DYE SOLAR CELLS

Subject:
ET1039: Nanotechnology

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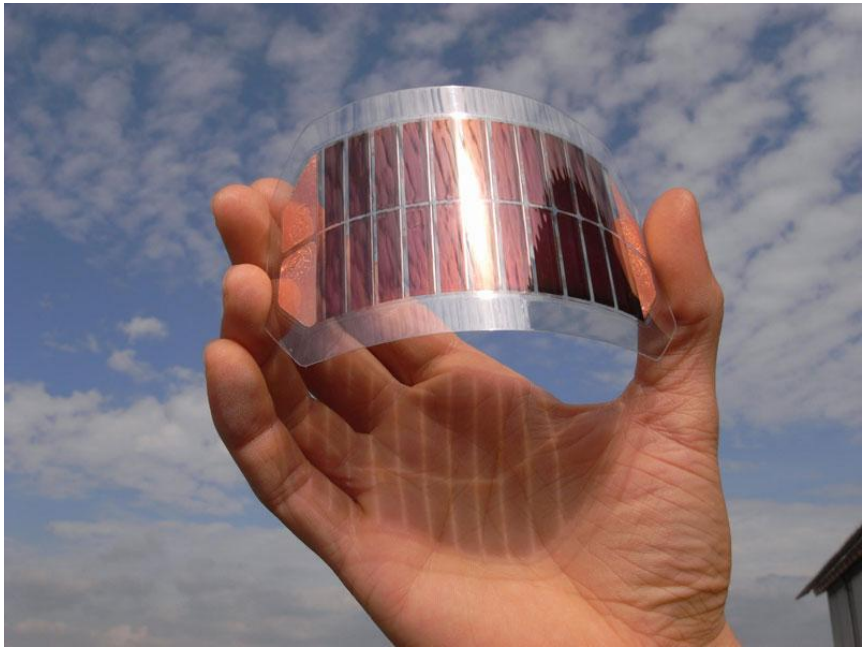
Introduction

- Renewable and solar energy
- It transforms solar energy to electricity with a REDOX process.

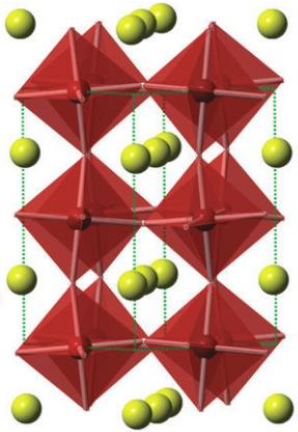


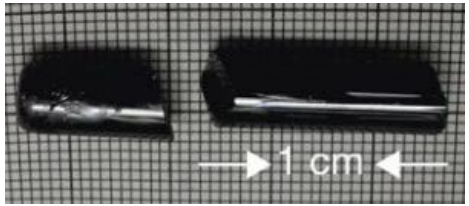
History

- The inventors: 1988, Brian O'Regan and Michael Grätzel
- A lot of investigations and publications to improve:
  - Efficiency, 15-10%
  - Losses
  - Adaptation

Interesting improvements

- In 2007, Wayne Campbell, realized organic dyes based on porphyrin
- Porphyrin was used like a synthetic dye solution
- Porphyrin is a component of the chlorophyll used by plants on photosynthesis
- This DSC's can work on cloudy conditions





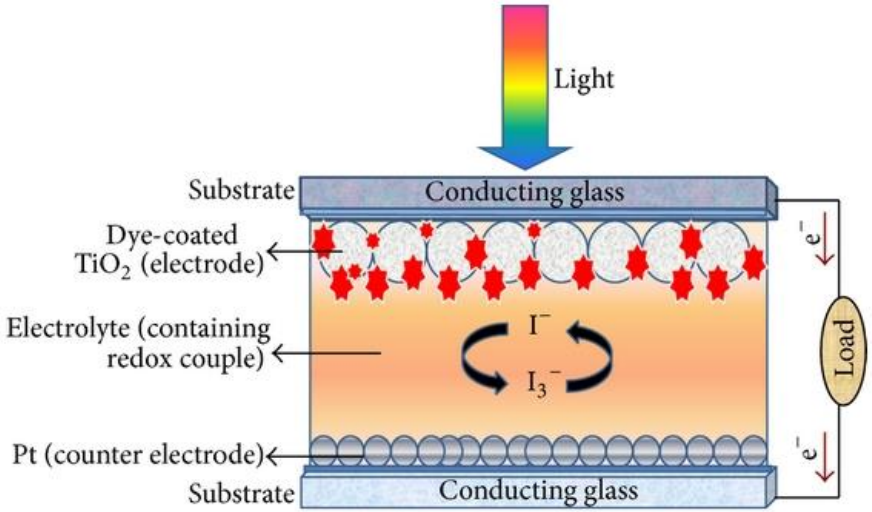
- In 2012, Northwestern University researchers solved lifetime problems.
- They used a solid electrolyte to avoid liquid losses.
- Is a perovskite formed by Cesium, tin and iodine, called

(CsSnI3)

Parts of a dye solar cell

Conductive glass:

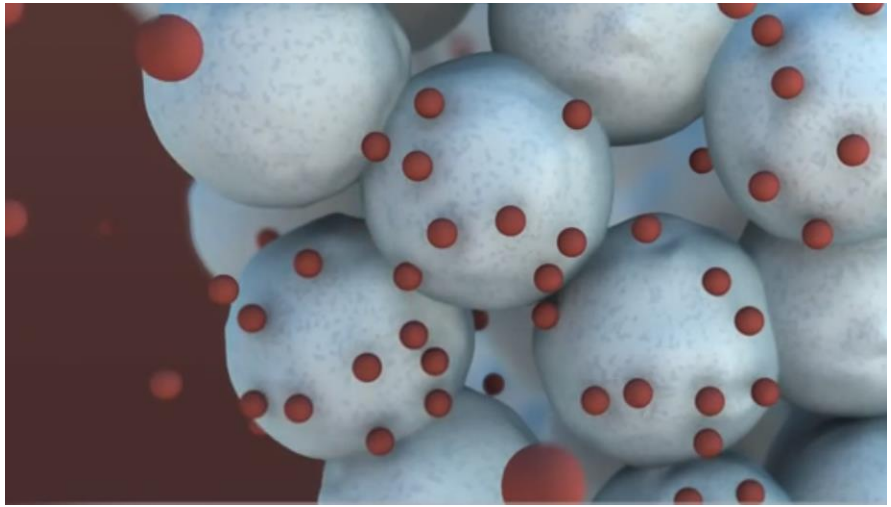
- **Fluorine doped with tin-oxide (FTO)**
- Tin-doped indium oxide (ITO)



Parts of a dye solar cell

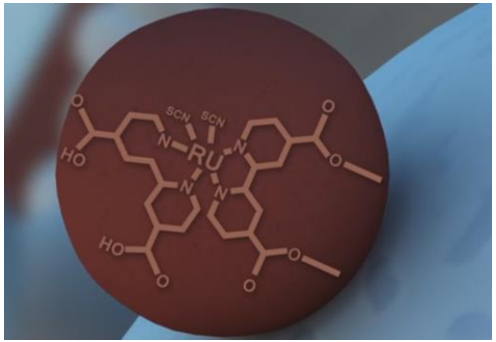
Titanium dioxide (TiO_2)

- It is a really porous material. Good conductivity.



Dye molecules

- It is formed by a ruthenium (Ru) complex.
- It communicates the electrolyte to the TiO_2



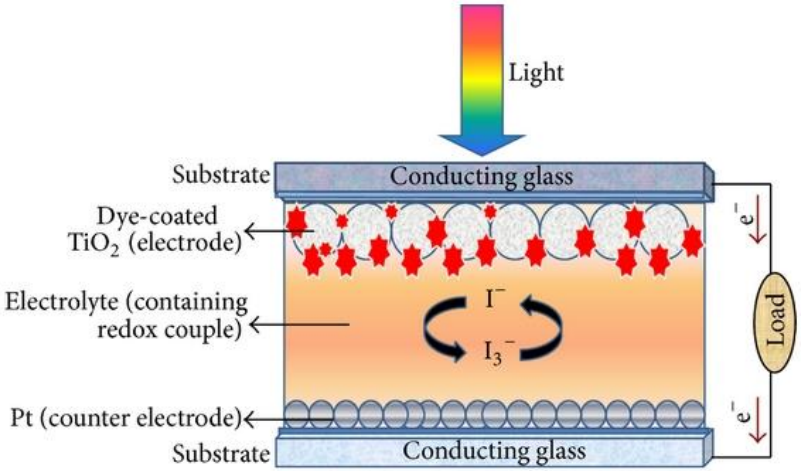
Parts of a dye solar cell

Second glass(Cathode):

- Thin film of platinum, works like a catalyser.

Electrolyte:

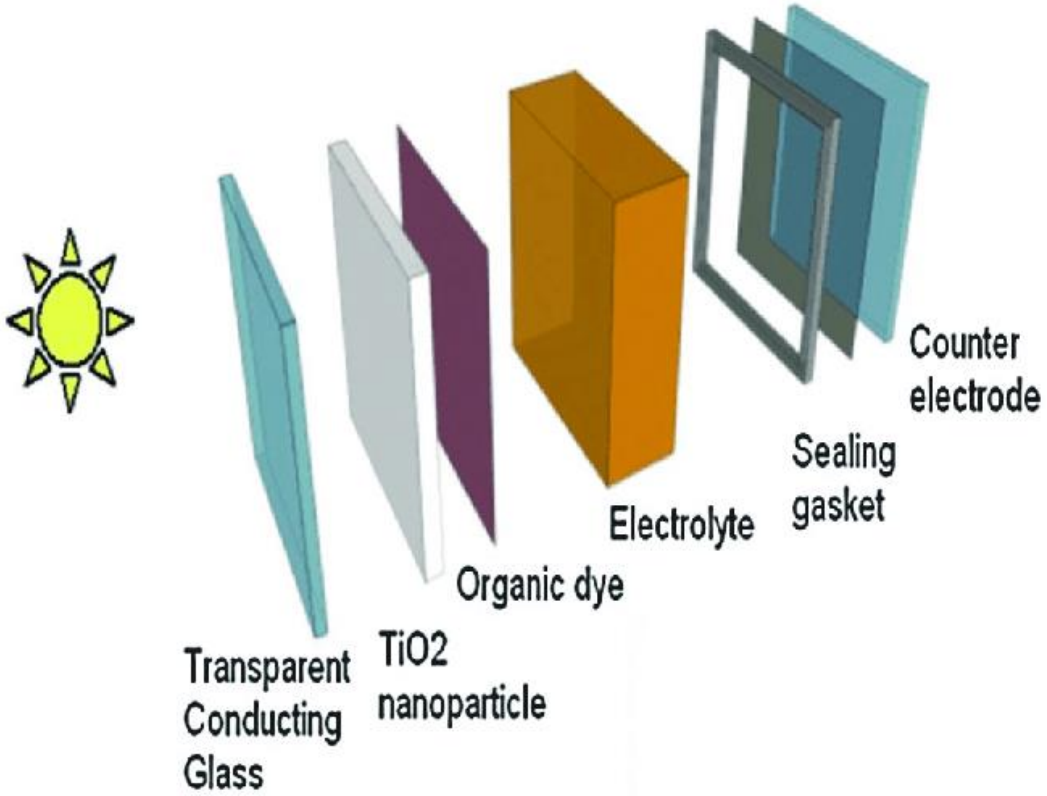
- **Iodine and tetra butyl ammonium**
- Gel-polymer
- Tetra butyl iodide
- 1-butyl-3-methylimidazolium iodide
- Guanidine thiocyanate and 4-tert-butyl pyridine



How is it made?

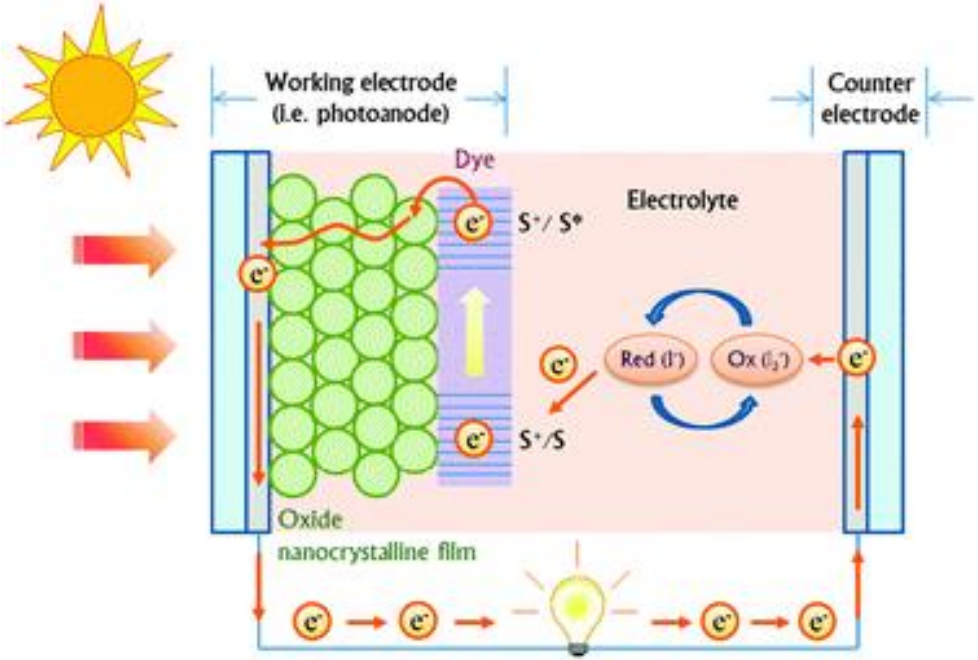
To make a Dye solar cell there are 3 differents steps:

- Prepare the working electrode
- Prepare the counter electrode
- Assembling the bought electrodes



Functioning

Produce electricity by transforming the light energy it receives into electrical energy.

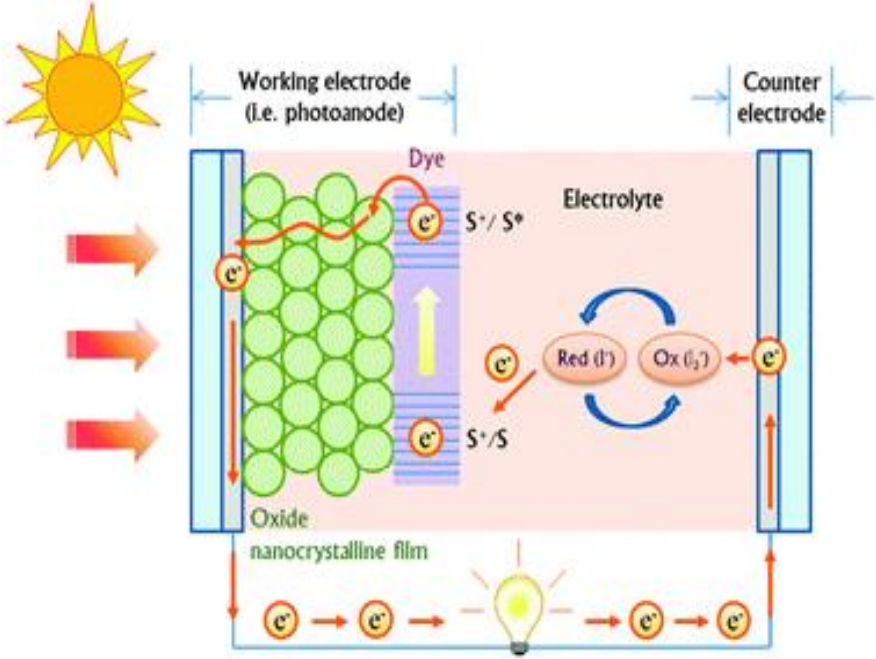


1) The dye catches photons of incoming light to excite electrons.

1) The dye injects the excited electrons for the light into the TiO_2.

1) The electron is conducted away by nanocrystalline TiO_2. .
2) These electrons that come out of the working electrode can be used for small appliances.

1) The chemical electrolyte in the cell then close the circuit so that he electrons are returned to the dye.

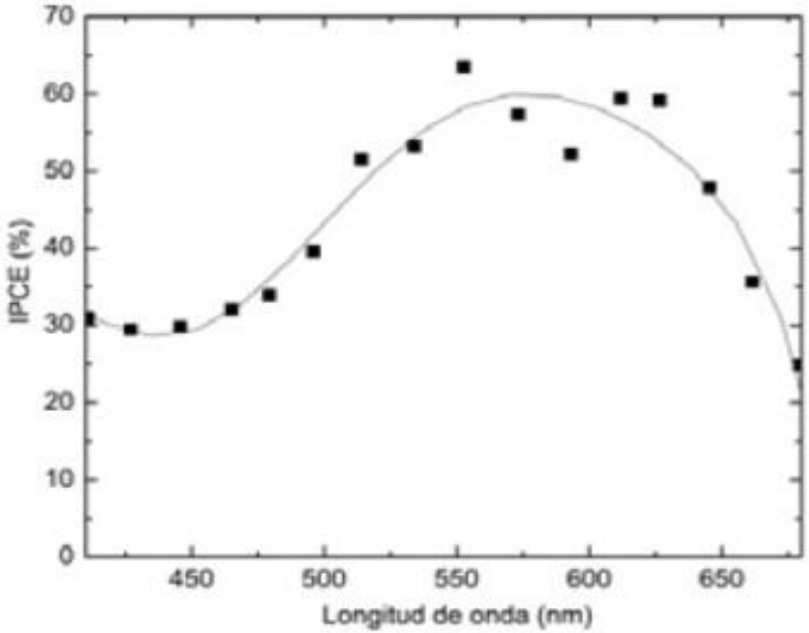


Efficiency

Is defined as how much electrical energy is obtained from a solar energy.

High efficiency , due to the high probability that a photon is absorbed in the TiO_2 layer, in addition to that, the dyes are very efficient in converting the absorbed photons into free electrons.

Most of the energy loss is due to the conductivity of the TiO_2 or the optical losses in the front part of the electrode.



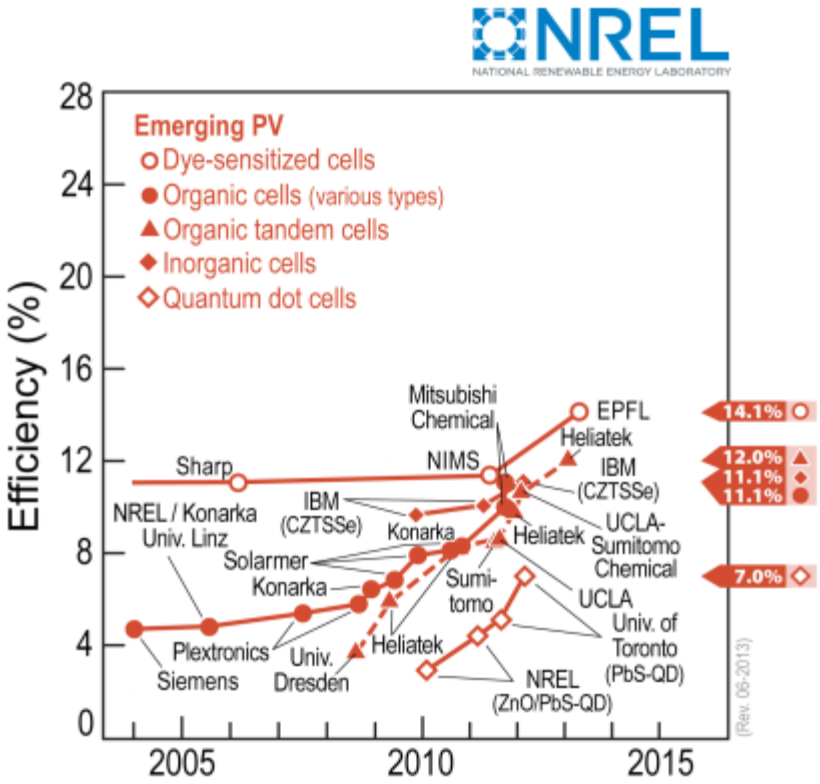
2006: efficiency of 11%

Of a very thin film of nanoparticles of TiO_2 that allows a greater transference of electrons in its band of conductivity.

2017: efficiency of 22%

Adding a material with perovskite structure as a light conductor on the TiO_2 layer and an organic material as a replacement for the electrolyte.

It is continue working in different ways to increase their efficiency, it looks for ways to increase the transmission of electrons in the layer of TiO.



Advantages

- Low-light performance
- High temperature performance
- Maximum efficiency (around 11%)
- Ecological (committed with the environment)
- Versatile (Highly, flexible, robust and durable)
- Low cost

Disadvantage

- It isn’t an option for large scale deployments (as a photovoltaic plates)
- Not very stable at varying temperatures (Only on liquid electrolyte)
- Ultraviolet radiation

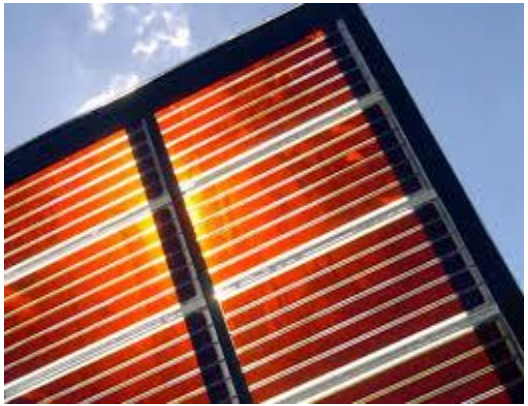
Applications

- First commercial applications
  - G24 innovations
  - Clothes and bags
  - Feed your mobile

- Other application:
  - Dye solar cell glass
  - Block the sunlight

Conclusion

- Renewable energy
- Efficiency
- Easy to build
- Ultraviolet radiation



Thank you,
any question?