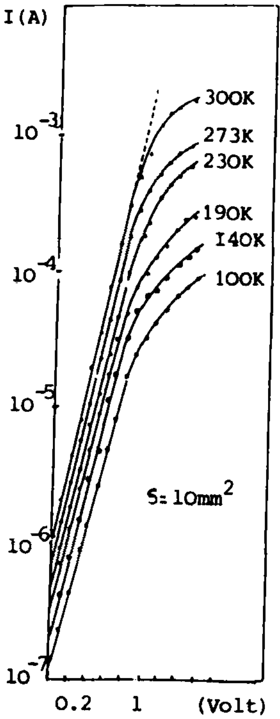

FIGURE 2 DARK (I.V) CHARACTERISTICS

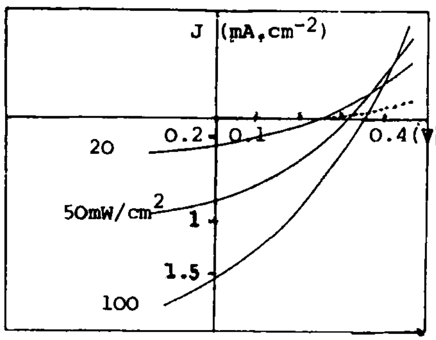

FIGURE 3 ILLUMINATED (J-V) CHARACTERISTICS

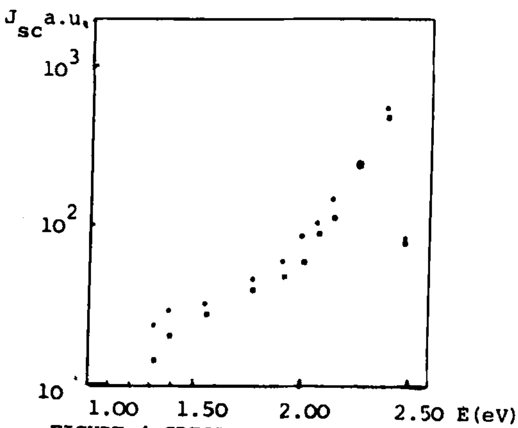

FIGURE 4 SPECTRAL RESPONSE
▪ -UNDOPED CELL
• -DOPED CELL