

Cel·les solars sensitivitzades amb colorant

Dr. Laia Pellejà i Puxeu

Barcelona, 5 novembre 2014

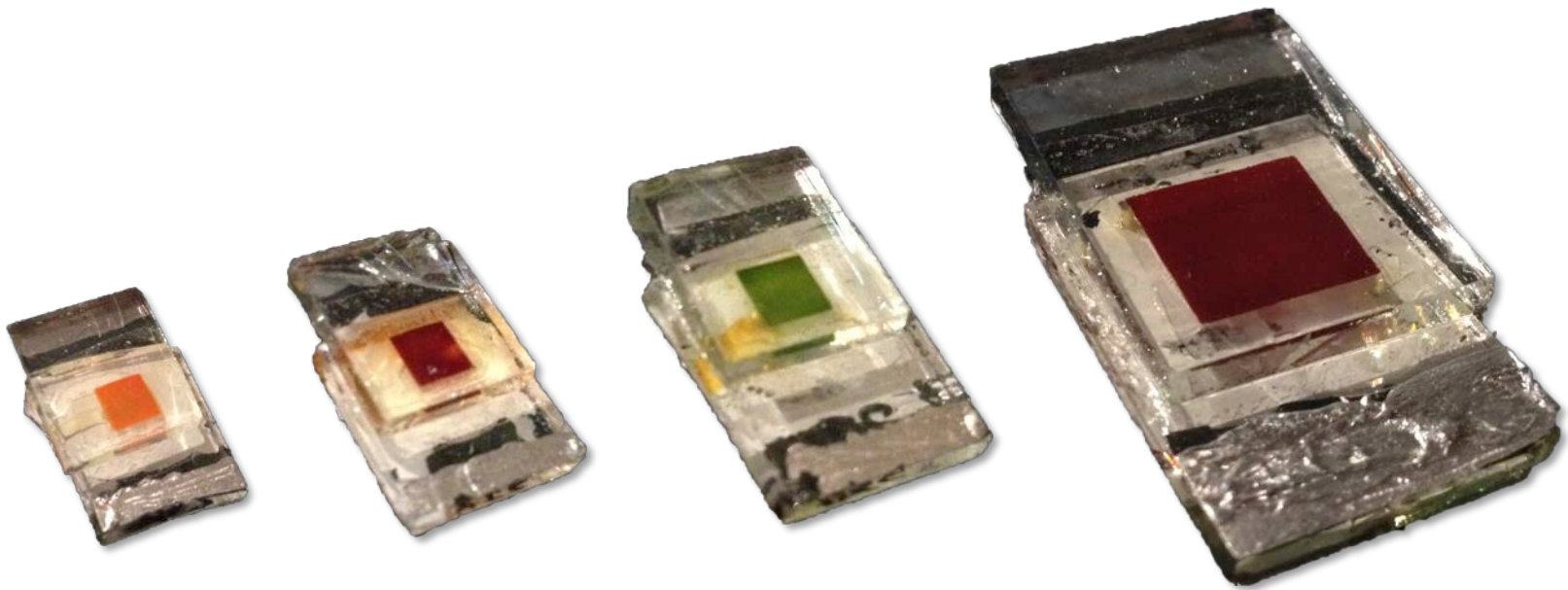


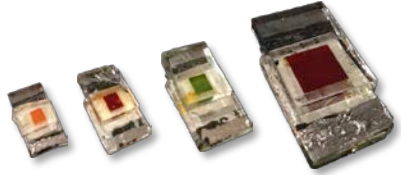
Institut Català
d'Investigació Química



Què són les cel·les solars sensitivitzades amb colorant?

Com funcionen?





A low-cost, high-efficiency solar cell based on dye-sensitized colloidal TiO_2 films

Brian O'Regan* & Michael Grätzel†

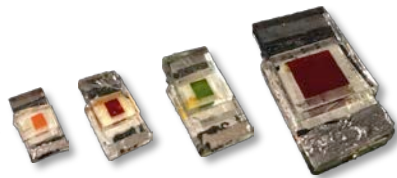
NATURE • VOL 353 • 24 OCTOBER 1991



Michael Grätzel



Brian O'Regan



A low-cost, high-efficiency solar cell based on dye-sensitized colloidal TiO_2 films

Brian O'Regan* & Michael Grätzel†

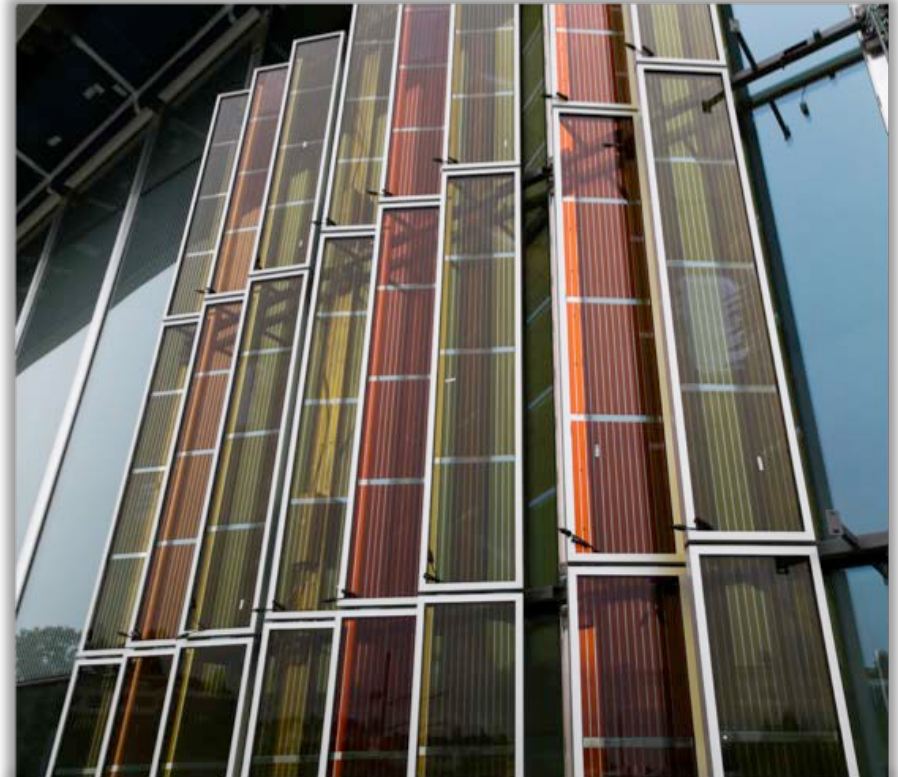
NATURE • VOL 353 • 24 OCTOBER 1991



Michael Grätzel

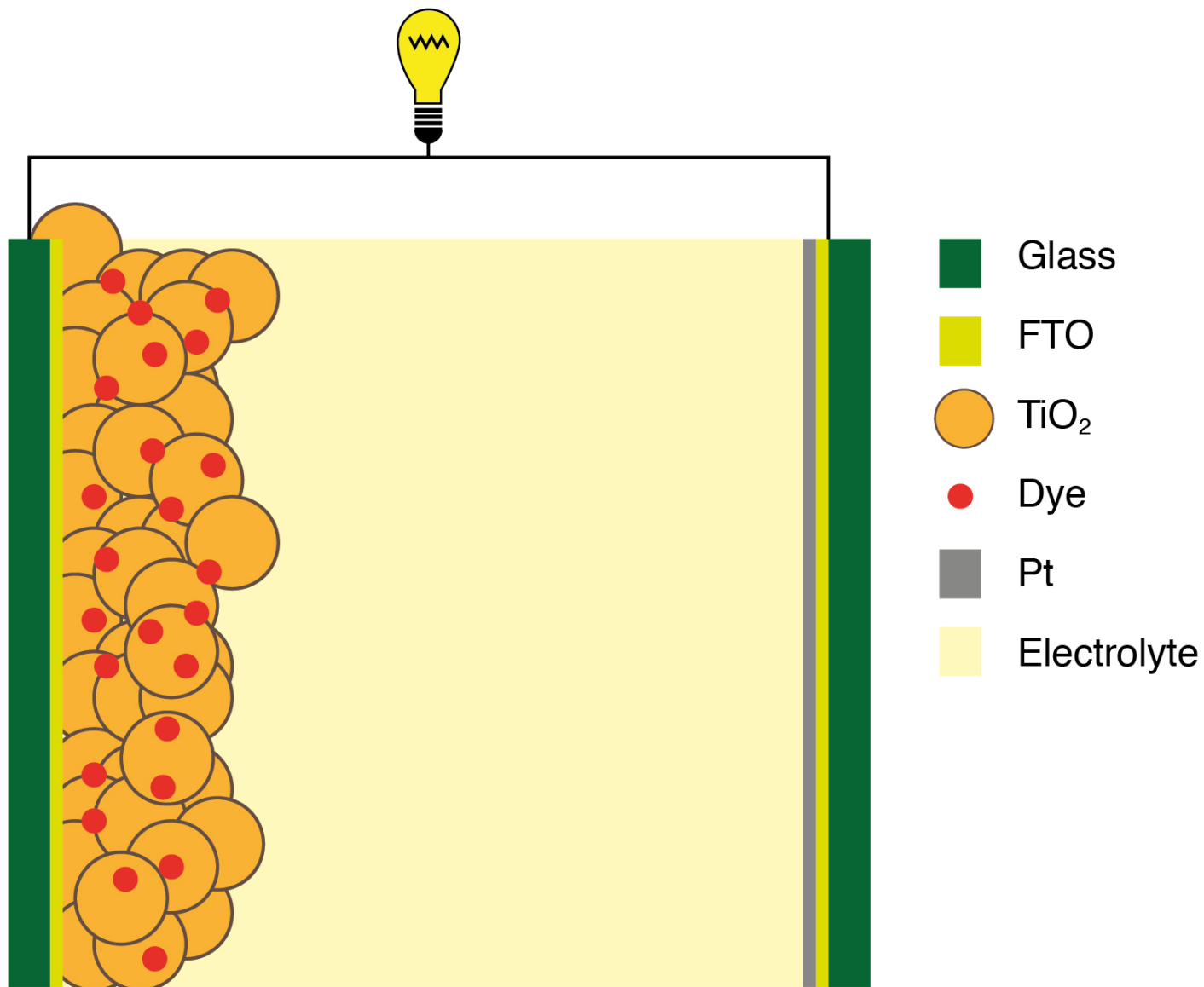


Brian O'Regan

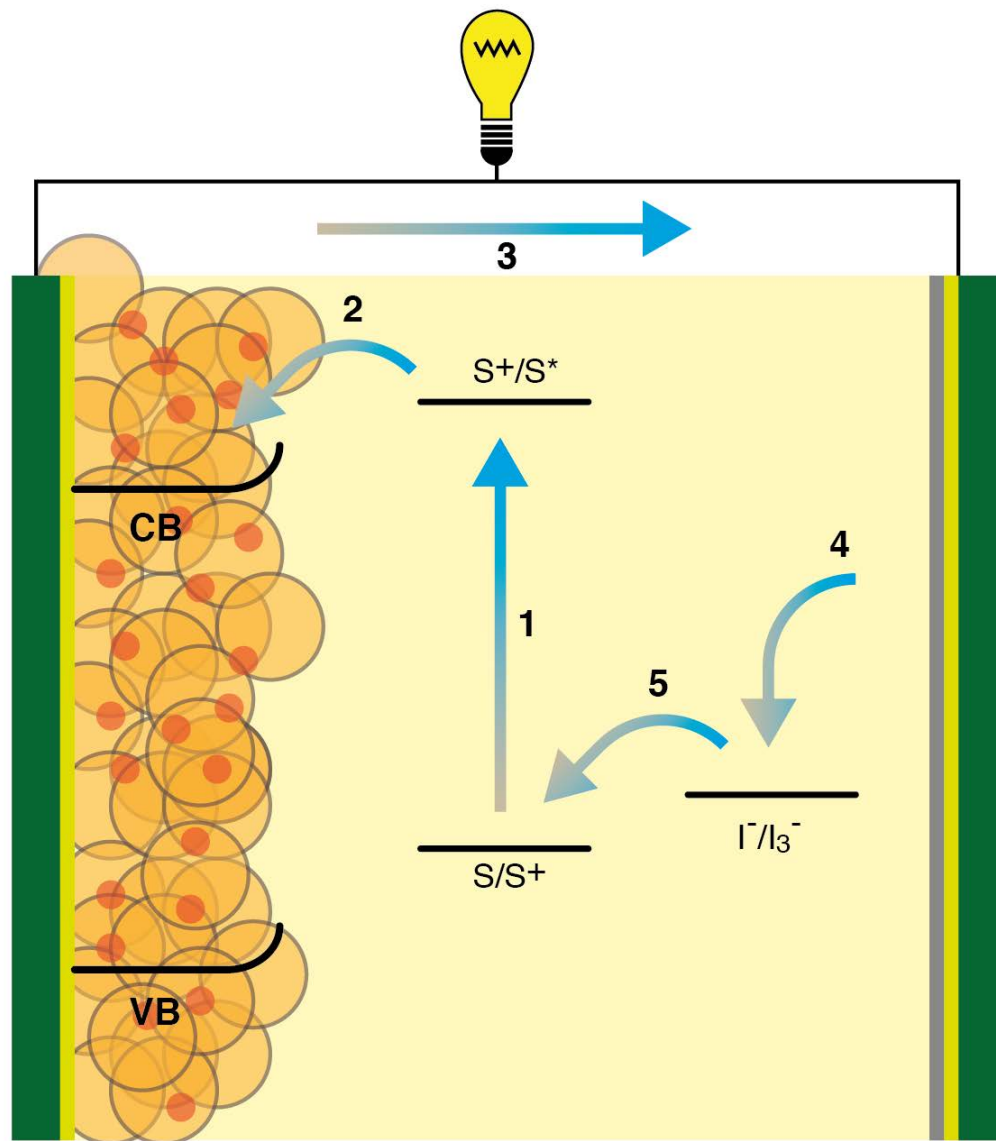


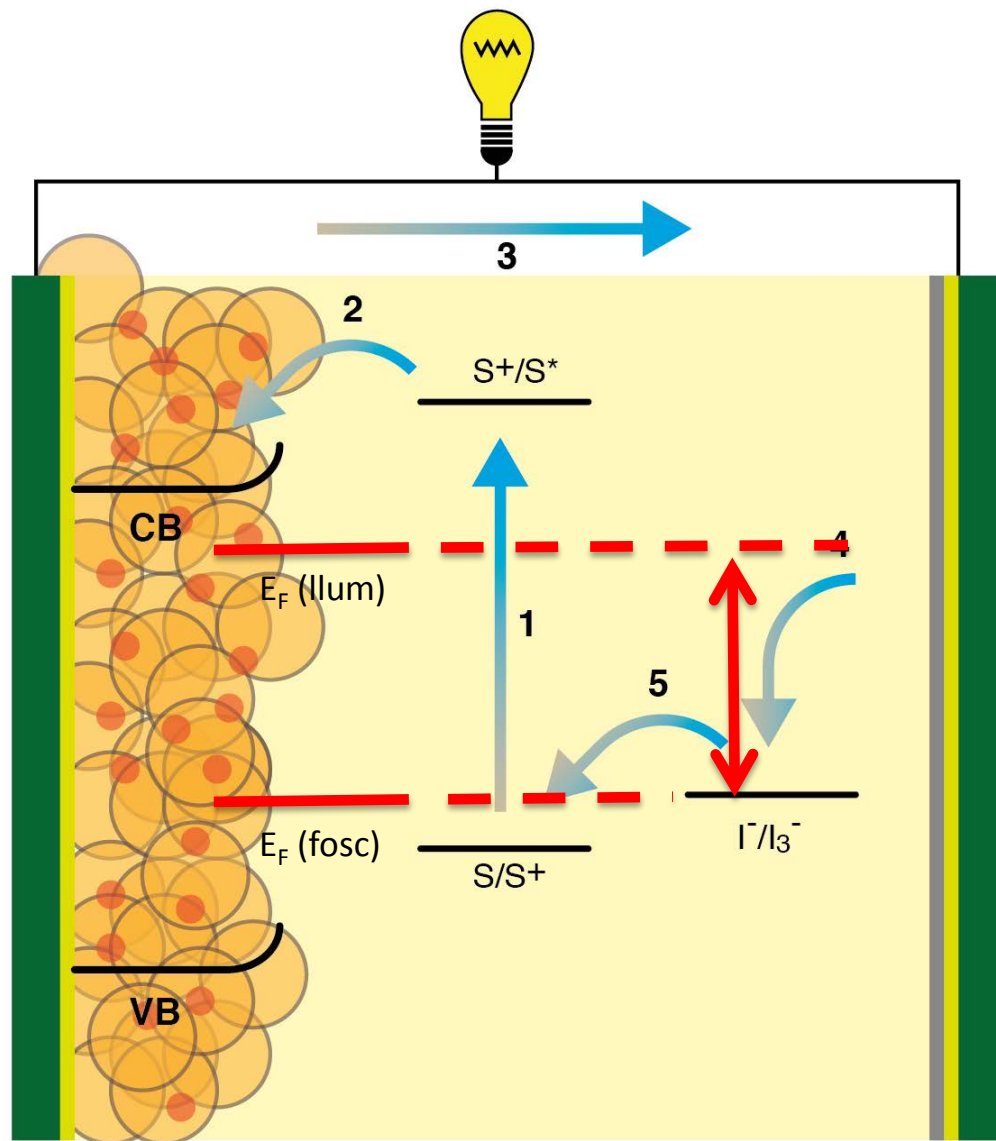
EPFL Convention Center, Lausanne

Representació esquemàtica

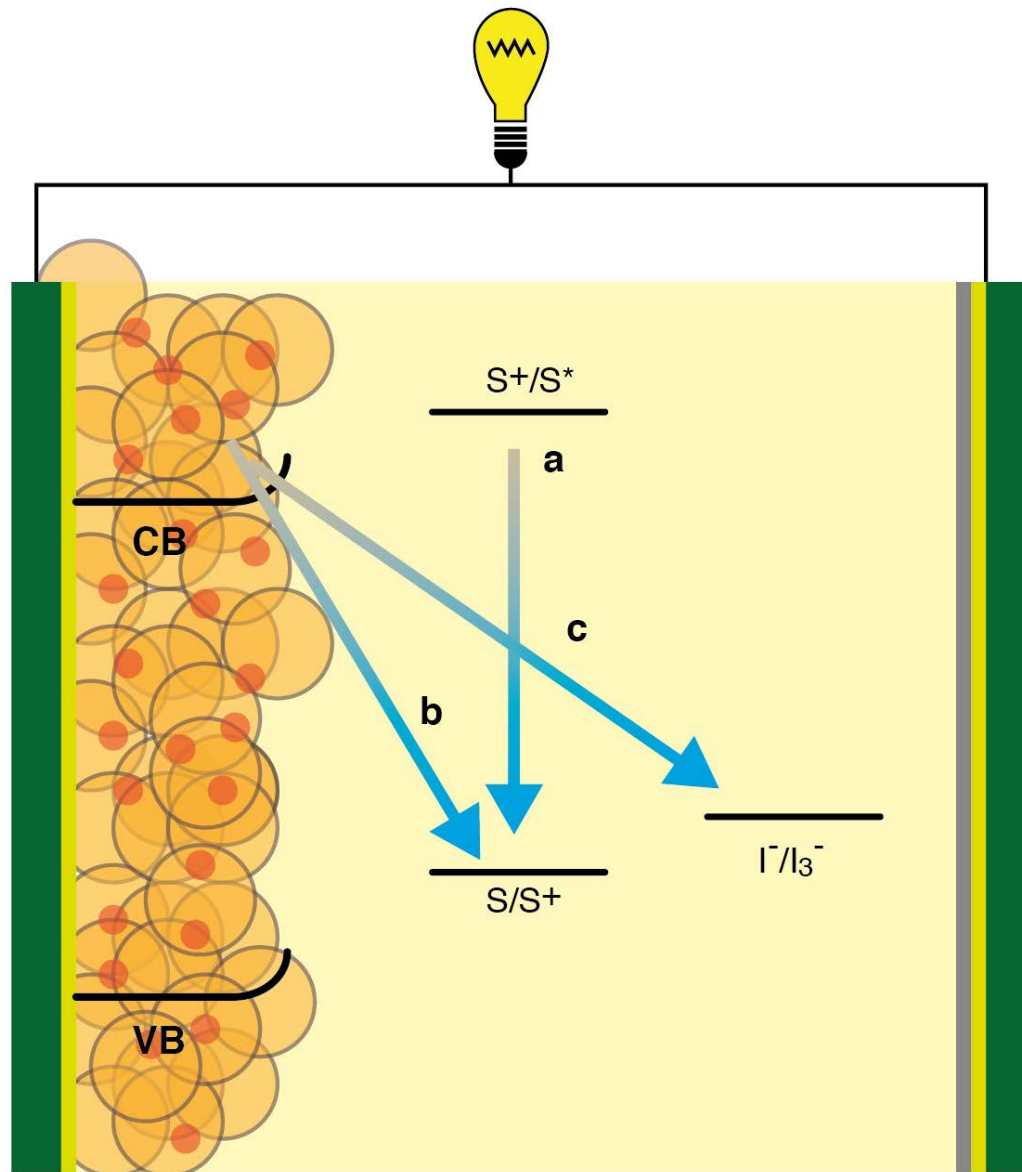


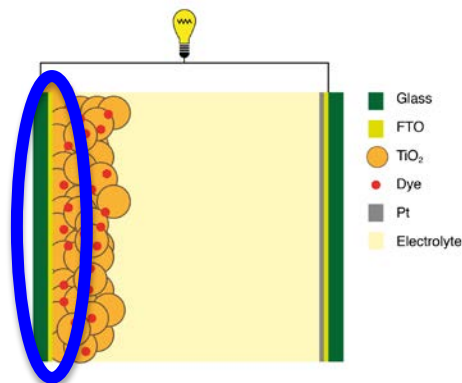
Processos de transferência de carga





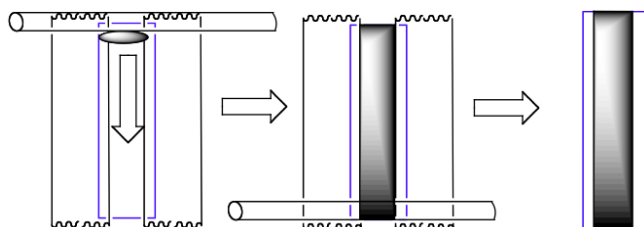
Pèrdues



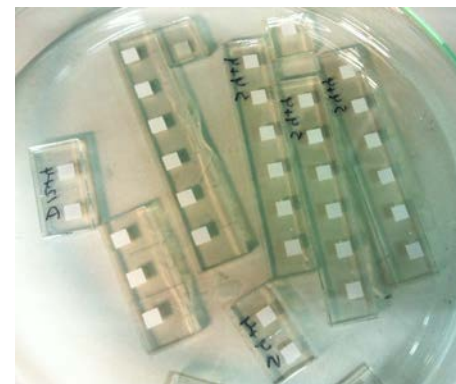


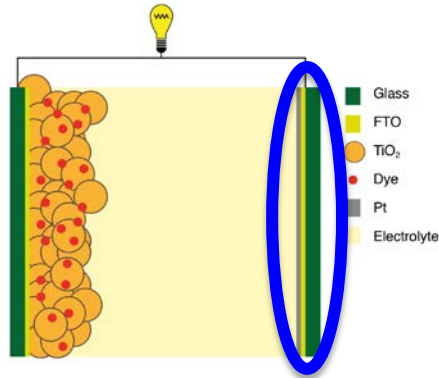
L'elèctrode de treball

- Material conductor transparent : FTO
tractament: neteja, escafament, capa densa TiO_2
- Semiconductor: TiO_2 , ZnO , SnO_2 , SrTiO_3 , ZnO -recobert SnO_2



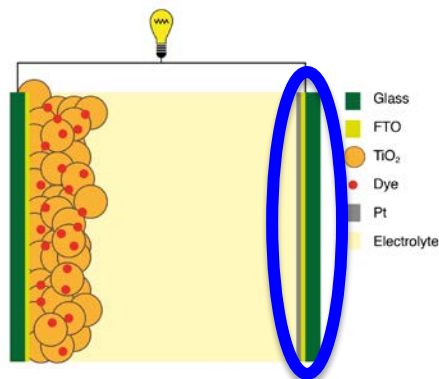
20 nm TiO_2 nanoparticles: 4-12 μm , capa d'absorció de llum
400 nm TiO_2 nanoparticles: 3-4 μm , capa de refractora de la llum
Capa ultrafina de TiO_2 : $\sim 1\text{nm}$





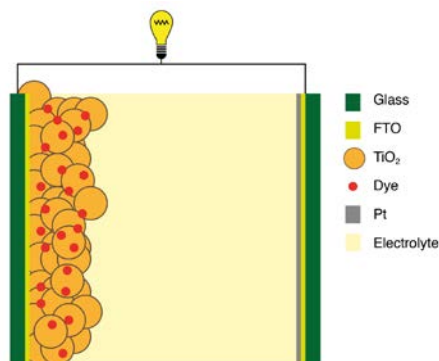
El contraelèctrode

- Material conductor transparent : FTO
tractament: neteja, escalfament
- Capa de resistència baixa: platí, grafit, PEDOT



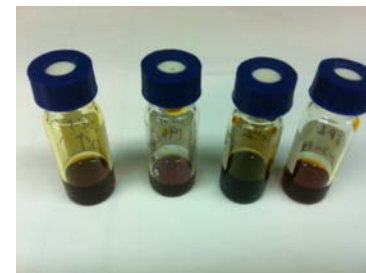
El contraelectrode

- Material conductor transparent : FTO, ITO
tractament: neteja, escalfament
- Capa de resistència baixa: platí, grafit, PEDOT



L'electròlit

- Bon contacte
- Elevada conductivitat
- No ha de degradar ni deabsorbir el colorant
- Estable
- Potencial redox apropiat

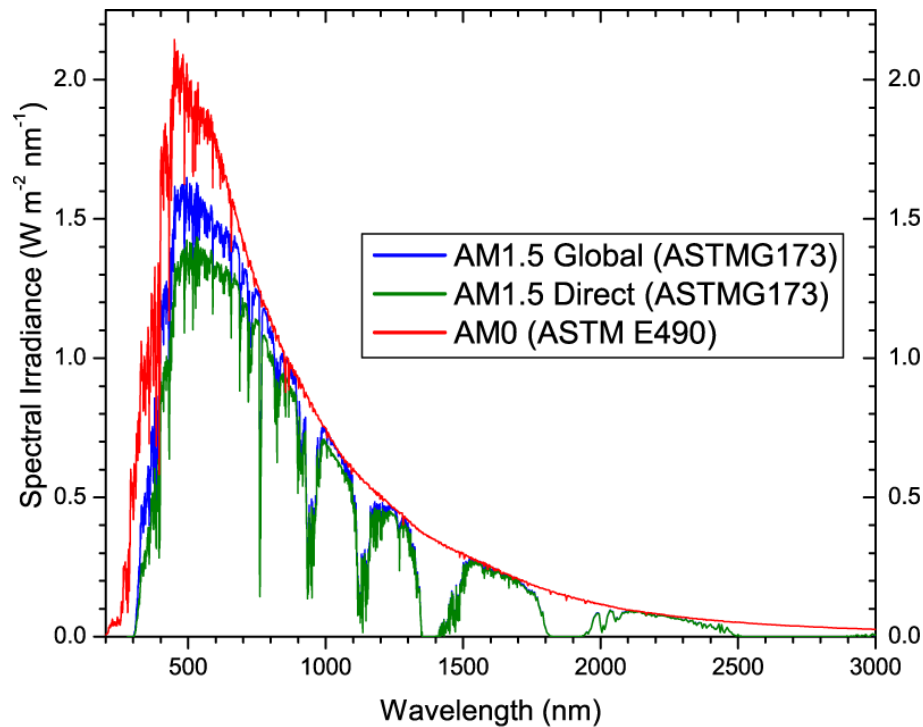


Elevat nombre de parelles redox: I^-/I_3^- , $Co(II)/Co(III)$, $SeCN^-/(SeCN)_3^-$, polímers orgànics i molècules orgàniques petites.

Mètodes Experimentals

El colorant

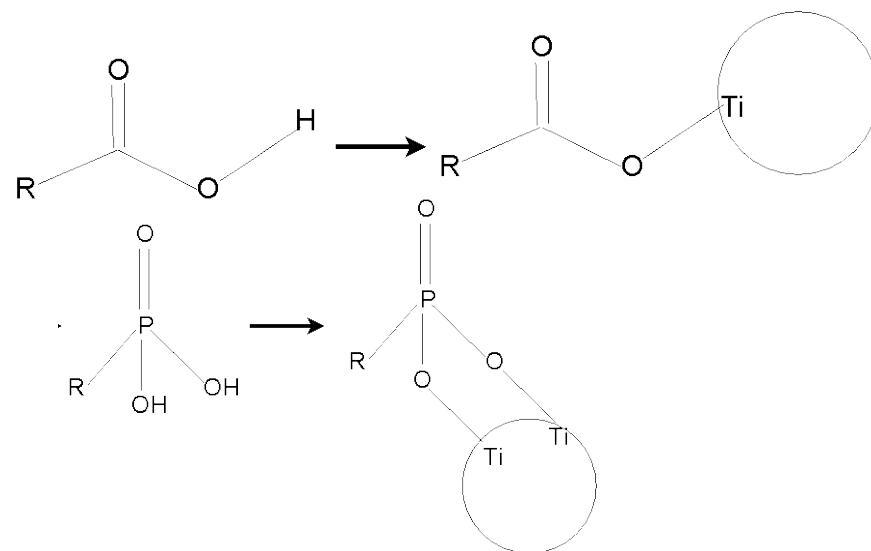
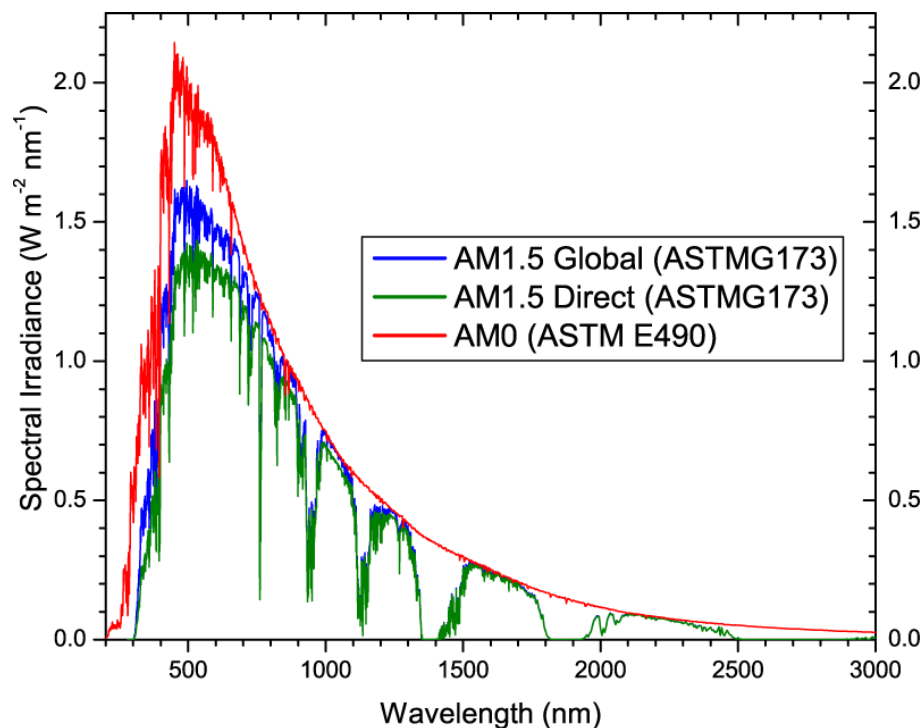
- Absorbir llum en l'espectre visible
- Enllaç fort
- Distància apropiada HOMO-LUMO
- Estable



Mètodes Experimentals

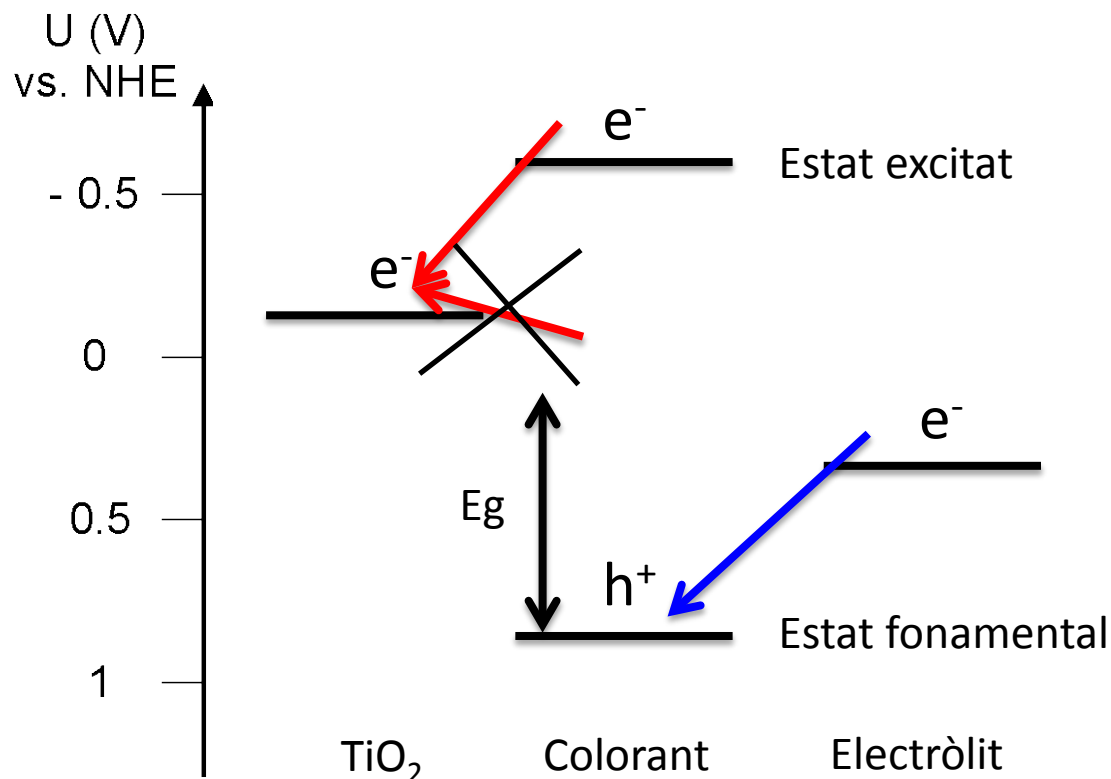
El colorant

- Absorbir llum en l'espectre visible
- Enllaç fort
- Distància apropiada HOMO-LUMO
- Estable



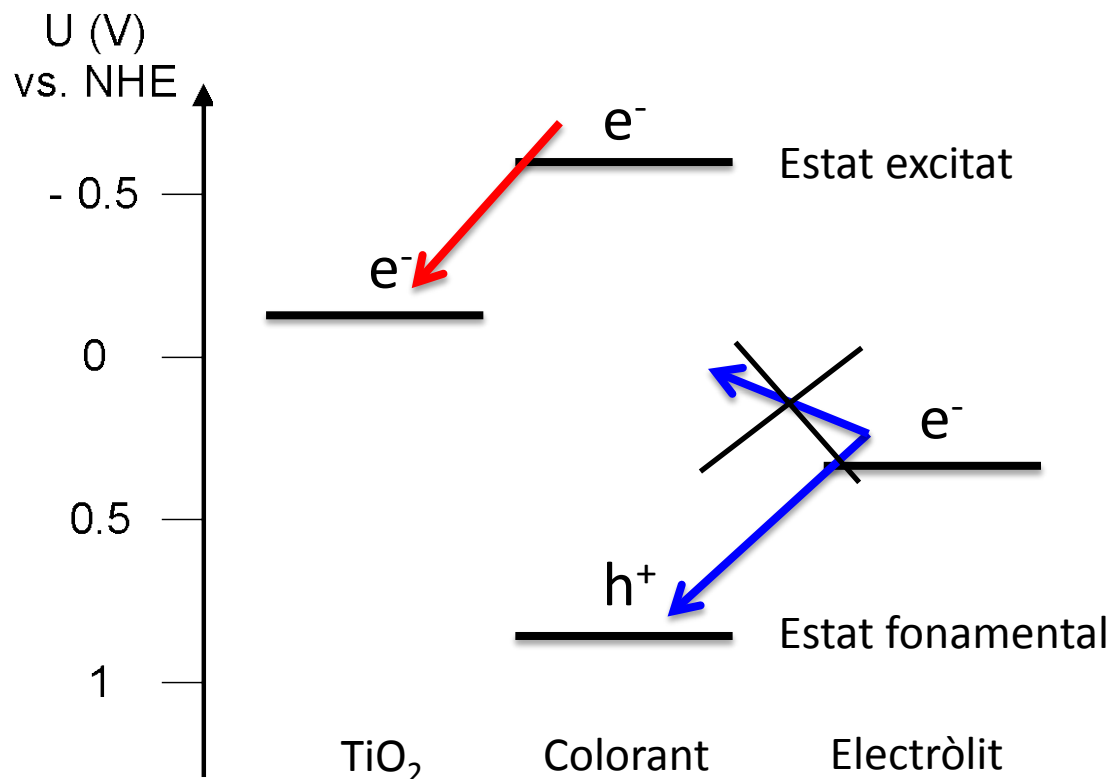
El colorant

- Absorbir llum en l'espectre visible
- Enllaç fort
- Distància apropiada HOMO-LUMO
- Estable



El colorant

- Absorbir llum en l'espectre visible
- Enllaç fort
- Distància apropiada HOMO-LUMO
- Estable



El colorant

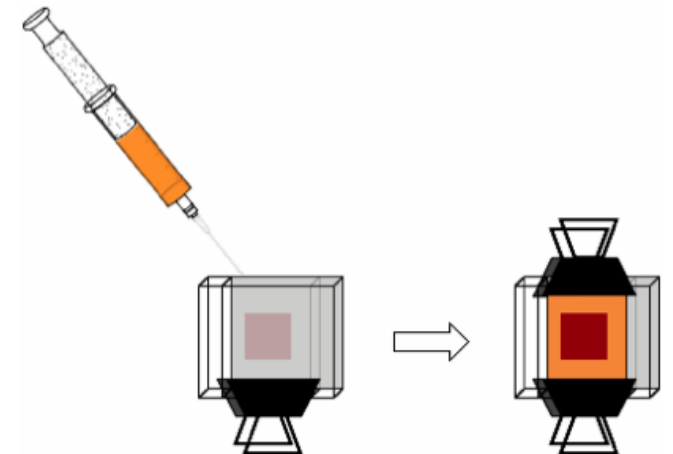
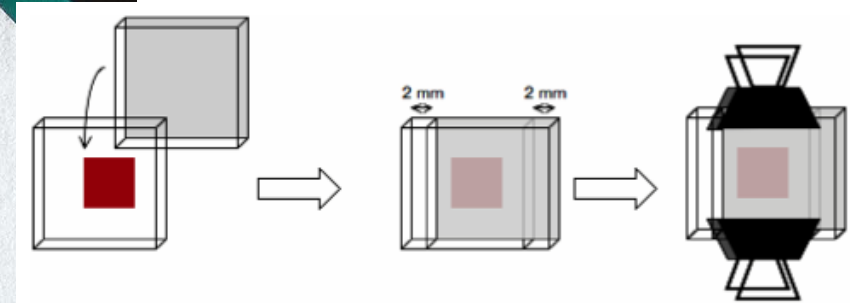
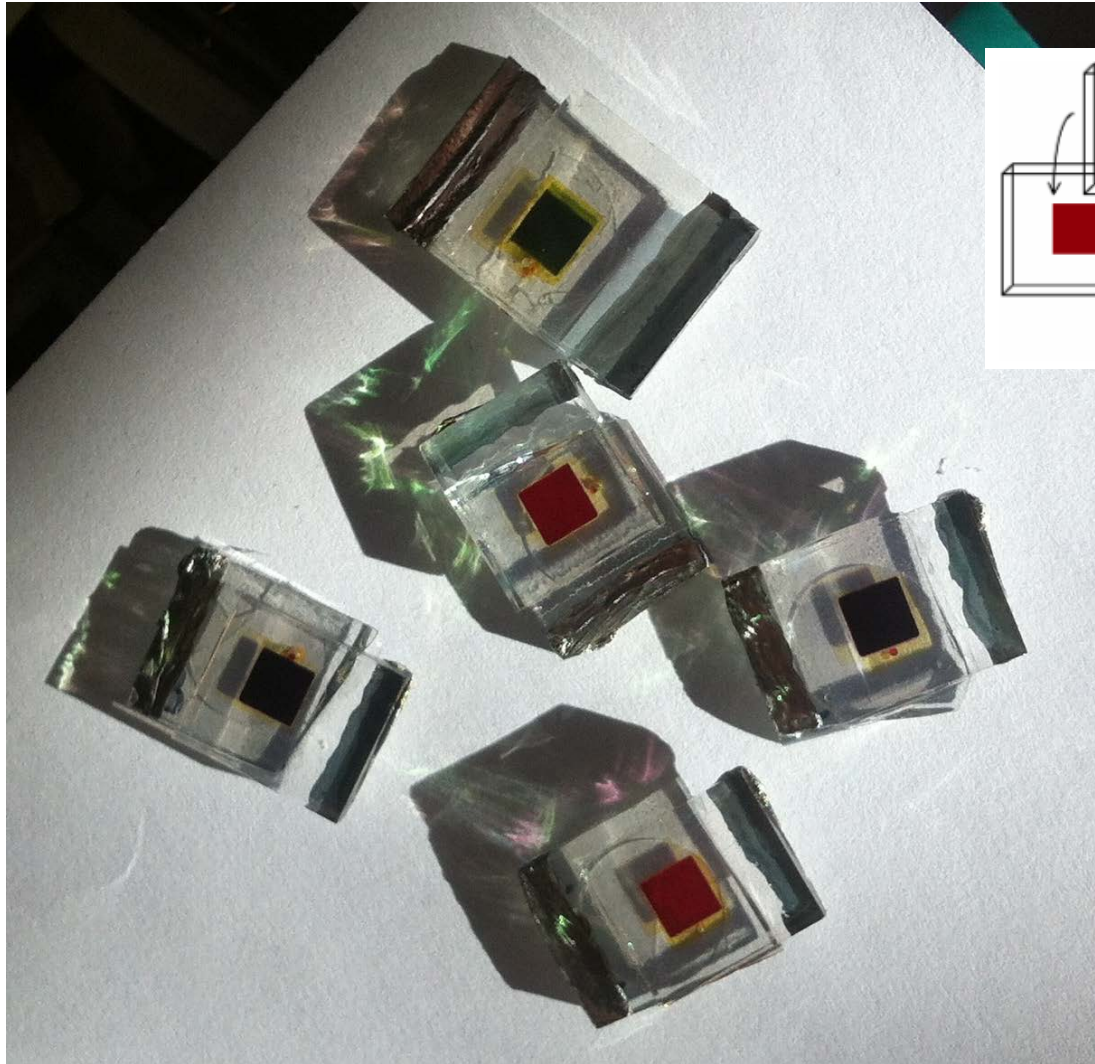
- Absorbir llum en l'espectre visible
- Enllaç fort
- Distància apropiada HOMO-LUMO
- Estable



Paràmetres a optimitzar en una DSCs:

- Grossor de les capes de TiO_2
- Composició electròlit
- Concentració de colorant i dissolvent
- Ús de co-adsorbents
- Ús de capa de bloqueig

Assemblatge del dispositiu

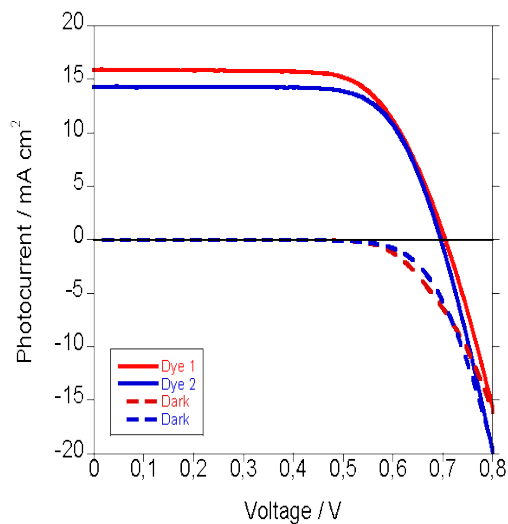


Caracterització dels dispositius

Power Conversion Efficiency

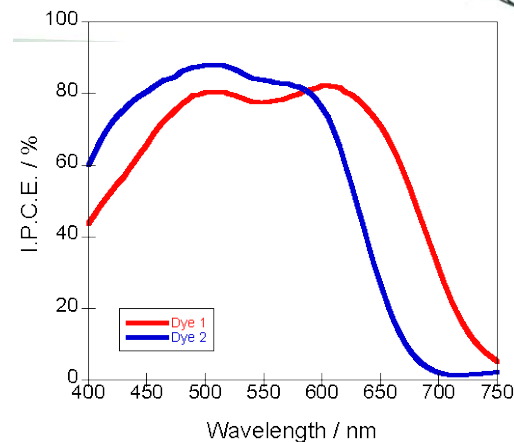
$$J_{sc} = \frac{I_{sc}}{\text{Area cell}}$$

$$\eta = \frac{J_{sc} \cdot V_{oc} \cdot FF}{P_{light}}$$



IPCE

$$IPCE(\lambda) = \frac{1240 \cdot J_{sc}(\lambda)}{\lambda \cdot P_{light}(\lambda)}$$

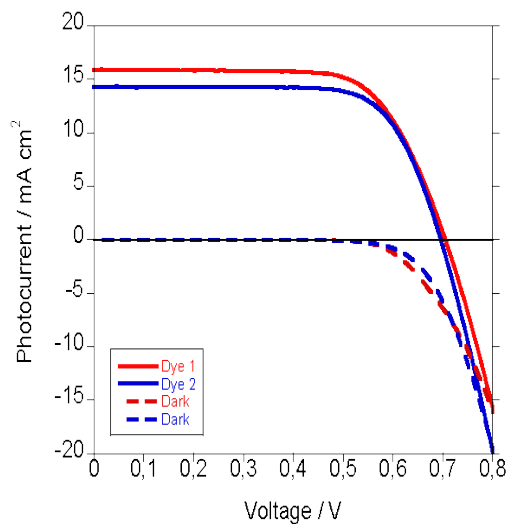


Caracterització dels dispositius

Power Conversion Efficiency

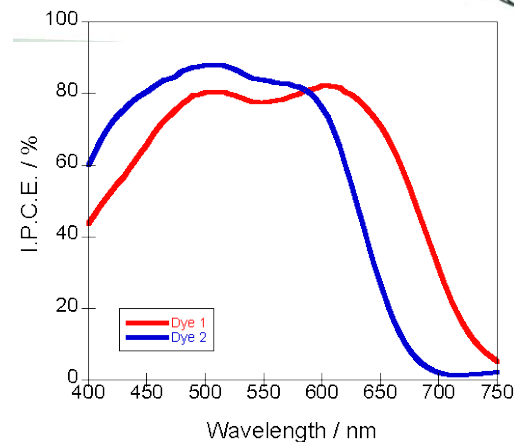
$$J_{sc} = \frac{I_{sc}}{\text{Area cell}}$$

$$\eta = \frac{J_{sc} \cdot V_{oc} \cdot FF}{P_{light}}$$

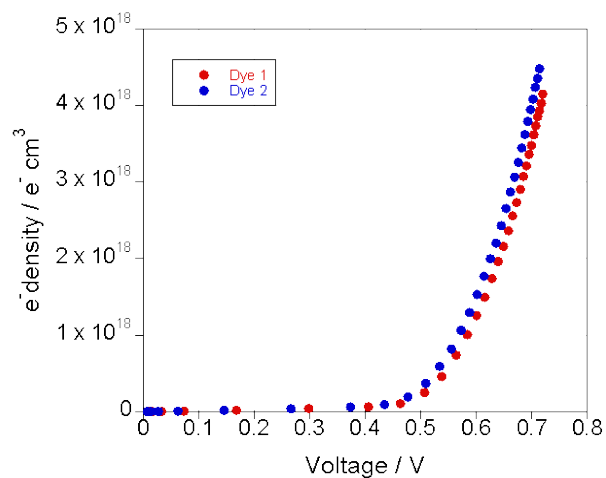
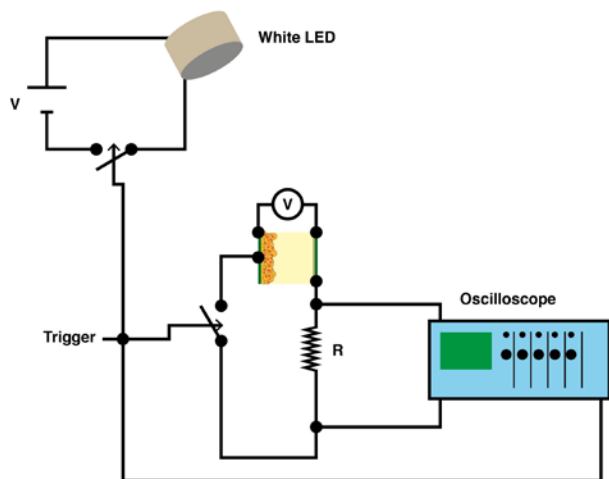


IPCE

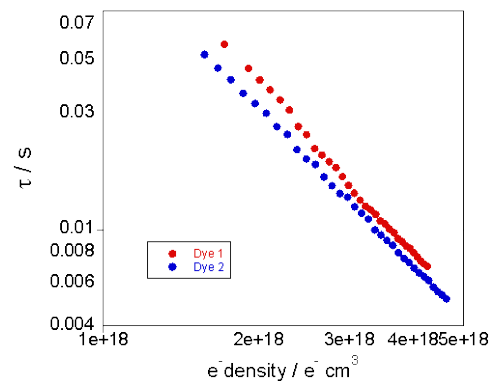
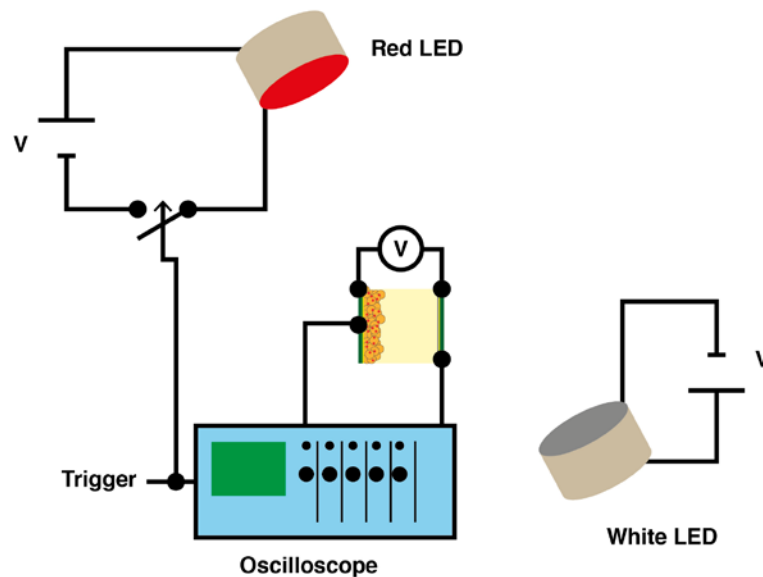
$$IPCE(\lambda) = \frac{1240 \cdot J_{sc}(\lambda)}{\lambda \cdot P_{light}(\lambda)}$$



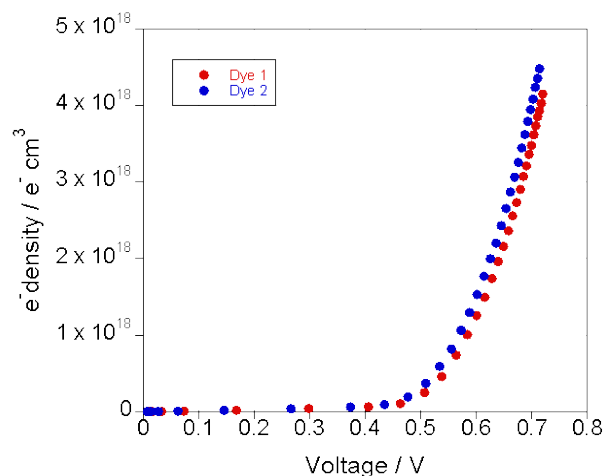
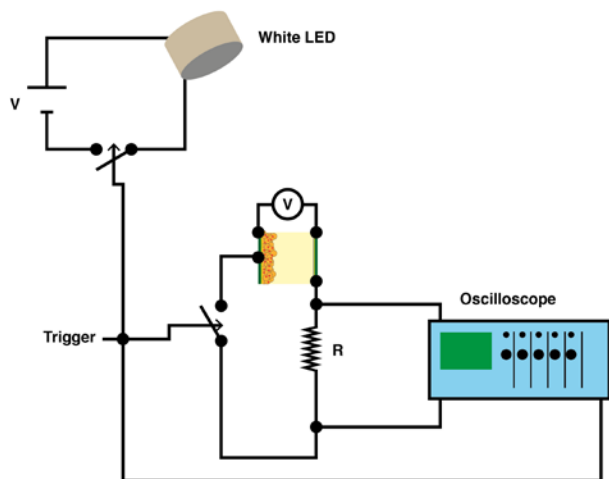
Mesures d'extracció de càrrega



Mesures de transients fotovoltaïcs

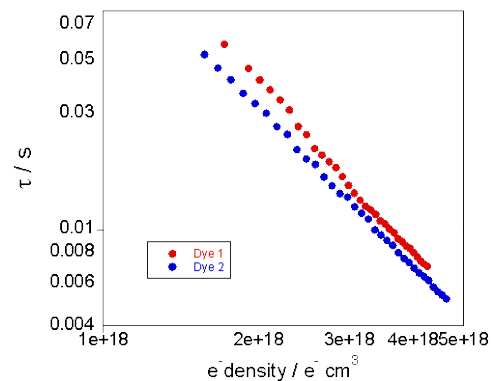
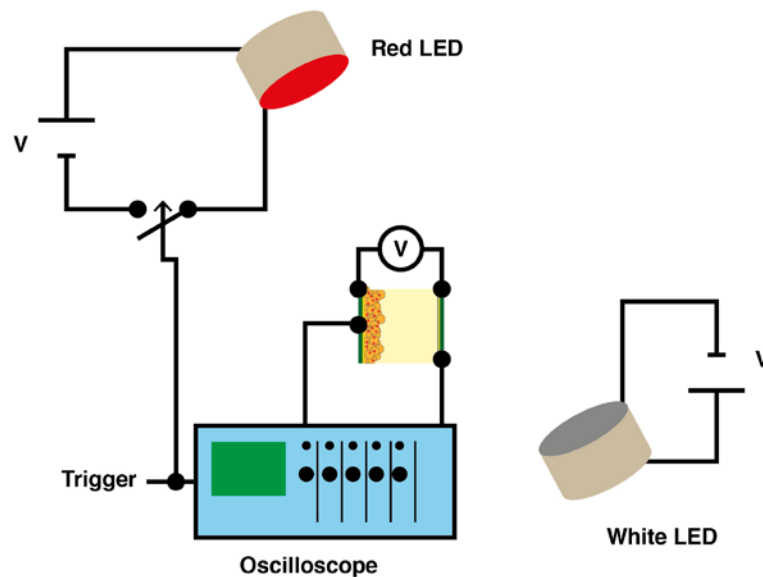


Mesures d'extracció de càrrega

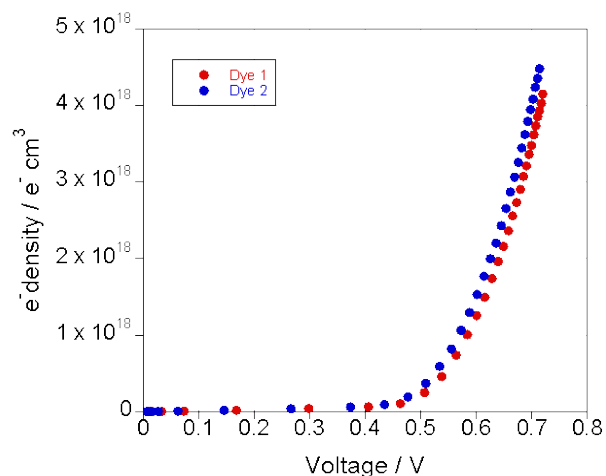
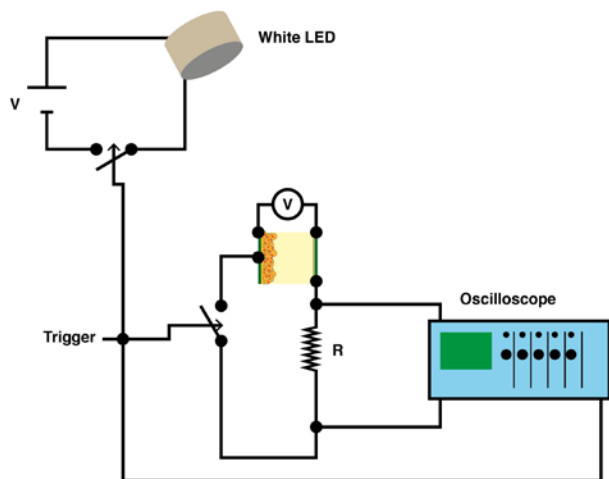


O'Regan, B.; Scully; Mayer, A. C.; Palomares, E.; Durrant, J., *J. Phys. Chem. B* **2005**, *109*, 4616-4623

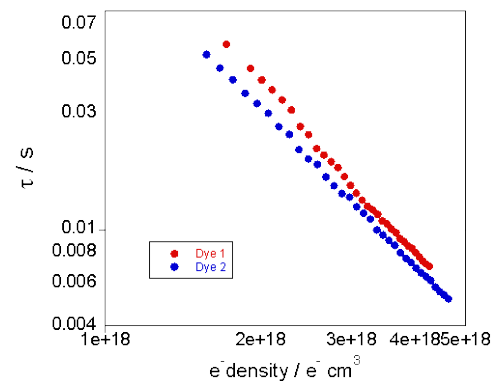
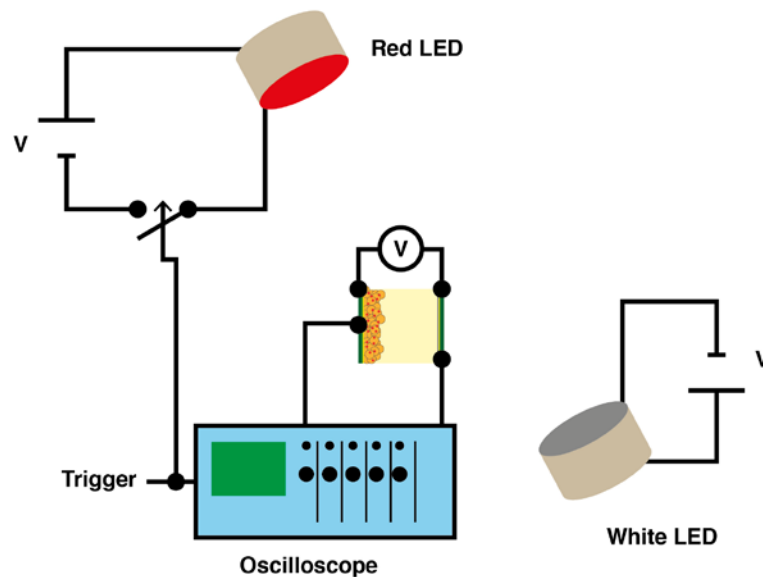
Mesures de transients fotovoltaïcs



Mesures d'extracció de càrrega



Mesures de transients fotovoltaïcs

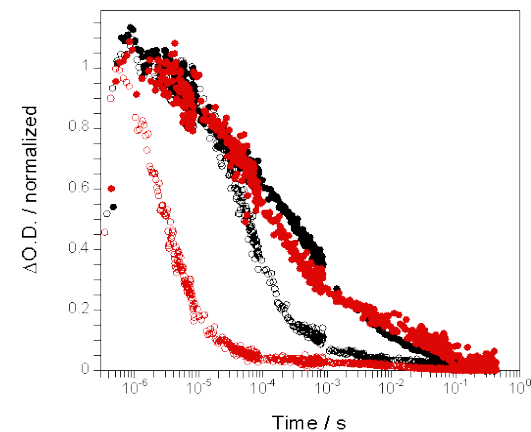
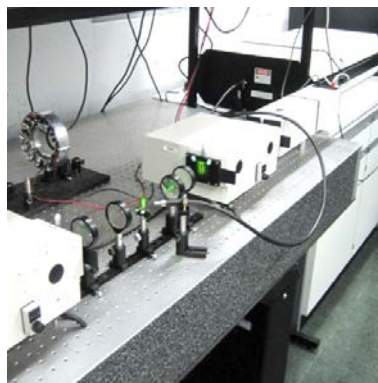
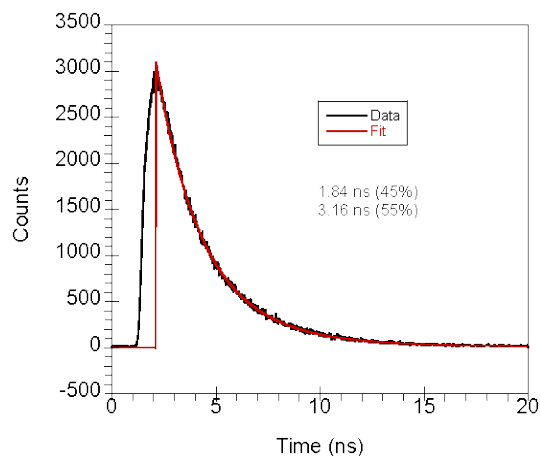
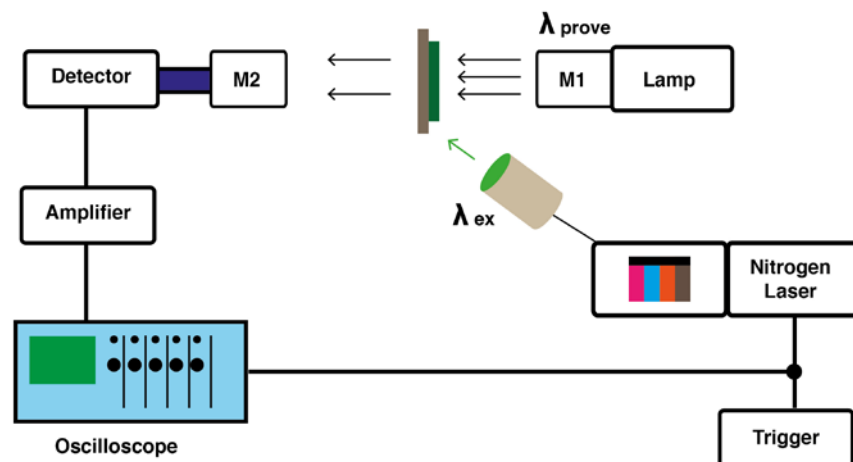


Mètodes Experimentals

Time correlated single-photon counting measurements

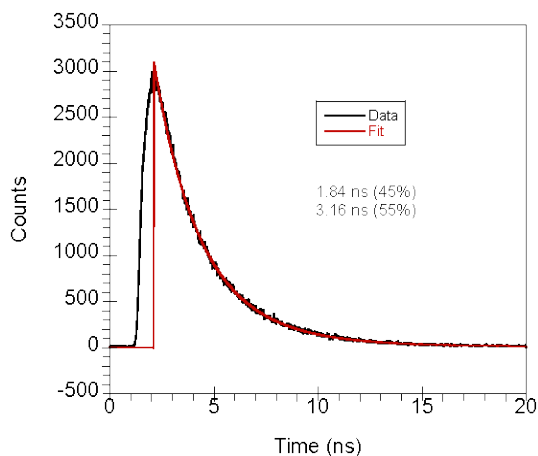
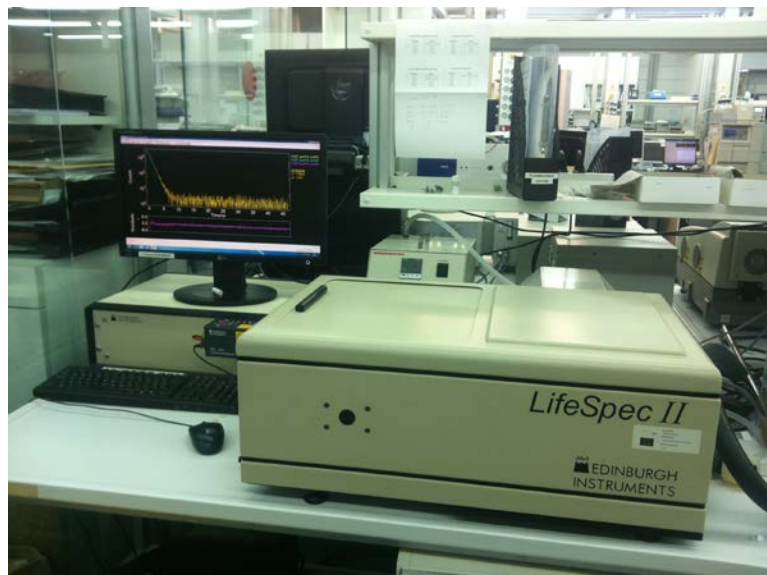


Laser-transient absorbance spectroscopy

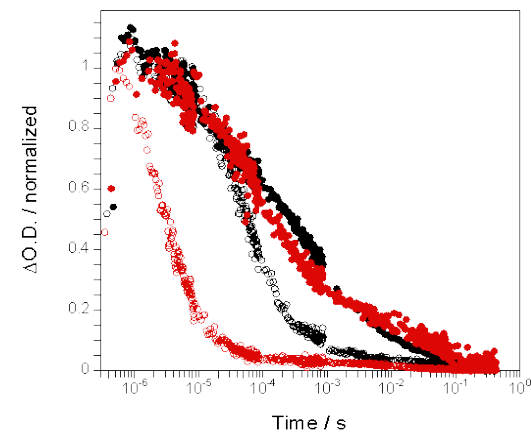
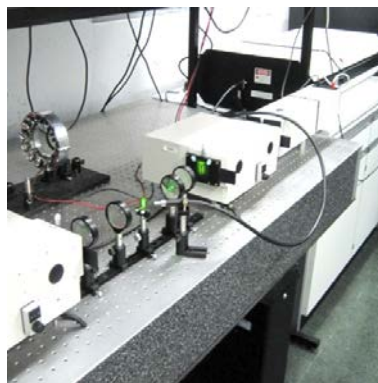
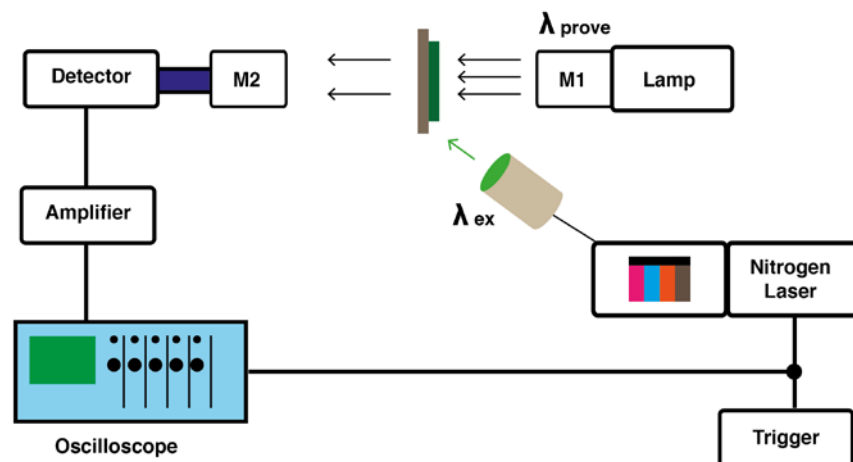


Mètodes Experimentals

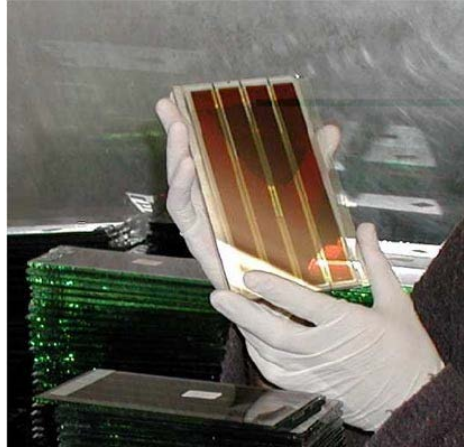
Time correlated single-photon counting measurements



Laser-transient absorbance spectroscopy



Aplicaciones

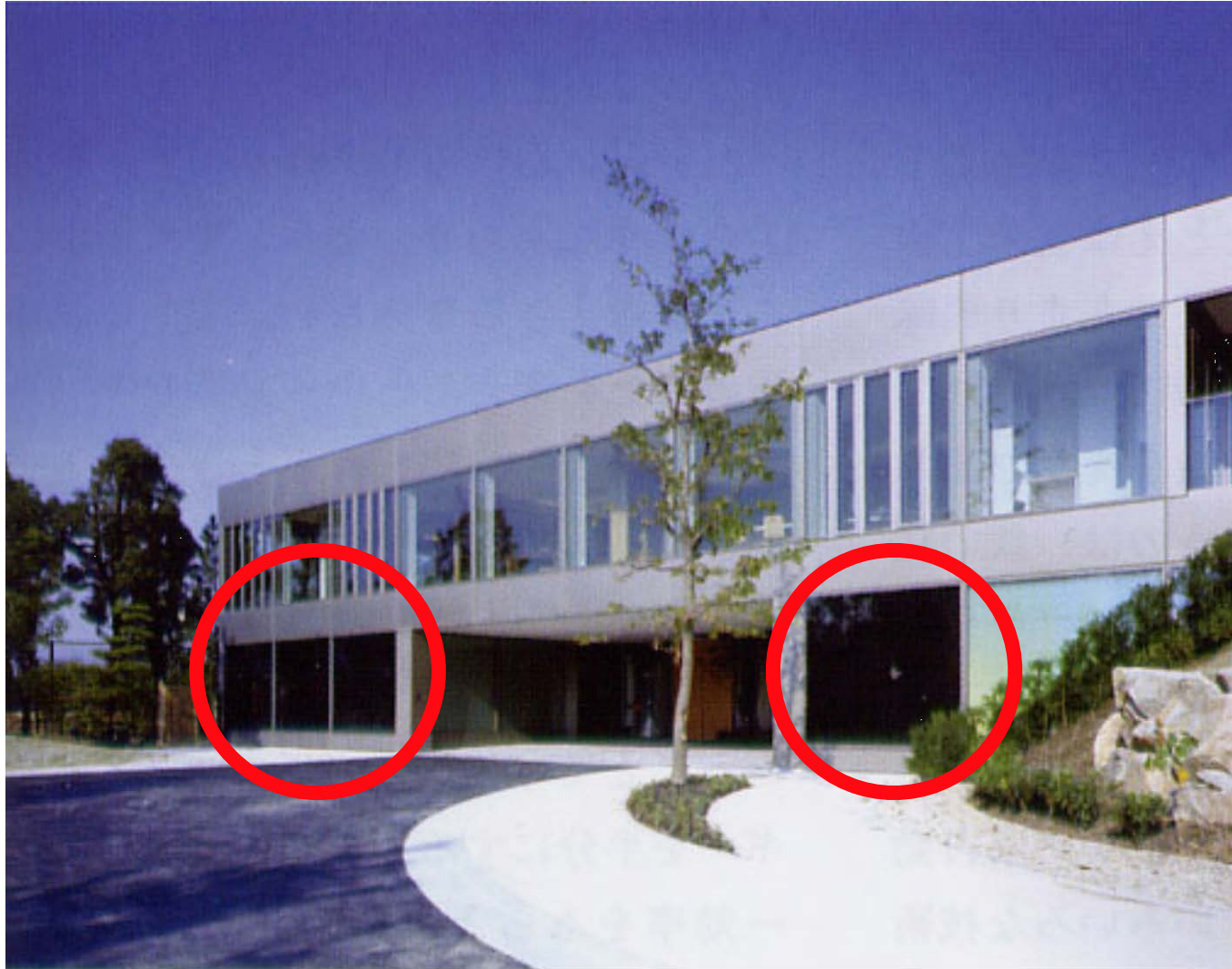


DYESOL™
GROUP of COMPANIES
Global Leaders in Dye Solar Cell Technology



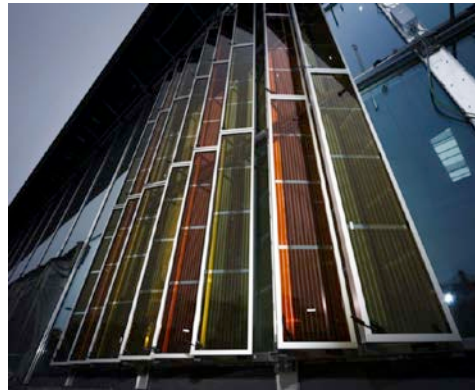
AISIN, SEIKI Co. y TOYOTA Central R&D Laboratories Inc. (2004)

Aplicaciones



The TOYOTA Dream House

Aplicaciones

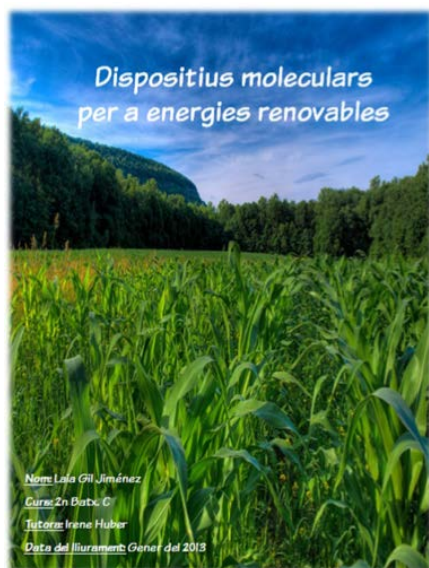
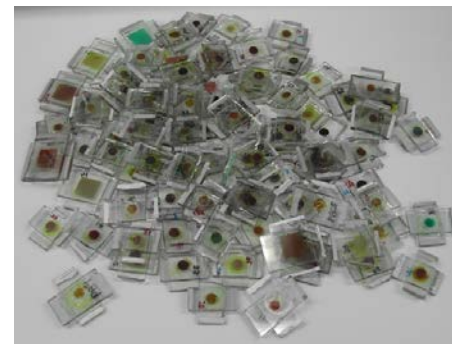


EPFL Convention Center
Lausana (Suïssa)

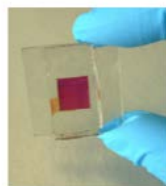




- Importància de les energies renovables.
- Coneixement d'una nova tecnologia.
- Interdisciplinar: tanta física com química.

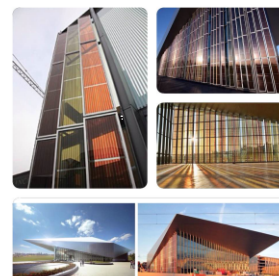


CEL·LES SOLARS SENSIBILITZADES AMB COLORANT



Autor: David Millan Santos
Tutor: Florenci Sales Vilalta
Curs: 2n BAT
Anys: 2011 - 2012
Institut Sol-de-Riu (Aleanar)

Cel·les solars de Grätzel



Irene Martos Mafé
2n BAT- A
Tutora: Josepa Baz



Gràcies per la vostra atenció!