EnerHarv 2024

PSMA International Workshop | 26-28 June, 2024 | Perugia, Italy

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EnerHarv 2024 Workshop:

Printable, Lightweight, and Flexible Organic-based EH Systems: Materials, Processes, and Applications

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OVERVIEW

- ❖ IOT challenges and Energy Harvesting value proposition
- ❖ *Strategies for OPV power density improvement*
- ❖ *How to integrate EH OPV to Real Life Applications*
- ❖ *conclusions*

IOT challenges and Energy Harvesting value proposition

OPV current power densities around 40-50 µW/cm² at lab level and from 25-35 µW/cm² at Fab level, compatible with existing low power electronics.

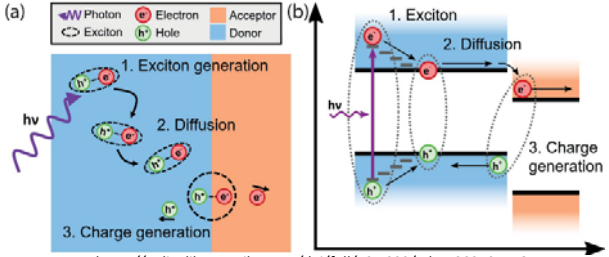
We at Dracula Technologies Manufacturing organic, sustainable, environmentally friendly PV energy harvesting components that eliminate the need for battery replacements of IoT devices and sensors inside building

Key Areas for Enhancing OPV to Better Serve the IoT Market:

- **Materials**
- **Process**
- **Design**
- **applications**

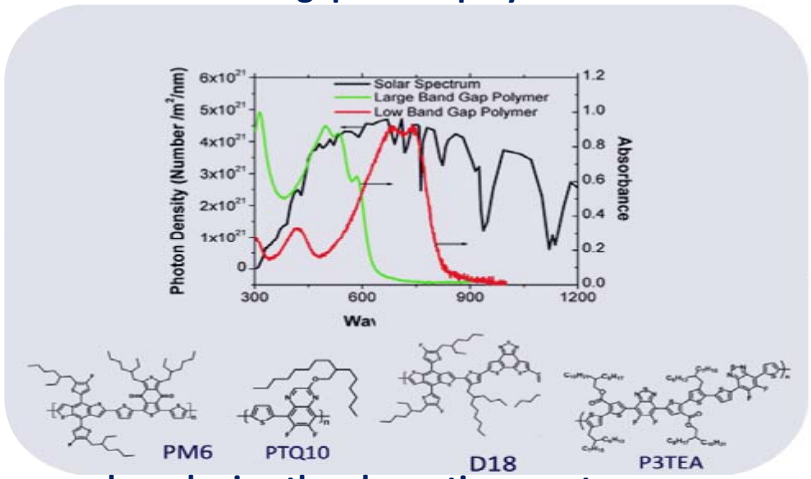
Hwang, S., Yasuda, T., *Polym J* **55**, 297–316 (2023). https://doi.org/10.1038/s41428-022-0

Main strategies for increasing the efficiency of organic solar cells



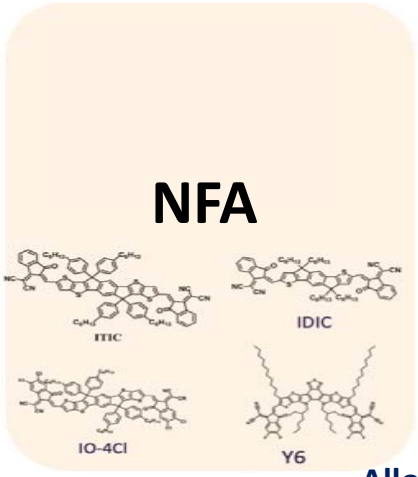
https://onlinelibrary.wiley.com/doi/full/10.1002/admt.202101556

New low band gap donor polymers



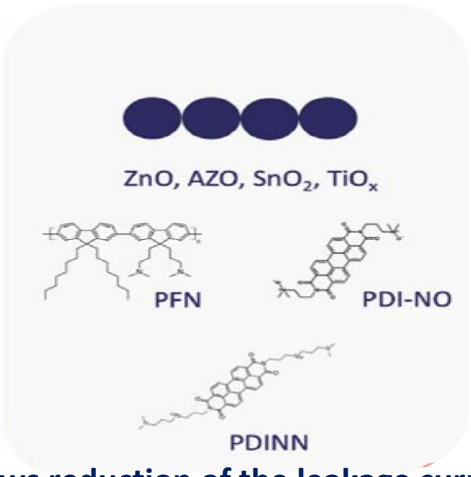
broadening the absorption spectrum.

New non fullerene Acceptor



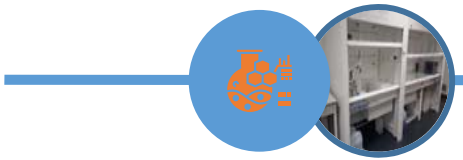
allow the modification of their chemical groups and bonds to increase the open-circuit voltage beyond 1 V.

Efficient interfacial layers (IL)
HTL and ETL

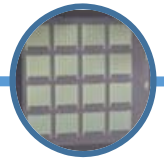


Allows reduction of the leakage currents and assist in charge extraction

Main strategies Manufacturing process



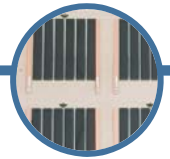
Preparation
of the substrate

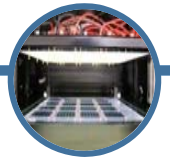


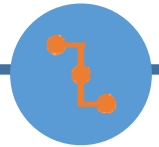
Ink formulation

Printing step

Thanks to the partnership signed with industrial MGI as part of the company's latest fundraising, this part of the process is already under control at the 300x300mm scale

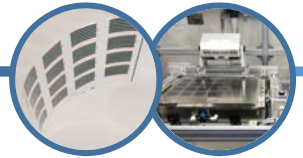






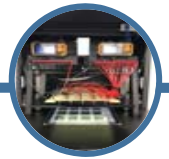
Connection

Semi-manual preparation
at unit module scale



Encapsulation

Encapsulation through
a 300x300 mm system

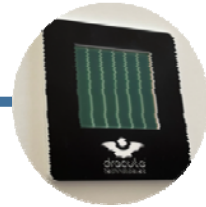


Characterization
& validation

Ability to process 16 modules simultaneously

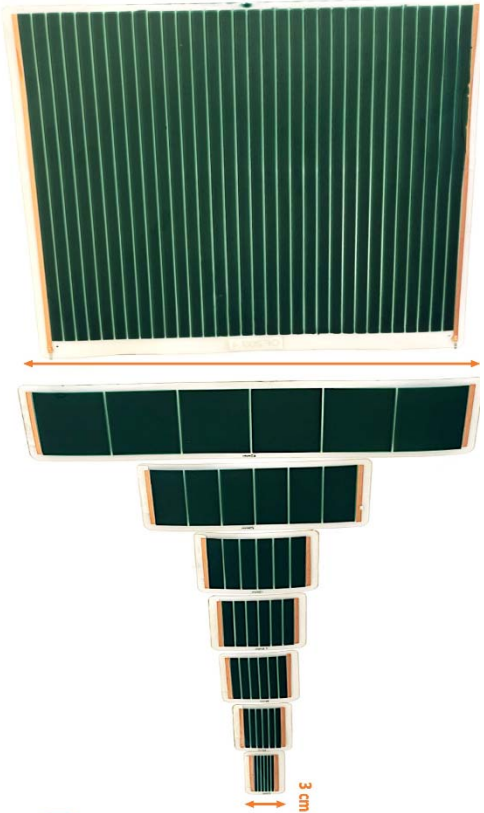
Cutting

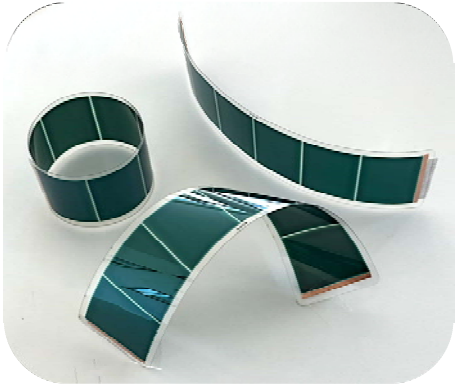
No splitting because we are in unitary module

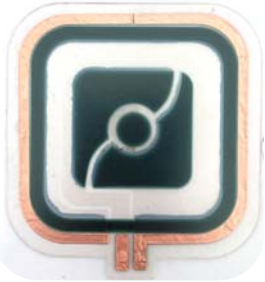


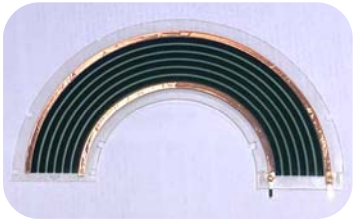
Integration step

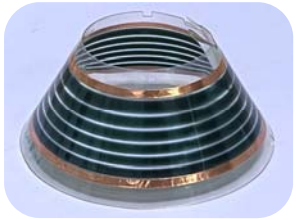
Process that offer flexibility of size and shape

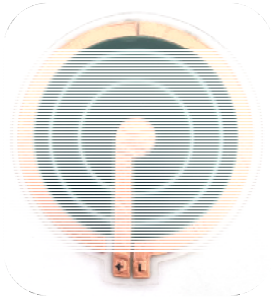












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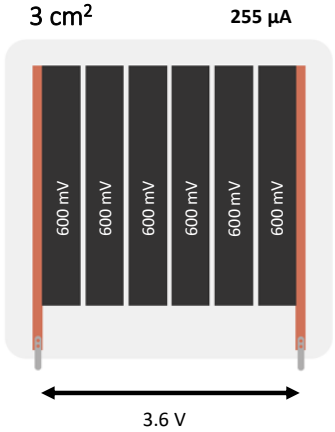
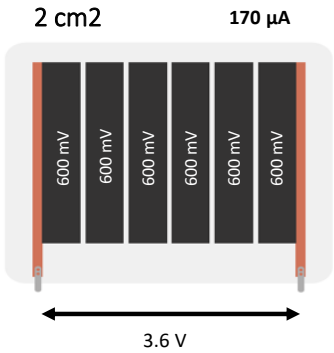
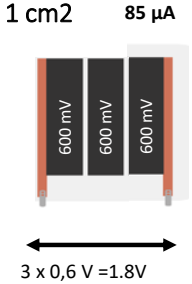
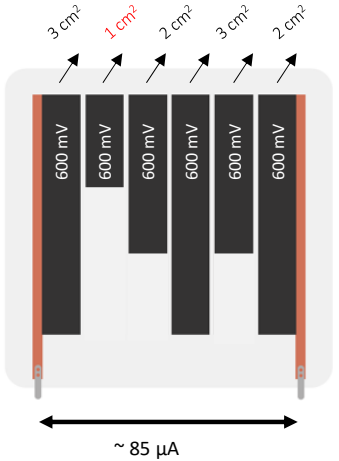
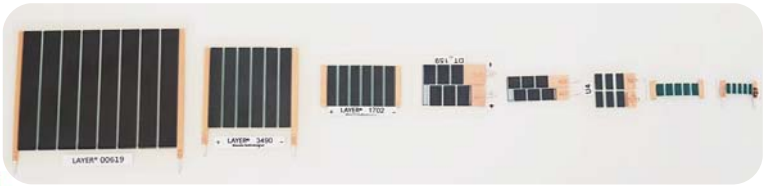
Strategy by design to optimize system performance



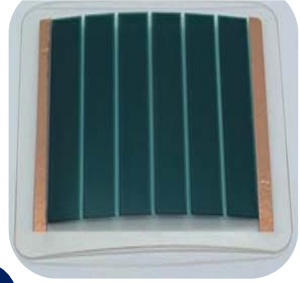








Demokit #6 - LAYER®: Typical OPV Characteristics



Encapsulated to protect from O_2 and H_2O

Working temperature : -30°C to 50°C

Organic solution: From carbon based molecules and polymers

Bifacial : it collects photons from front and back

Green solution:

No toxic materials
No halogenated solvents
No toxic waste
High recyclable rate

Flexible : bending radius 2 cm

Long terme stability: > 10 years

(indoor conditions)

Light weight : 0.04 g/cm²

Thin : 0.20 mm

Freedom of design : inkjet

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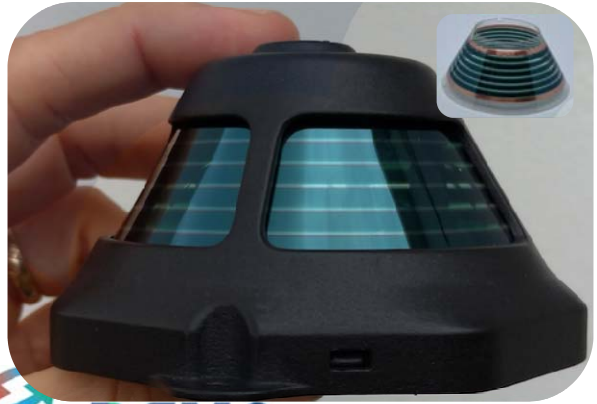
Example of self powered indoor devices with low TCO

Remote control

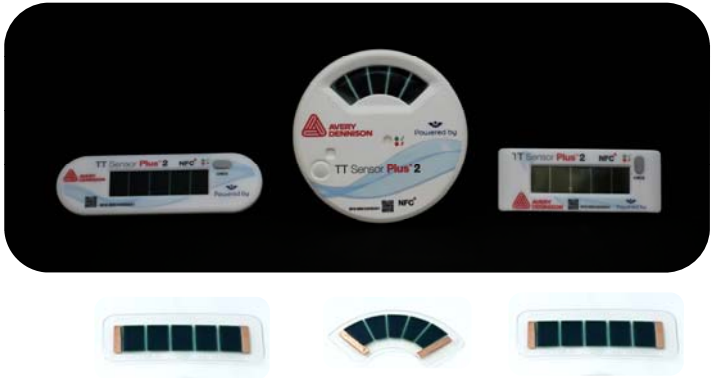
Battery-free LoRaWAN Geolocation

BLE CO2 Sensor

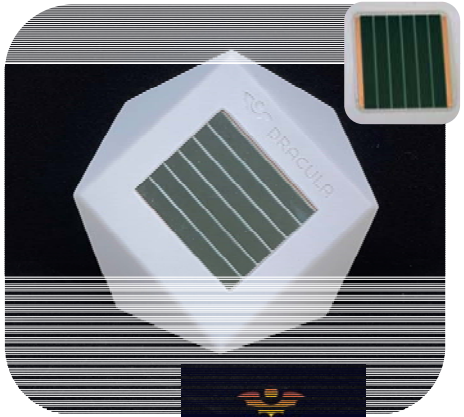
Very-low-power infrared imager



Temperature Logger



LoRaWAN /BLE Smart BEACON



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Conclusions

- The IoT market holds significant potential for indoor PV energy harvesting.
-
- One major challenge is to eliminate the replacement of batteries.

- There is still big potential for improving the OPV performance. Substantial R&D efforts on materials (Donor/Acceptor, IL) are required.

- The most suitable OPV applications are those that meet energy needs while reducing the total cost of ownership (TCO) of the product.

Q & A

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Thanks very much for your time and attention!

Questions/comments???

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