PRINTABLE PROTECTIVE DIODE FOR ORGANIC SOLAR MODULES

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ABSTRACT

The development of the next generation of printed solar photovoltaic modules requires extended research to improve the efficiency and the lifetime of the solar cells but also of the printed electrodes and bypass diodes. These latter prevent the destruction of the solar cells in case of partial shading due to hotspots [1], the aim of this work is to fabricate a printed bypass diode.

1. INTRODUCTION

Printed organic solar panels represent a new technology necessitating the introduction of a printed bypass diode in the panel. Our objective is to print bypass diodes using abundant and nontoxic materials. Additionally, a high current density (*i.e.*, 1 to 10 A/cm^2) is necessary to allow the current of multiple strings of cells flow effectively.

Bypass diodes require a low reverse current and should not generate photocurrent. Metal oxide semiconductors have been selected because they fulfill the requirements. They are not toxic, abundant with large bandgap (they don't absorb visible light, and can be printed). Several materials have been selected and tested in a different configuration such as Schottky diode or p-n heterojunction.

2. DESCRIPTION OF THE STUDY

Tin dioxide "SnO_2" is the major material that will be presented. It is a naturally n-type semiconductor with a work function of 4.58 eV (measured by Kelvin probe). It can form a Schottky contact with a conductor with greater work function or a p-n heterojunction with a p-type semiconductor.

Schottky diode has been chosen due to its simple architecture, a commercialized SnO_2 nanoparticles 15% in H_2O colloidal dispersion by Alfa Aesar is spin coated on top of an ITO/Glass substrate at 1500 RPM for 1min forming a thickness of 150 nm measured by mechanical profilometer. After annealing for 1hr at 120°C PEDOT:PSS is spin coated on top of SnO_2 at 4000RPM for 1 min with a thickness of 50nm (profilometer), then 70 nm of silver 'Ag' evaporated to serve as the top electrode. Schottky contact is expected between n-type SnO_2 and heavy doped p-type PEDOT:PSS with a work function of 4.94 eV (KP)

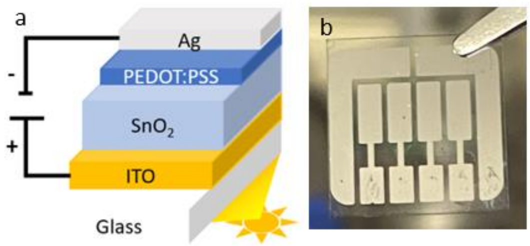
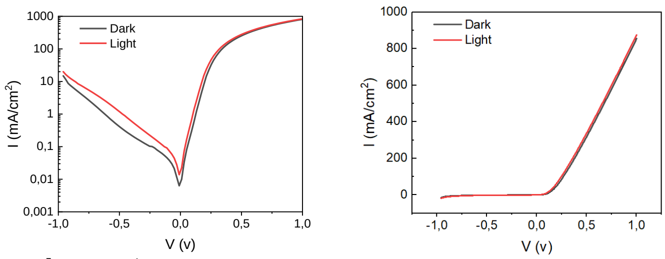


Figure 1: Device architecture (a) and sample photograph (b) (15x15 mm^2) each device has an area of 10.3 mm^2 (4 devices in each sample)

3. RESULTATS

The I-V curve of the device showed a clear rectifying behavior in dark and under illumination with a difference between reverse and forward current of 2 orders of magnitude, more than 60 devices showed the same characteristics

Figure 2: I-V curve in semilogarithmic scale (Linear



in the inset)

4. CONCLUSIONS

A printed Schottky diode has been fabricated using n-type SnO_2 and an organic heavily doped PEDOT: PSS that acts as a conductor. The device showed a rectifying behavior with no photocurrent which can be promising for bypass diode application.

4. REFERENCES

[1] Vieira, R. G., de Araújo, F. M. U., Dhimish, M., & Guerra, M. I. S. (2020). A comprehensive review on bypass diode application on photovoltaic modules. In *Energies* (Vol. 13, Issue 10). MDPI AG. https://doi.org/10.3390/en13102472