AGENDA 2030 DI BOLOGNA

L'ITALIA SOSTENIBILE

IDEE E AZIONI PER IL FUTURO

BOLOGNA 20-21 MAGGIO 2016

C.N.R. AREA DELLA RICERCA DI BOLOGNA

Progetto SUNFLOWER: celle fotovoltaiche di natura organica

CNR ISMN

http://www.sunflower-fp7

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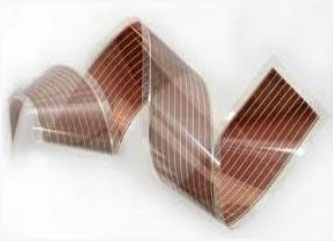
MOTIVATION: Why Organic Photovoltaics?

Key features:

- ☺ ***Processing***: low energy consuming and low cost R2R production
- ☺ ***Form-factor***: Different forms on light weight and flexible substrates
- ☺ ***Aesthetics:*** tuning of color, shape and transparency
- ☺ ***Harvesting factor:*** compatible with low light conditions (shadow tolerant)
- ☺ ***Environmental impact:*** short payback time and low carbon footprint.

No heavy metals are used.



- **BIPV** (building-integrated PV)
- Consumer/portable electronics

Project, Consortium and Focus

- **SU**stainable **N**ovel **FL**exible **O**rganic **W**atts **E**fficiently **R**eliable
- **4.5 years** (1/10/2011 to 31/3/2016)
- **17 partners**

efficient OPV architecture
Tandem devices

Assess
environ. impact

Solution processing
towards R2R

Enable significant
demonstrations

Project Targets

Increase efficiencies

- Materials development
- Device optimization

Increase expected lifetime

- Diffusion barriers/UV stable films
- Identification degradation mechanisms
- Life cycle assessment

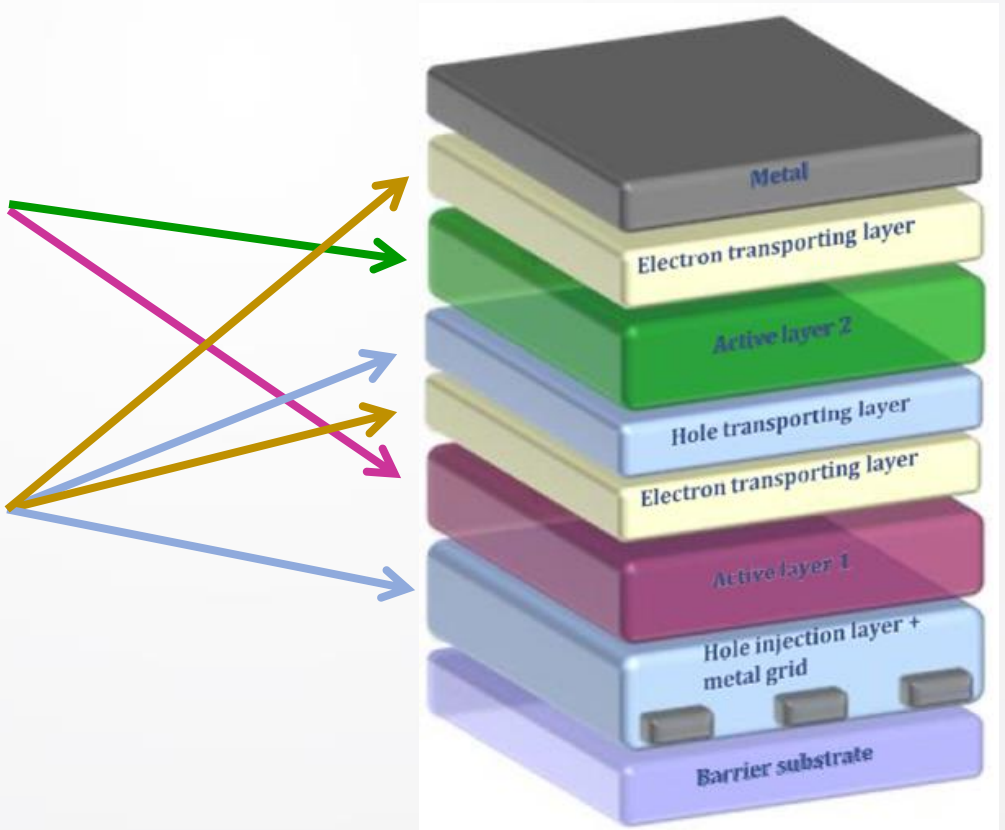
Decrease costs

- Industrially up-scalable materials and processes
- Cost effective solutions: barriers/electrodes

Materials development

- **80 new photoactive polymers** (high and low bandgap). PCEs between 6-8% in single-junction devices.
- Efficient and scalable **functional materials** (ETL, HTL) were developed and used
- **ITO-free electrodes** were also considered
  - Development of suitable **Barrier foils**

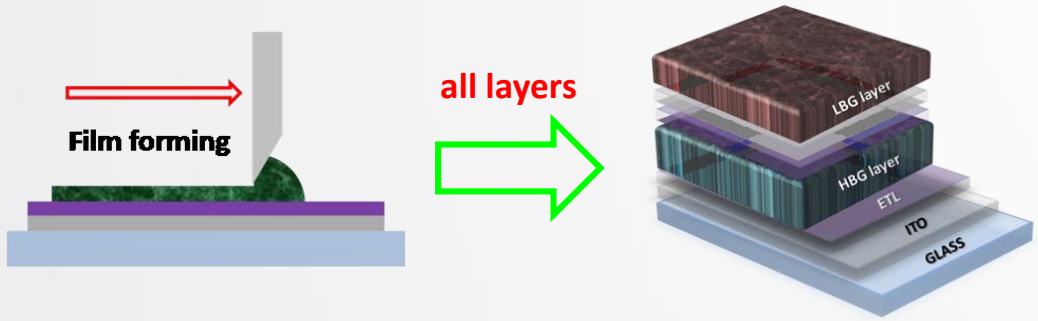
Tandem solar cell

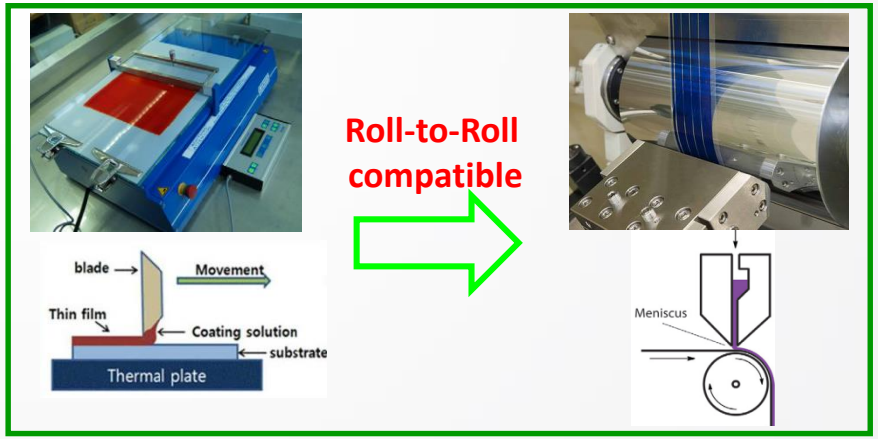


Process development: from lab to industrial production

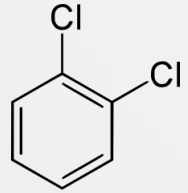
1- "More Realistic" processing conditions (*e.g.* blade-coating in air)

Why blade-coating?

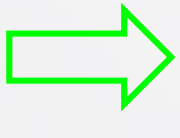




2- NON-HALOGENATED solvents



Halogenated solvent

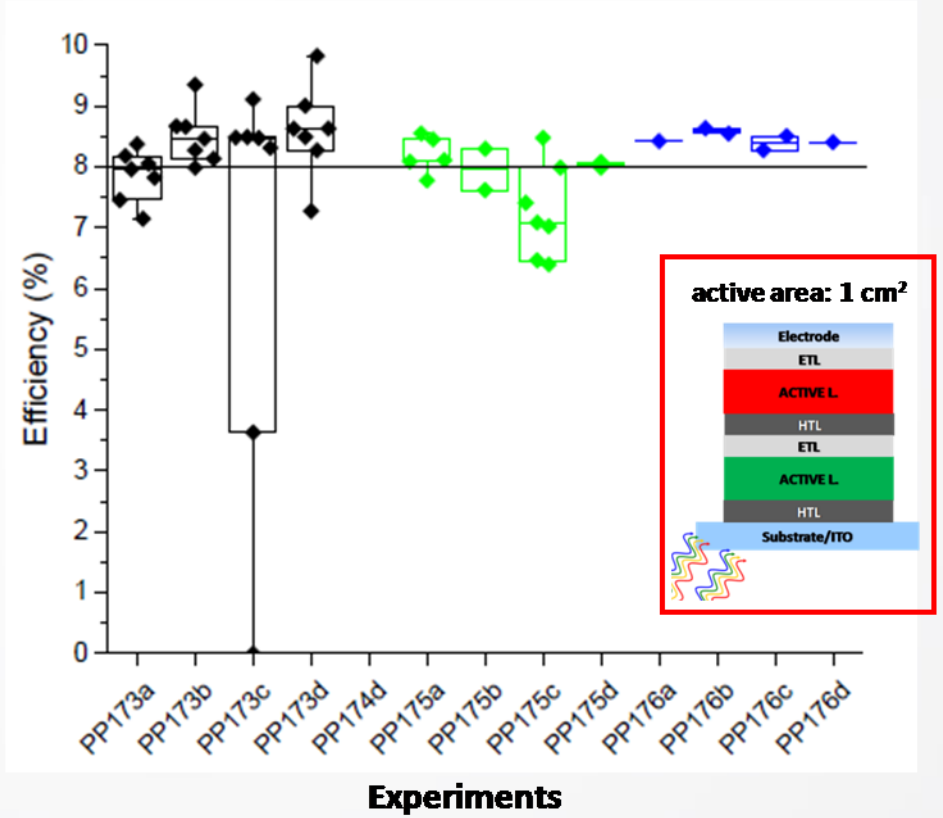


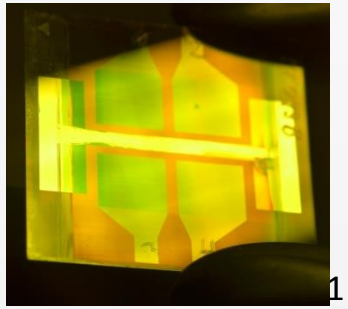
Non-Halogenated solvent

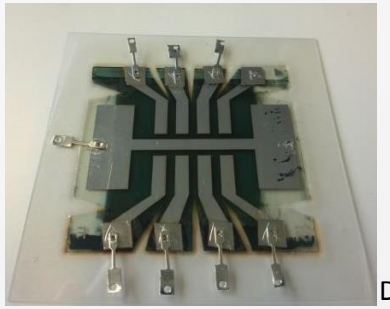
reduced costs, toxicity and environmental impact

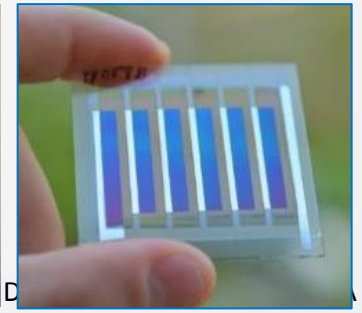
Tandem devices on Laboratory-scale

- Solution-processed solar cells
- Efficiencies of 8-9 % (on 1 cm^2), reproducible!
- Encapsulated devices measured by an independent external lab



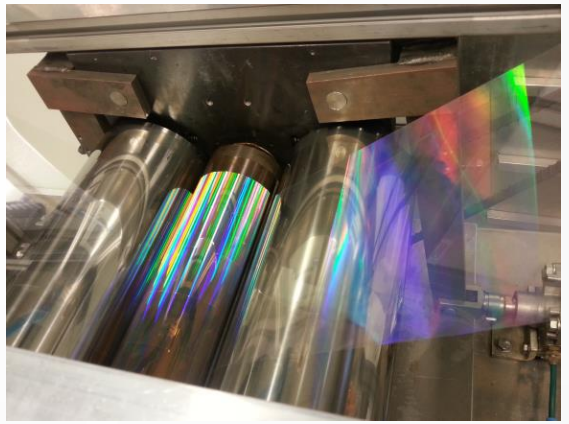


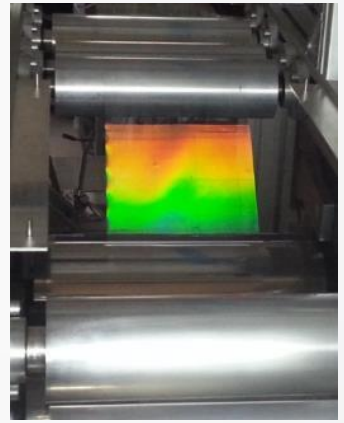


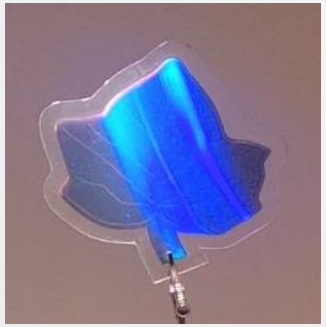


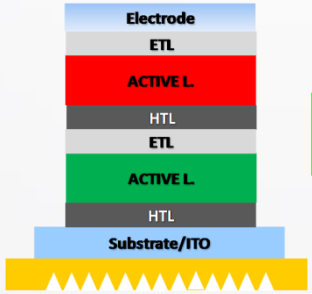
Light management: device efficiency up to 10%!

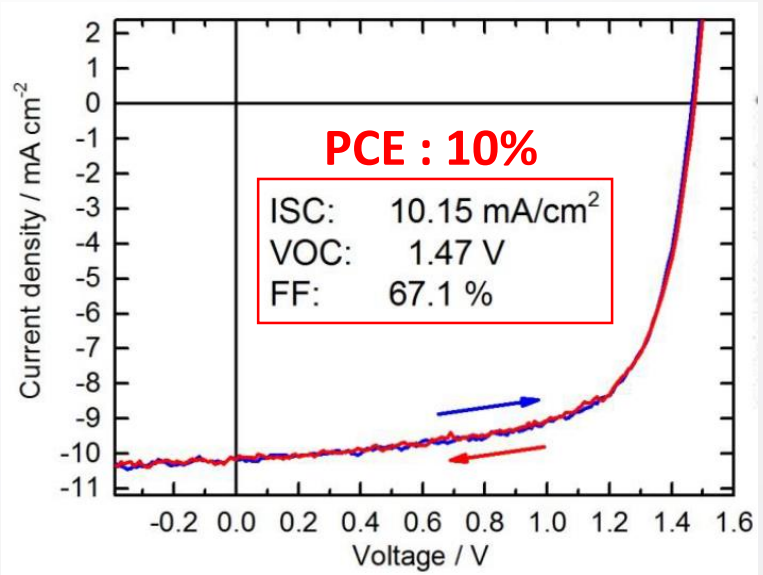
- **2D light management structures** from simulation to lab scale
- **PCE improvement > 10%**
- Process demonstrated to be **upscalable** via R2R embossing
- Additional **aesthetic effect**









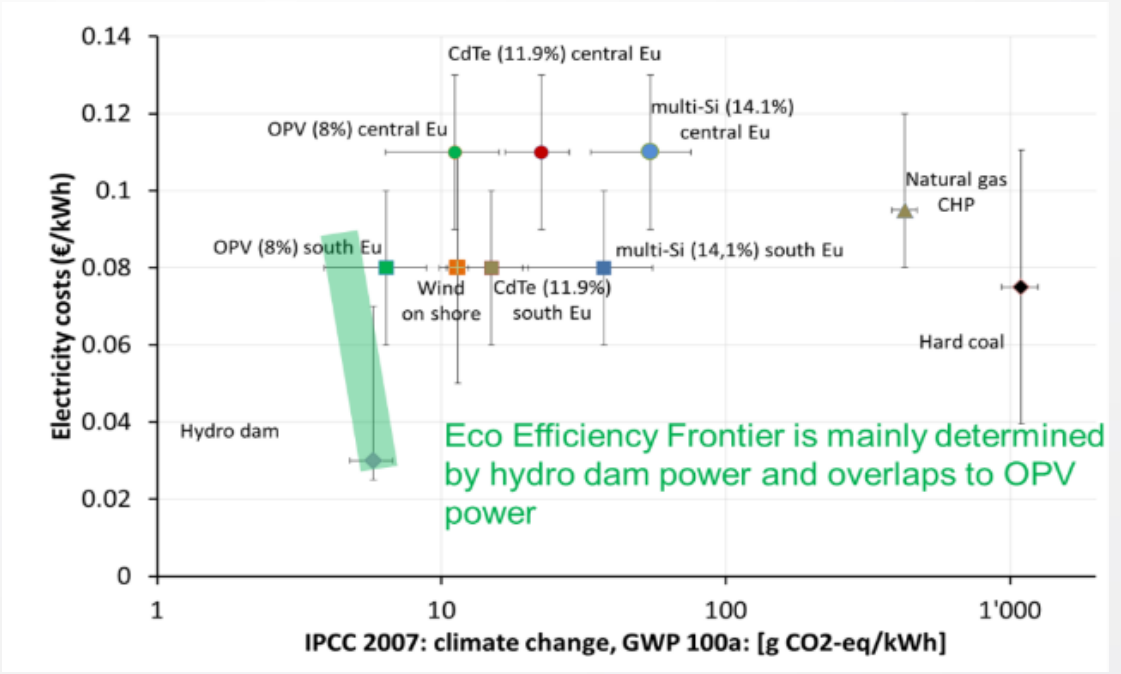


Ecological impact and eco-efficiency analysis

- First experimental **ecotoxicity analyses** for OPV devices (zebra fish eggs)
- **Eco-efficiency**: OPV seems one of the most sustainable power generation technology
- **Energy pay back time**: 3-4 months for OPV

  ~ 26% of CdTe and 15% of multi-Si

  (location & application case dependent)

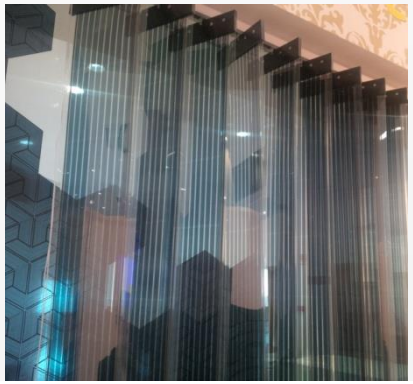


Event and Demo

«Solar energy in everyday life»– ICT 2015 Lisbon

OPV integration in:

- windows
- window blinds
- hand bags



Lifetime: 5-10 years (indoor)
Efficiency: lower than lab-scale cells

Sunflower wins the Best Publicly Funded Demonstrator award in the 2016 OE-A competition (during LOPE-C 2016)

Summary

- OPV should not be seen as a replacement of the current PV technologies
- OPV is potentially one of the most sustainable power generation technology
- Tandem OPV cells (on lab-scale) with efficiencies of 10%, using realistic and scalable materials and process conditions, were demonstrated.
- Fully printed OPV modules were produced and used for demonstrations (OPV living room: windows, vertical blinds and portable chargers).
- Further developments in terms of lifetime (under harsh conditions) and module efficiency are still required for a significant impact.

Thanks to …

EU commission for funding the project:

Sunflower printed organic photovoltaic cells

http://www.sunflower-fp7

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