Consiglio Nazionale delle Ricerche

DIPARTIMENTO PROGETTAZIONE MOLECOLARE

Il ruolo della chimica nei temi tecnologici dell'energia

CNR – Aula Convegni, P.le Aldo Moro 7, Roma
21 giugno 2011

La piattaforma tecnologica organica per l'energia: fotovoltaico plastico e illuminazione ad elevata efficienza

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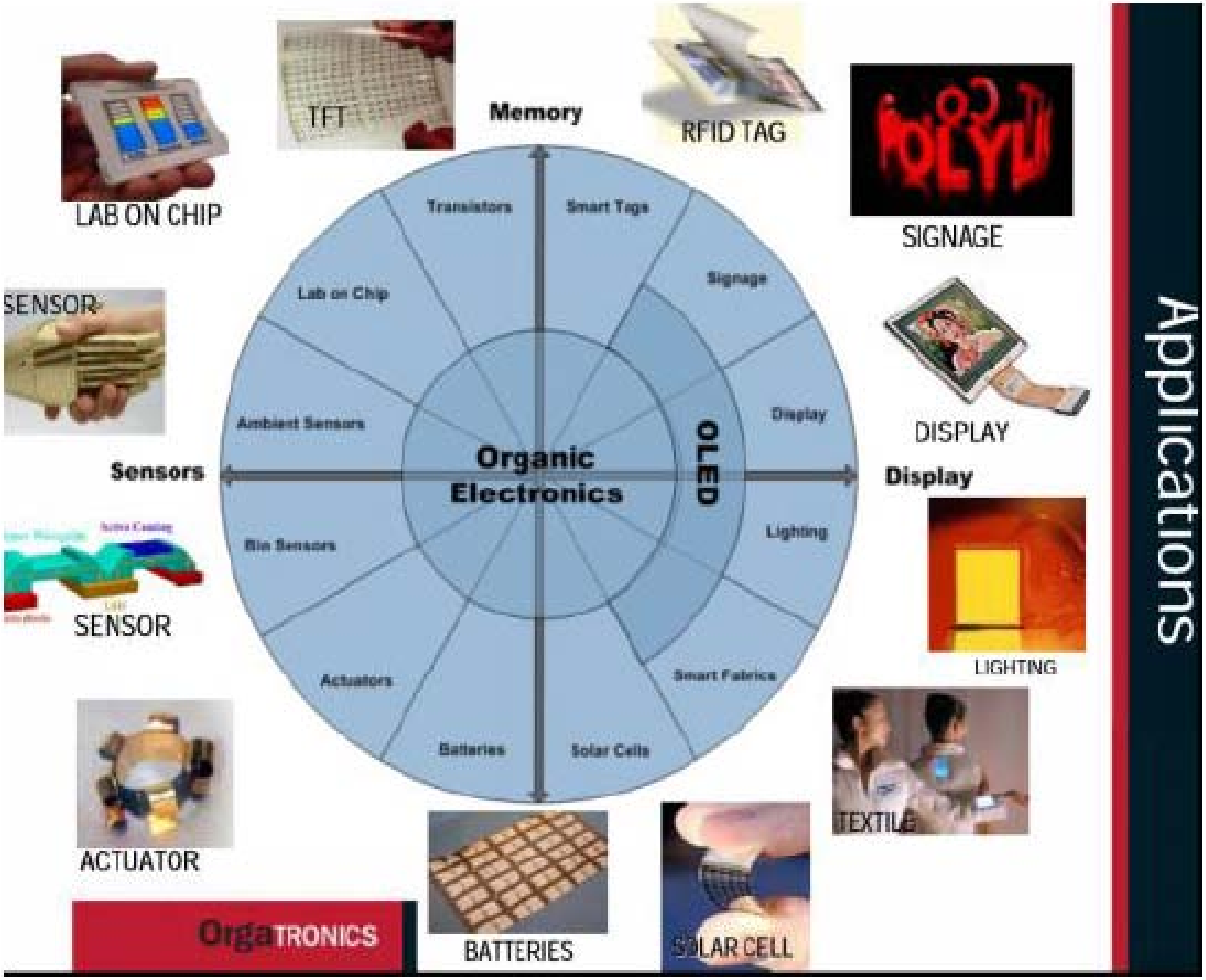
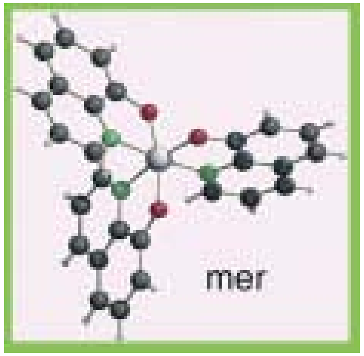
Agenda

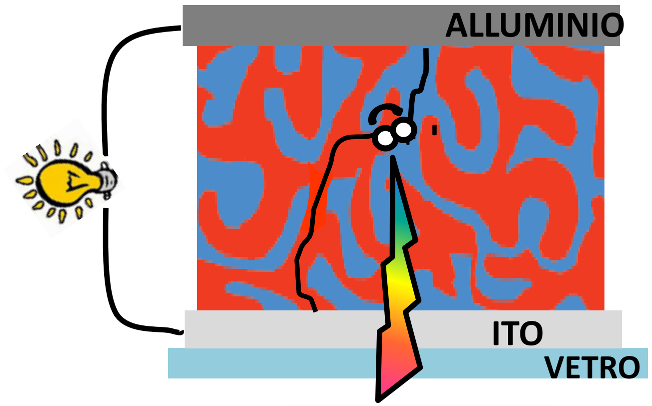
- La piattaforma tecnologica organica
- Obiettivi e strategie per lo sviluppo della tecnologia OPV
- La chimica nella catena di valore della tecnologia OPV
- Lighting organico, sostenibilità e risparmio energetico
- Gli obiettivi di prestazioni e prezzo per gli OLED
- Una iniziativa di partnership industriale nella fotonica organica
- Conclusioni

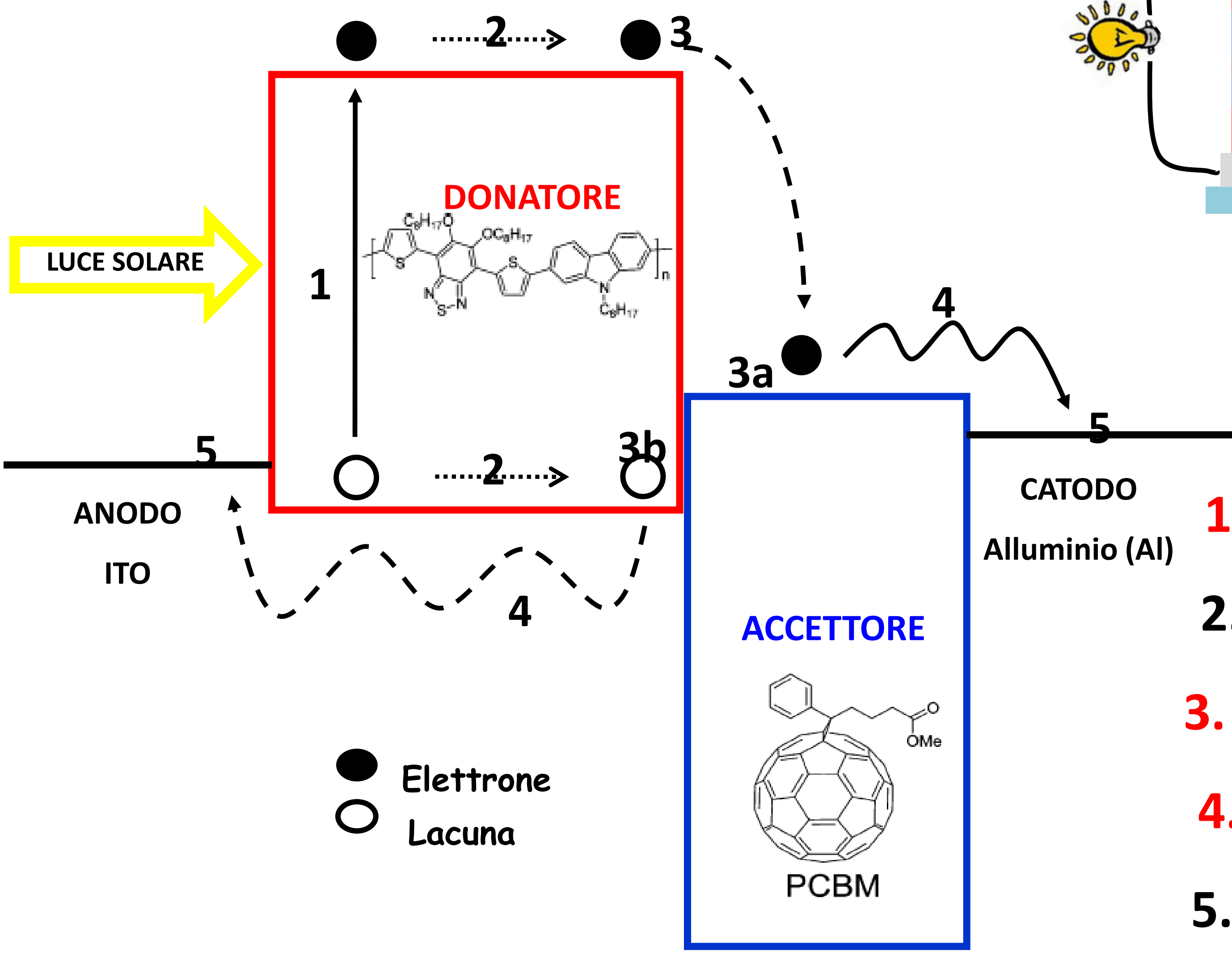




- •Flexible
- •Large area
- •Light weight
- •Low cost
- •Env. Friendly
- •Need to be protected!!

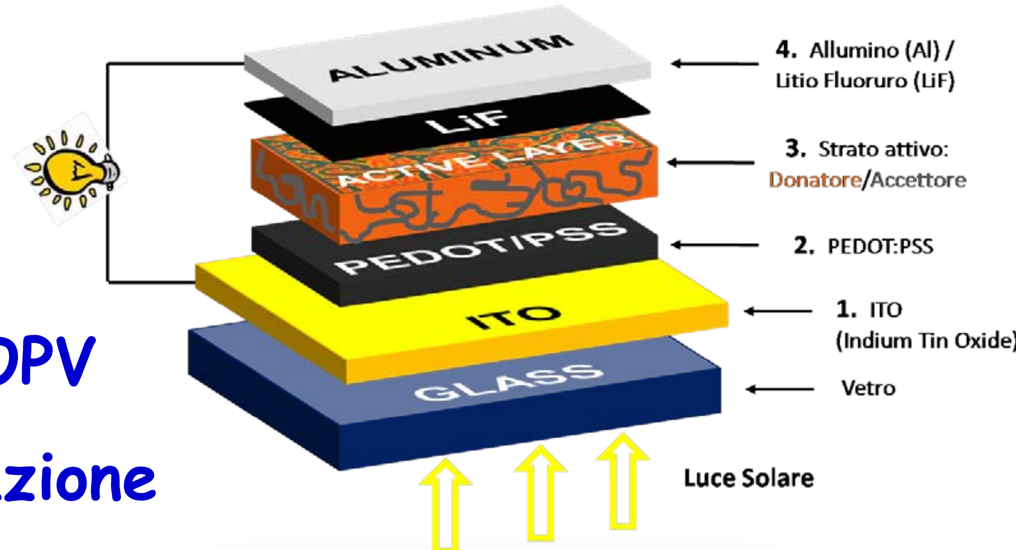
General Mechanism





1. Light absorption
2. Exciton diffusion
3. Charge separation
4. Charge transport
5. Charge Collection

Struttura della cella OPV e processo di fabbricazione



Ink-jet printer

Roll to Roll

Applicazioni di nicchia per tecnologia OPV

Goals and Innovations for OPV

8-10%

- **New polymers** (needs to be specified) and nano particles
- **Tandem cells** – novel architectures - Alternative ideas –
- Interlayer is of crucial importance, ZnO, TiO_2
- **Light management** structures – transparent electrodes, anti-reflection layers (stability, production?)
- **Morphology control**
- Device physics and advanced analytics – minimization of losses
- Efficiency (PEDOT+Ag)
- Upscalling issues consideration

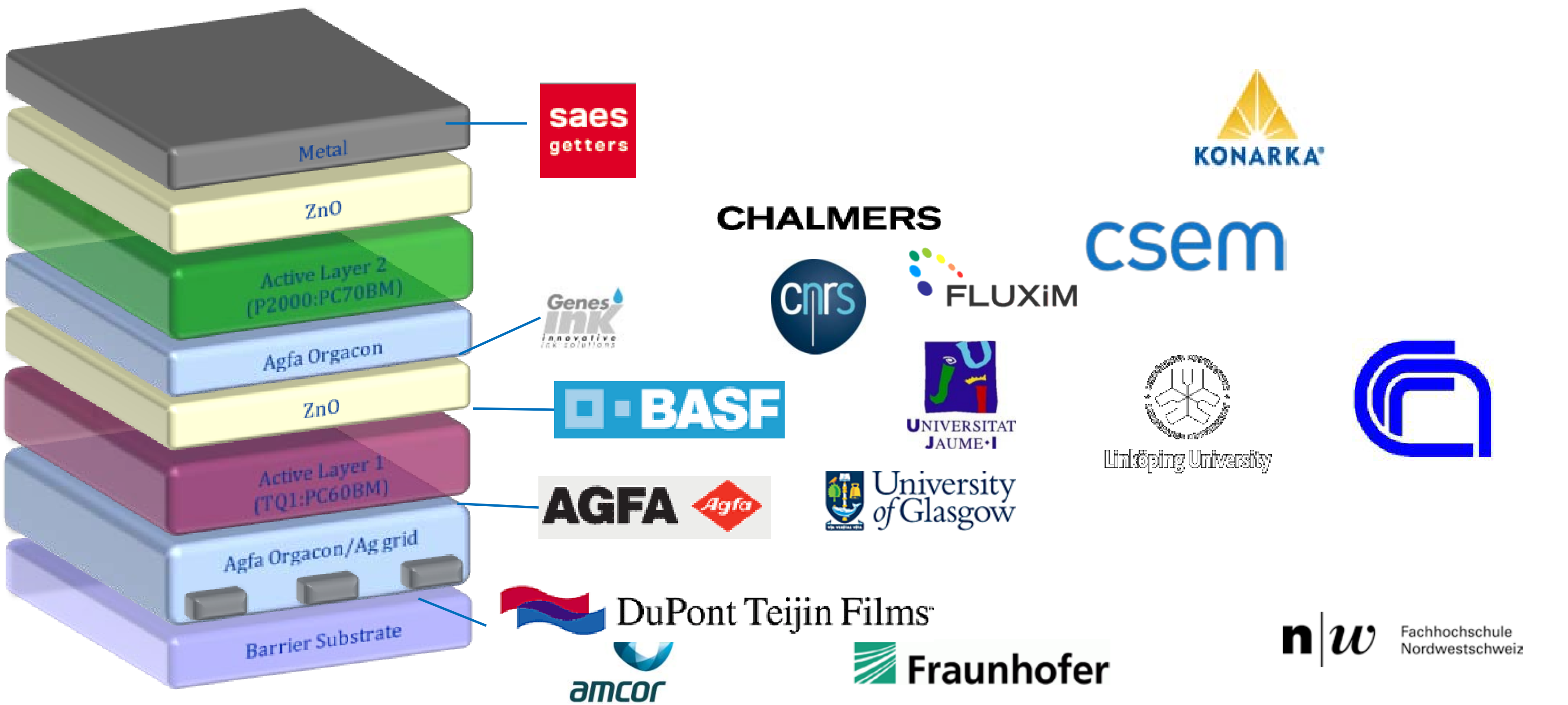
20 years

- Packaging + stable films
- **Degradation studies & correlations** (OTR, WVTR, UV) & extrapolations
- Improved interface materials
- **Weatherable films** (Novel additives + encapsulation + optimization)

0.7€/wp

- **Printed** transparent **electrodes** (PEDOT+Ag)
- Tools for mass manufacturing
- Efficient production techniques: **R2R**
- Controlled environmental impact
- **Cost effective barrier** production – ev. + R2R converting processes
- Weatherable films (Novel additives + encapsulation + optimization)

Sunflower – The first European IP on OPV technology



Materials / Formulation

Fundamental Mat. science

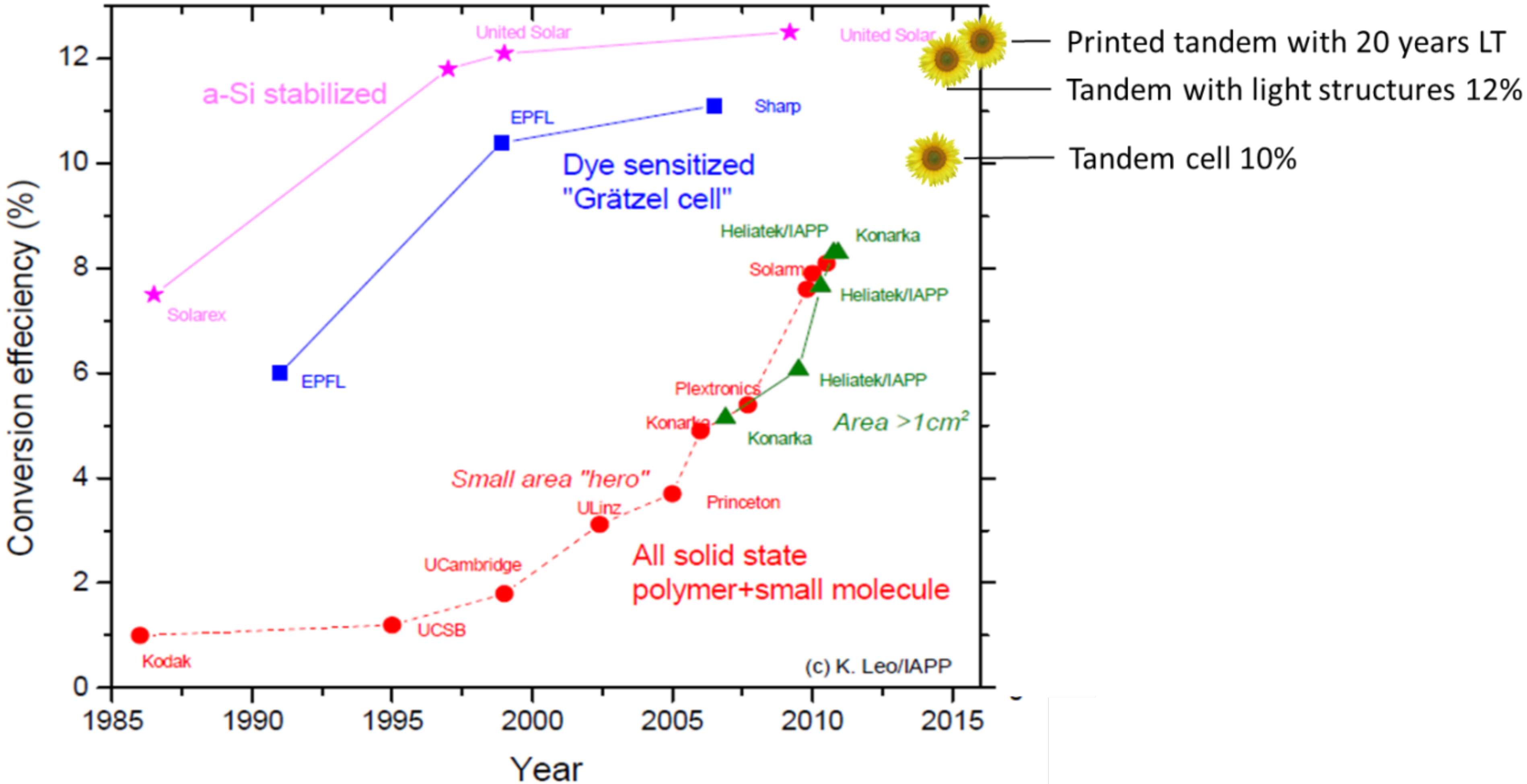
Devices/ Module / Processing

Lifetime /Eco impact /

SUNFLOWER rationale

- High efficiency needed to compete with other PV
- Multilayer structure (i.e. “tandem”) required to achieve high efficiency.
- Cost effective barriers, getters required to achieve higher lifetime
- R2R, atmospheric processes (printing) allow to bring costs down (Costs = Eur + kgCO_2)
- Replacement of In, Cd necessary to improve sustainability
- Basic and applied science required for photoactive materials, to achieve efficient and stable modules

SUNFLOWER rationale



Lighting, sostenibilità e risparmio energetico

Situazione Italiana

17% consumi elettrici nazionali in illuminazione

Consumo energetico italiano 350 TWh/anno

Sorgenti a stato solido su larga scala: risparmio pari a 25 TWh/anno nel 2025 (3 centrali nucleari da 1 GW)

Risparmio energetico tra il 5% e 10%

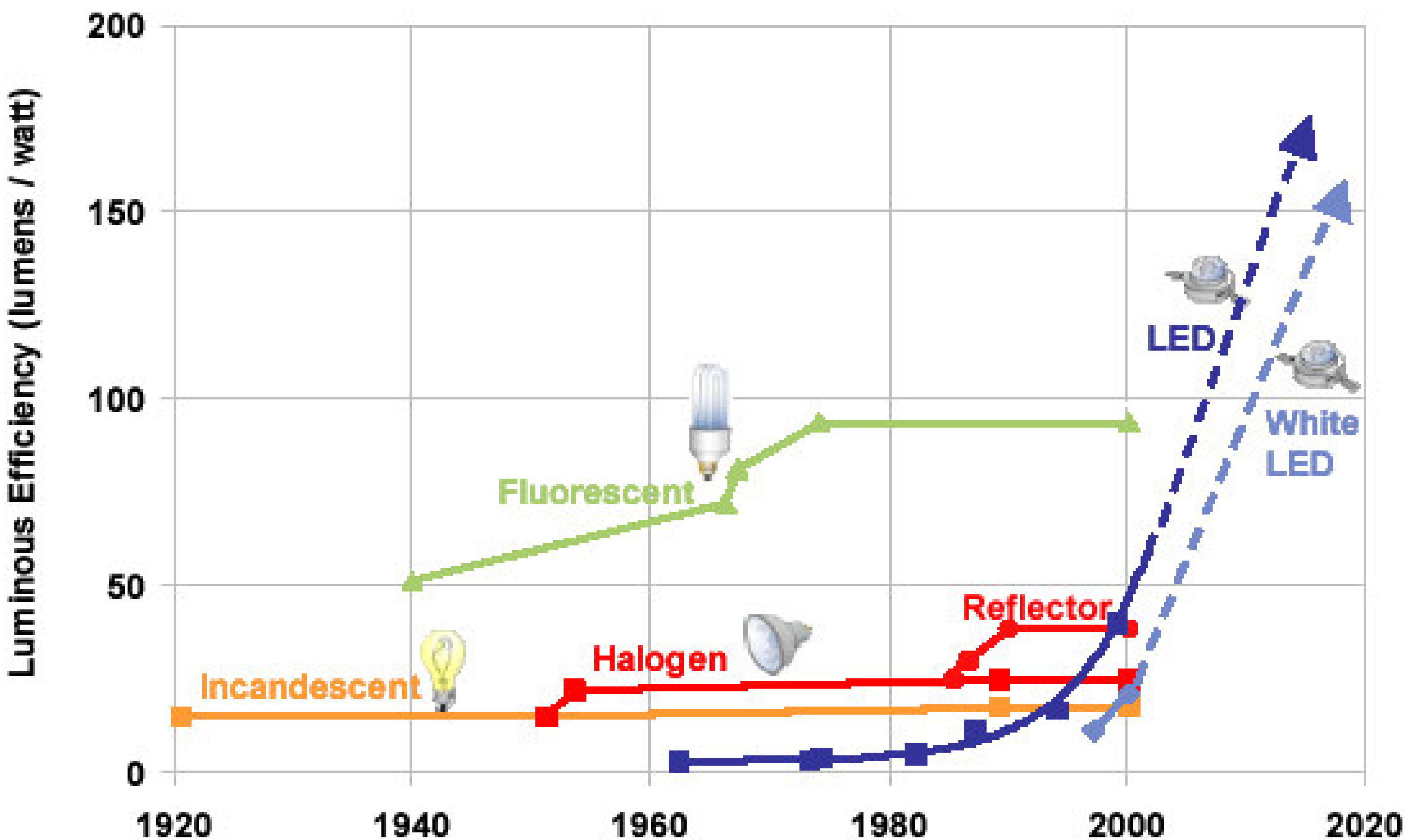
US Department of ENERGY

The new solid-state white light source would change the way we live:

- Worldwide electricity consumption due to lighting could be decreased by more than 50%, and total consumption of electricity could be decreased by more than 10%.
- Carbon emissions, and new capital infrastructure associated with electricity generation, would decrease proportionally by more than 10%.

http://lighting.sandia.gov

Proiezione di sviluppo tecnologia LED

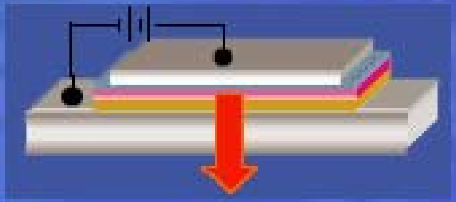


Source: Lumileds

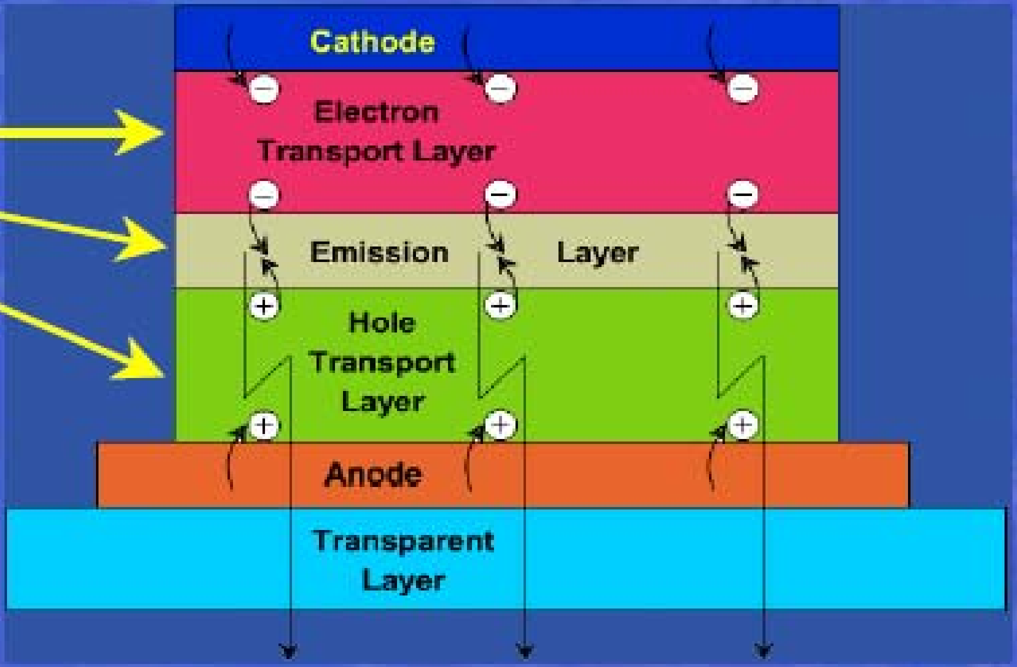
How does it work ?

Organic semiconductors

- OLED

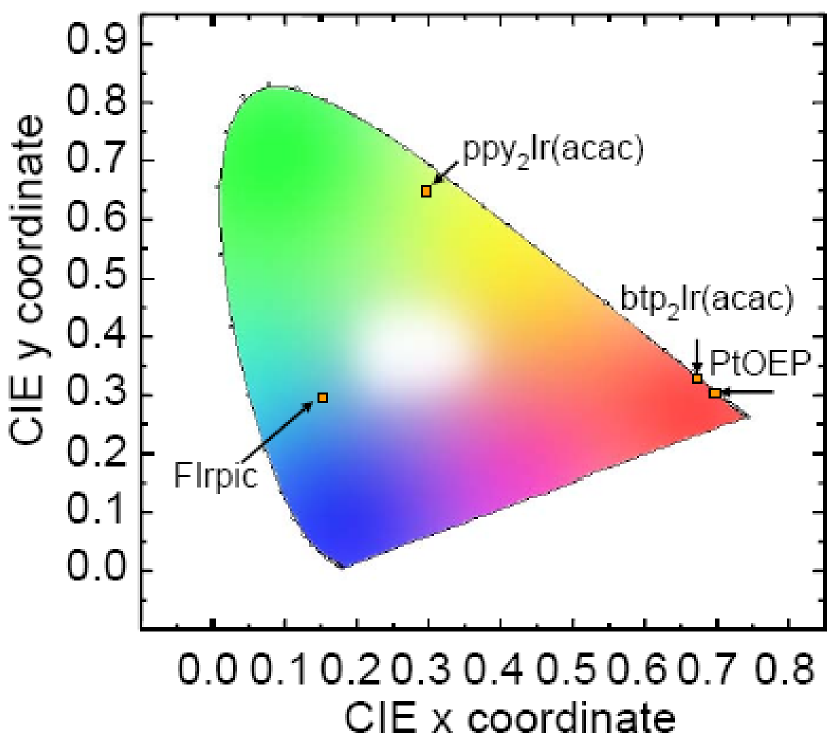


Organic semiconductors

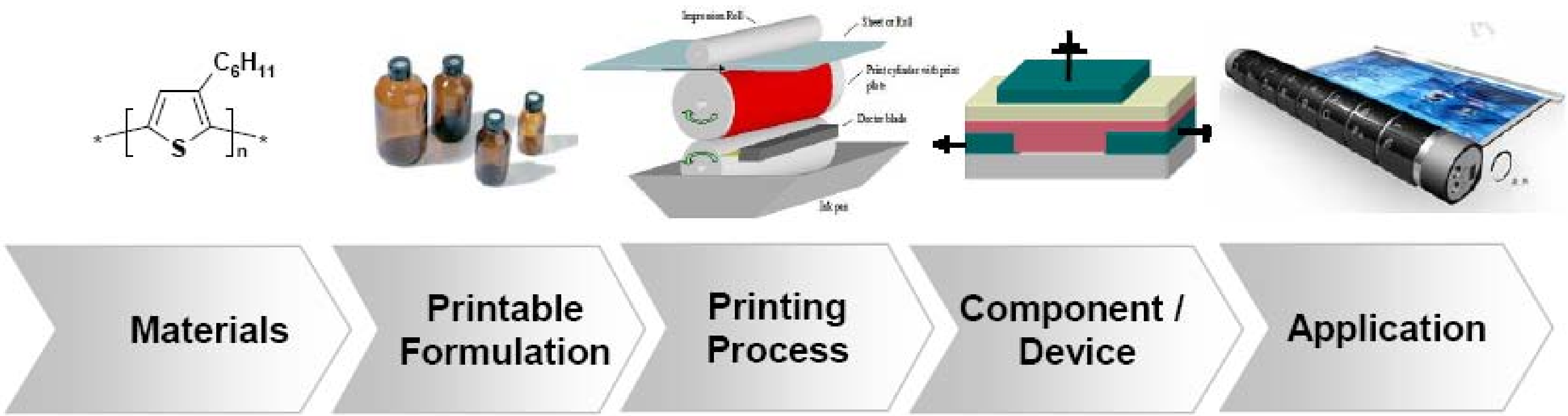


Organic materials cover the entire visible range

COLOR PURITY



Business according to existing applications
Business Model



Processing & Manufacturing

Roll to Roll

Screen printing

Vacuum deposition

Obiettivi temporali di prezzo e prestazioni per OLED (stabilite da DOE, OIDA, NEMA)

	2002	2007	2012	2020
Luminous Efficiency (lm/W)	10	50	150	200
Lifetime (thousands hours)	0.3	5	10	20
Flux (lm per device)	10	3000	6000	12000
Lumen cost ($ per klm)	>200	50	5	<1

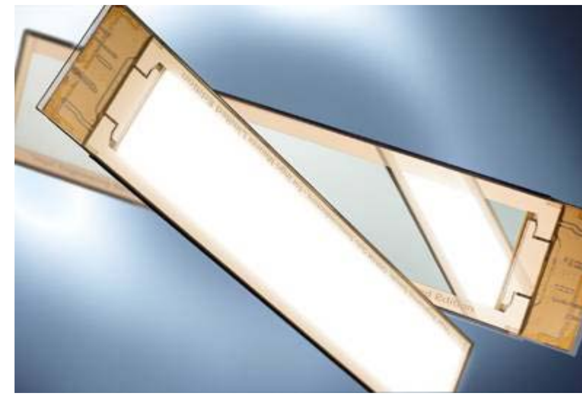
Abbassamento Del costo

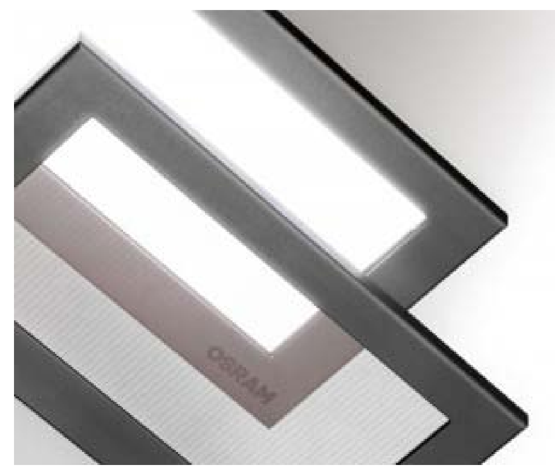
OIDA (Optoelectronics Industry Development Association) – USA

DOE (Department of Energy) – USA

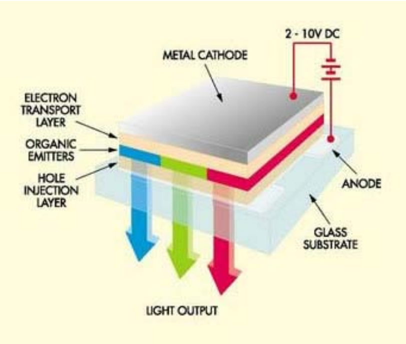
NEMA (National Electrical Manufacturers Association) – USA

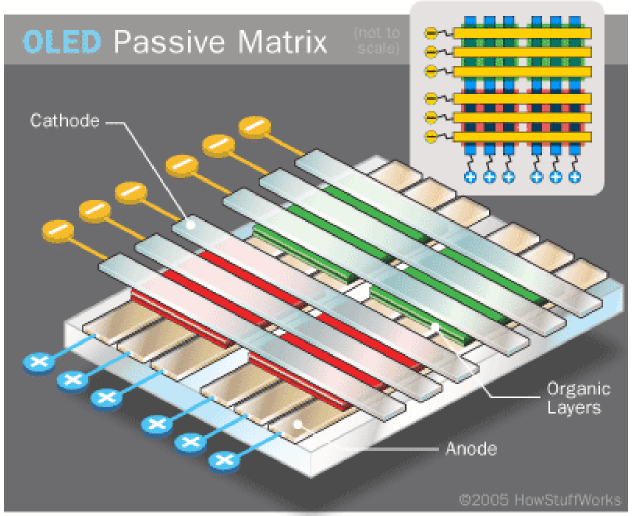
Valorizzare le specificità della tecnologia

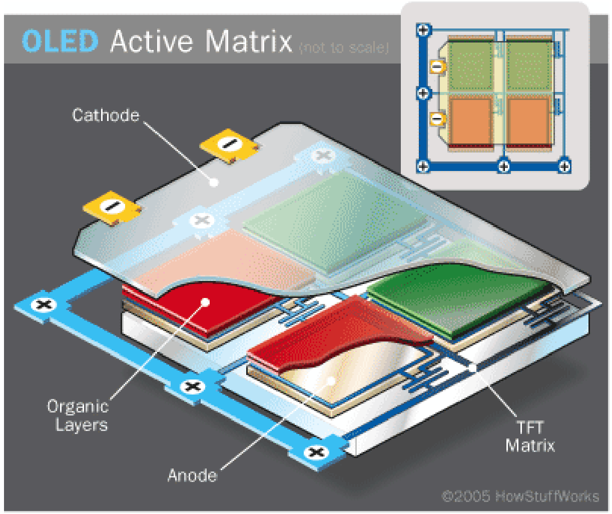




Display OLED





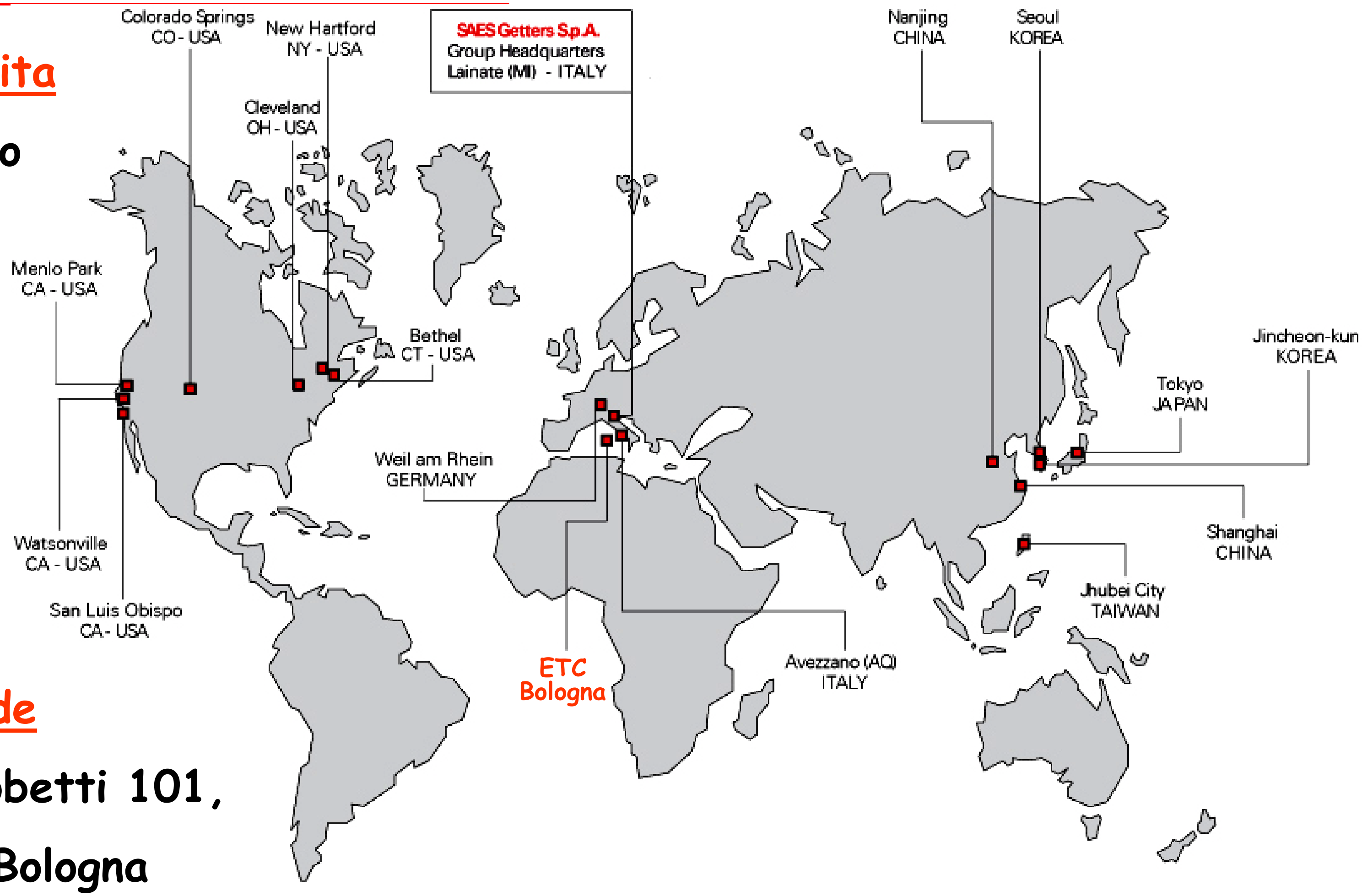


E.T.C. S.r.l.

Data di nascita

12 Febbraio

2010



Sede

Via Piero Gobetti 101,

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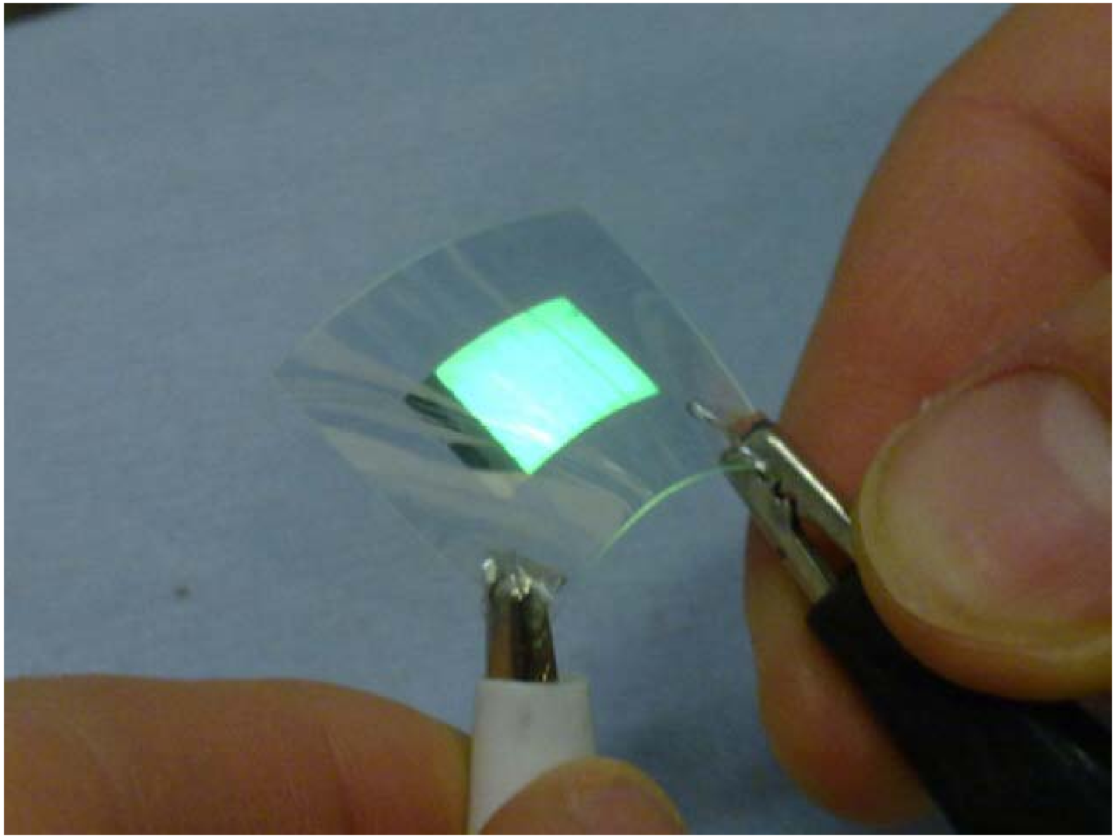
c/o CNR

we support your innovation

ETC FlexOLED Technology



Conclusioni

- La piattaforma tecnologica organica offre un ampio spettro di potenzialità applicative nel campo dell'energia
- La chimica può *giocare* un ruolo fondamentale nello sviluppo della tecnologia OPV R2R
- Il lighting organico può combinare in modo unico efficienza, basso costo e design innovativo
- Le caratteristiche *Knowledge Intensive* dei materiali e della tecnologia organica consente di combinare efficacemente la ricerca pubblica e quella industriale

Grazie per l'attenzione!

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