VẬT LIỆU ỨNG DỤNG TRONG CHUYỂN HÓA NĂNG LƯỢNG MẶT TRỜI

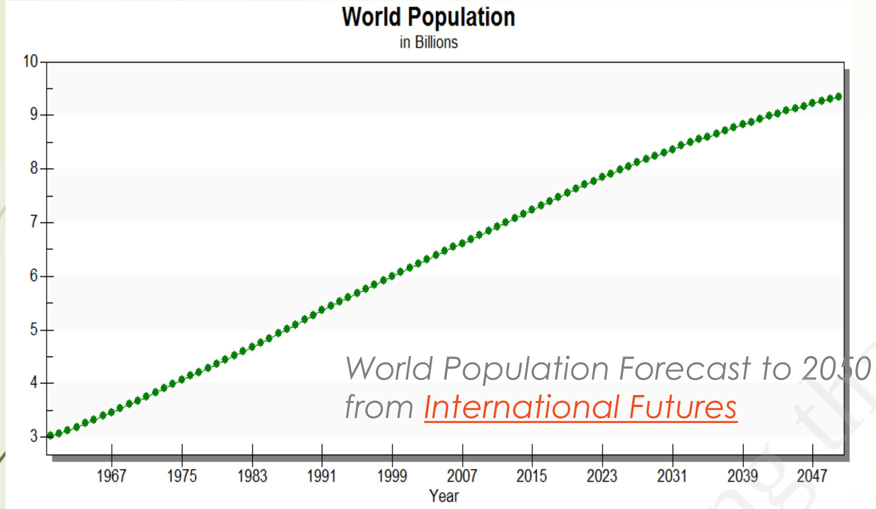
TS. NGUYỄN TUYẾT PHƯƠNG

ĐH KHOA HỌC TỰ NHIÊN TP.HCM – THÁNG 10 NĂM 2017

Outline

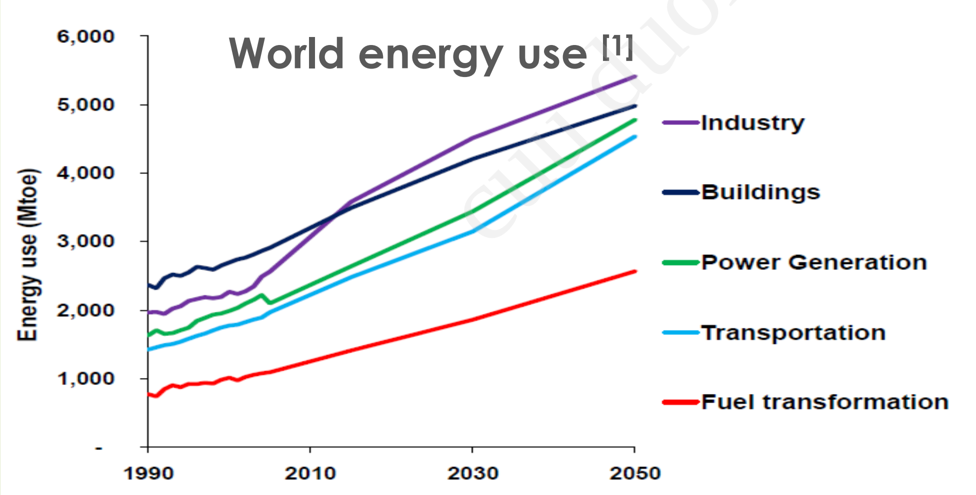
1. Introduction
   - Global energy
   - Photovoltaic technology
   - Materials in solar energy conversion
2. Silicon solar cells
3. Inorganic thin film solar cells
6. Hybrid solar cells

1. Introduction
Global energy



http://en.wikipedia.org/wiki/File:World_Population_Forecast_to_2050_from_International_Futures.png

(BP) The world energy consumption:
- **grew 5.6% in 2010, the highest rate since 1973**
- **will at least double by 2050 with a predicted population of approximately nine billion**



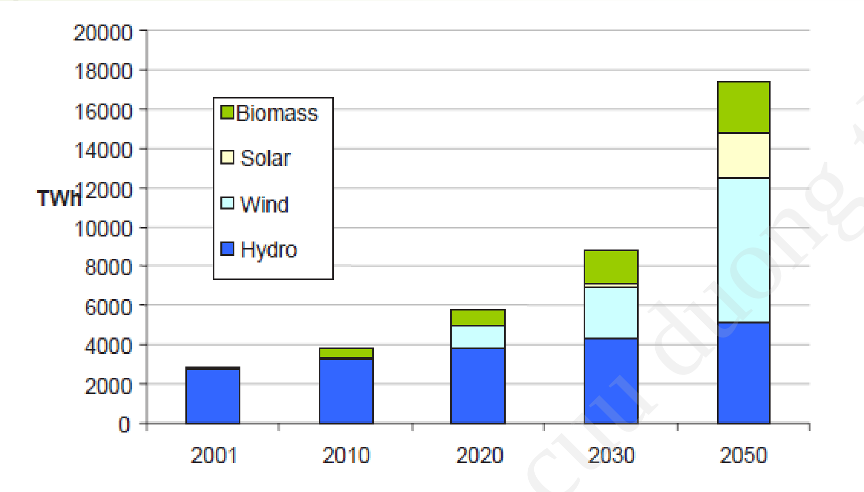
All the scenarios to 2050 have been analyzed based on an increasing World population, a slow economic growth, a reduction of available fossil fuel, the problem of CO_2 emission and climate change policy, etc. for a sustainable development

[1] International Energy Agency: Energy technology perspective 2008 – Scenarios and strategies to 2050

1. Introduction
Global energy

The International Energy Agency (IEA):

"How to achieve a clean, clever and competitive energy future"



Recommended annual production of World renewable electricity *(European Commission: World energy technology outlook – 2050)*

Renewable energy resources: solar energy, wind energy, geothermal energy, bio-energy, ocean energy, hydrogen power and other natural resources

Use of renewable energy: 35 – 46% of total power generation requirement by 2050

More than 30% of world electricity coming from renewable energy

Beyond 2030, solar energy becomes an important factor for the generation of electricity by for example thermodynamic power plants and photovoltaic systems integrated into buildings.

1. Introduction
Photovoltaic

1.7 x 10^5 Tera-Watt

~ 10% → 60 TW

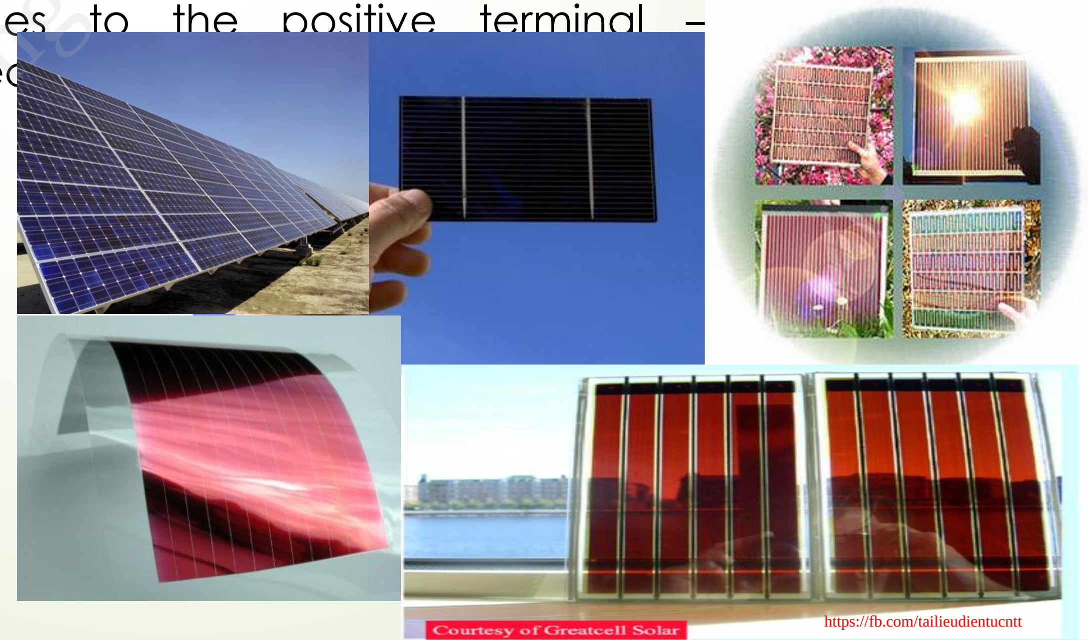
600 TW

Energy demand : ~ 28 TW (2050)

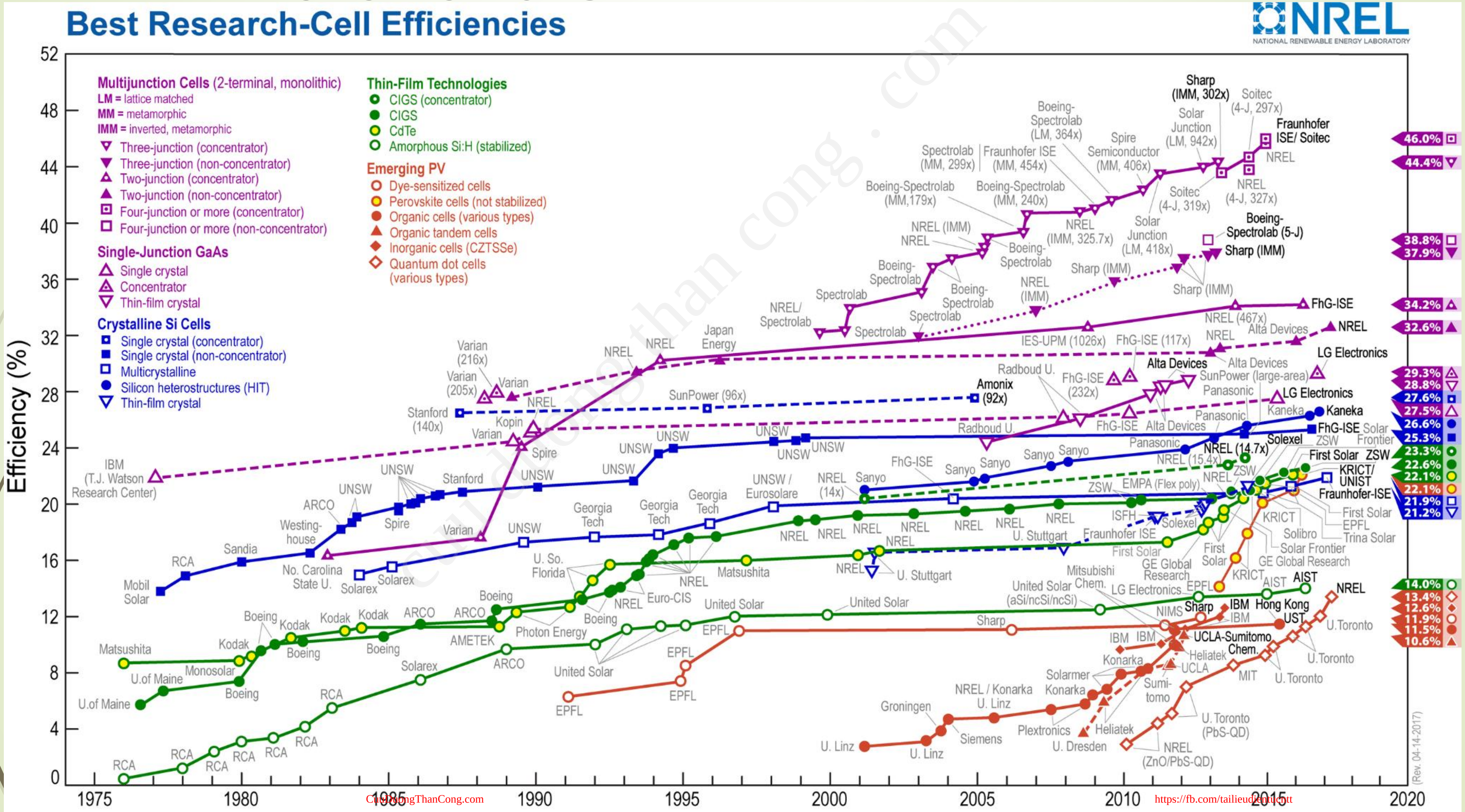
Photovoltaic (PV): the most direct way to convert solar radiation into electricity based on the photovoltaic effect

(1) The absorption of light to generate an electron – hole pair

(2) The separation of electron and hole by the structure of the device – electrons to the negative terminal and holes to the positive terminal – g elec



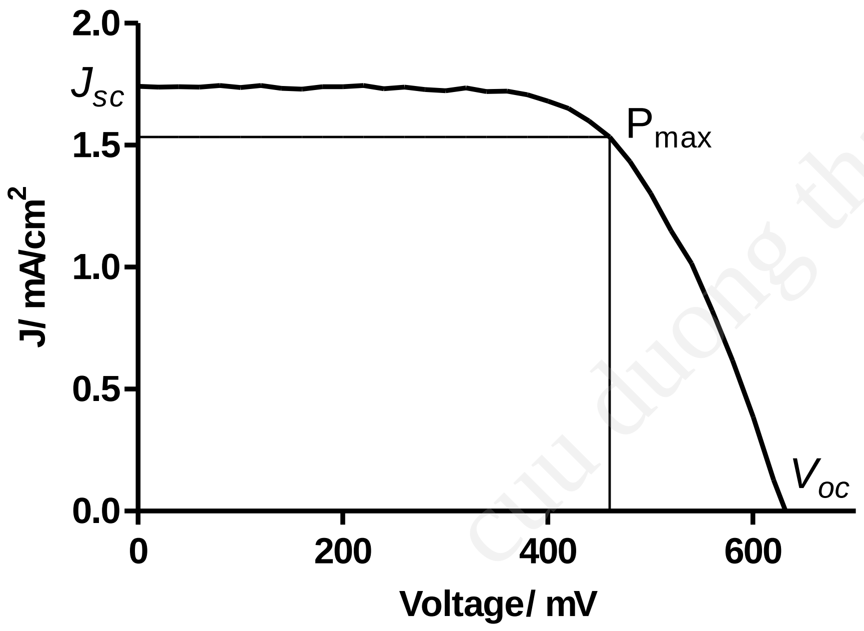
1. Introduction Photovoltaic



1. Introduction
Photovoltaic operation

A solar cell is determined by measuring the photo current density *J* at different potentials *V*.

The standard condition for efficiency measurement of solar cell:
1 Sun, AM 1.5 G, 25°C (1.000 W/m^2)



$J - V$ curve of a DSC, produced with the N719 dye and non-robust electrolyte.
Light intensity: 100 W/m^2, active area of DSC: > 8.0 cm^2, η: 7.05%, FF: 64%.

Overall solar to electrical energy conversion efficiency

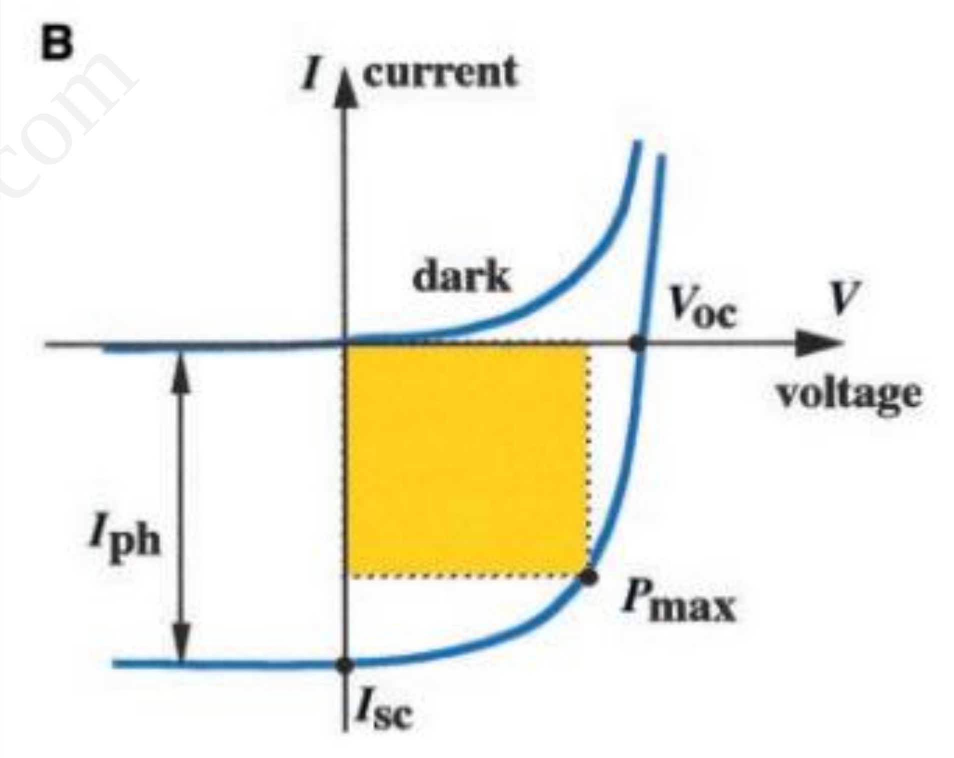
$$\eta = \frac{J_{sc} \times V_{oc} \times FF}{P_{in}}$$

Fill factor of the cell

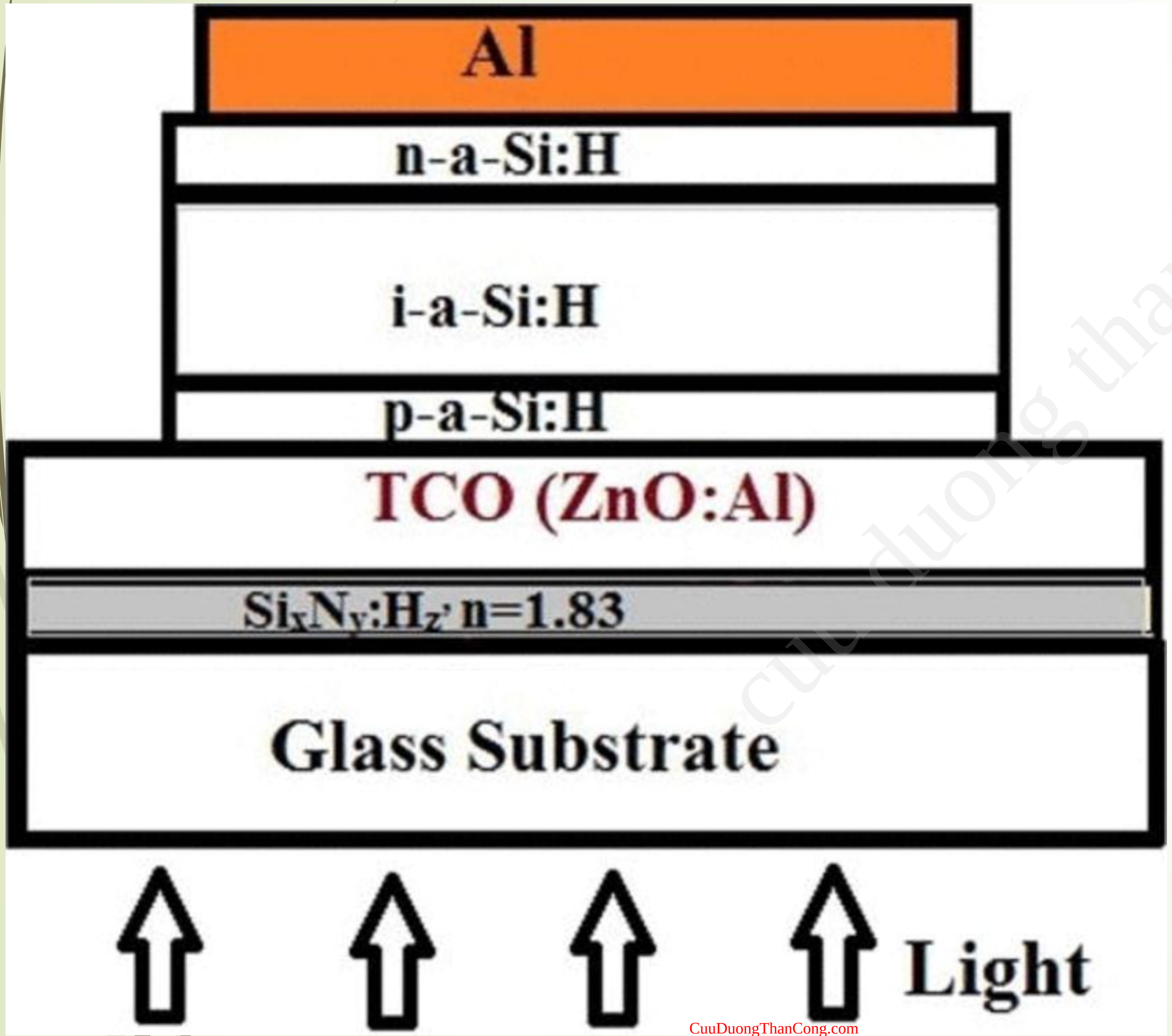
$$FF = \frac{P_{max}}{J_{sc} \times V_{oc}}$$

1. Introduction Photovoltaic

Updated table of solar cell performance



Silicon Solar cells



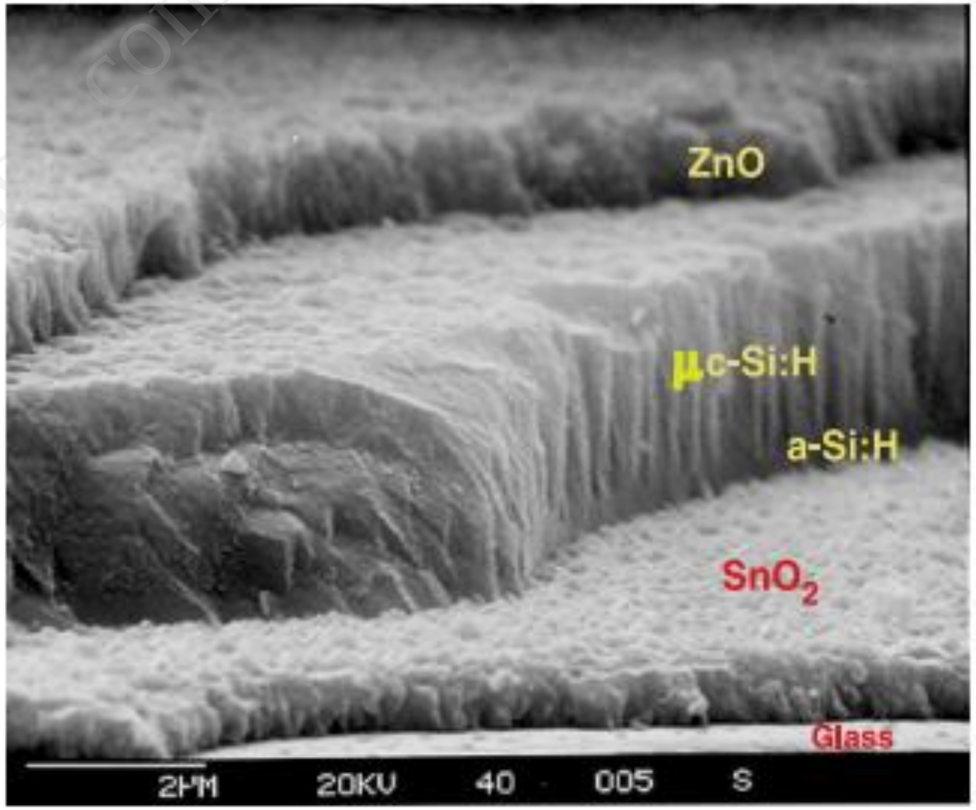
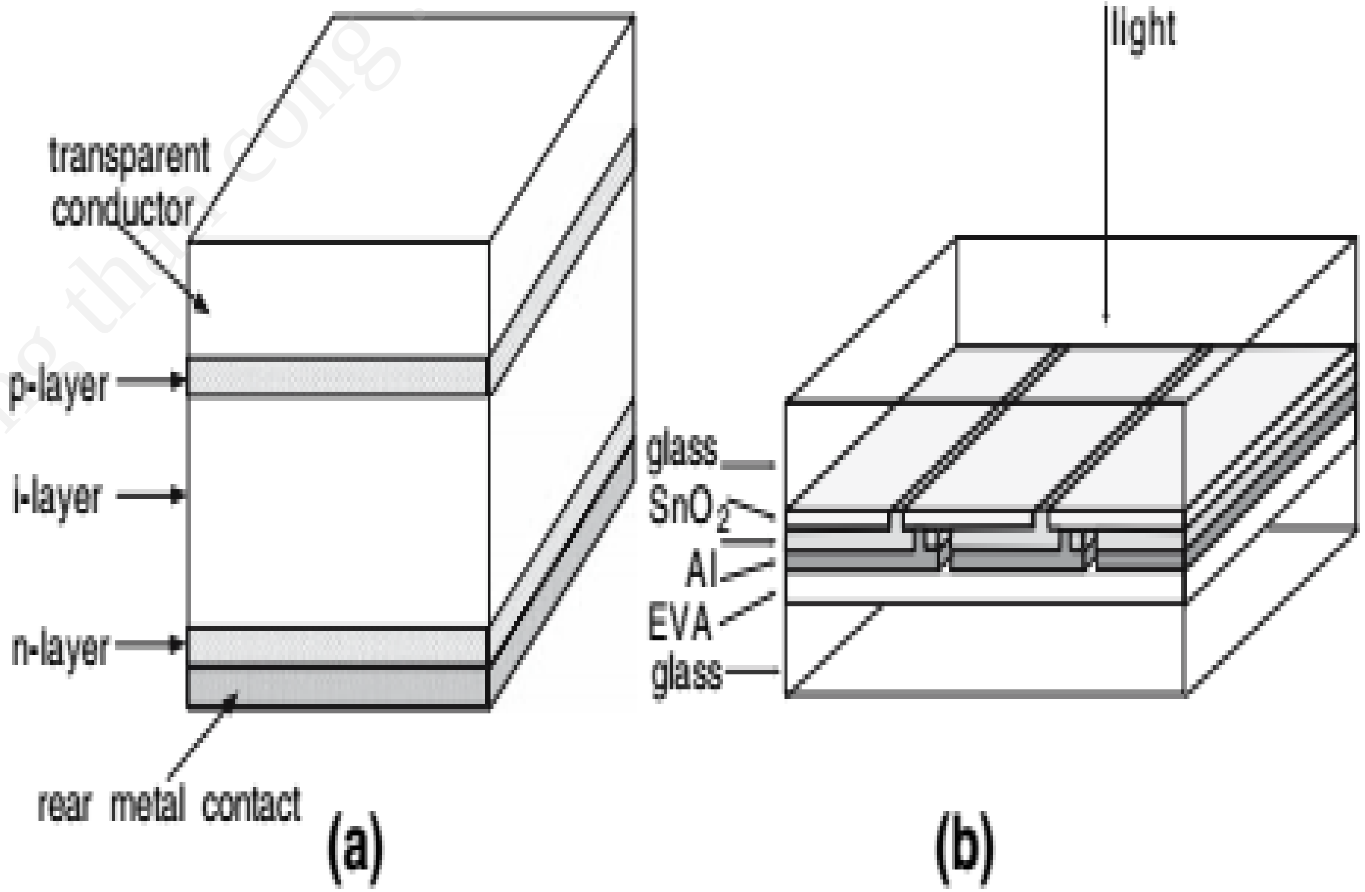


Fig. 5. Microcrystalline and amorphous silicon tandem solar cell, as introduced by the IMT (so-called "micromorph" solar cell) (26) Scale bar, 2 μm.

Silicon Solar cells

Fig. 2 (**a**) Single-junction amorphous silicon solar cell; (**b**) Individual cells deposited onto a glass sheet are laterally connected in series by the approach shown



Silicon Solar cells

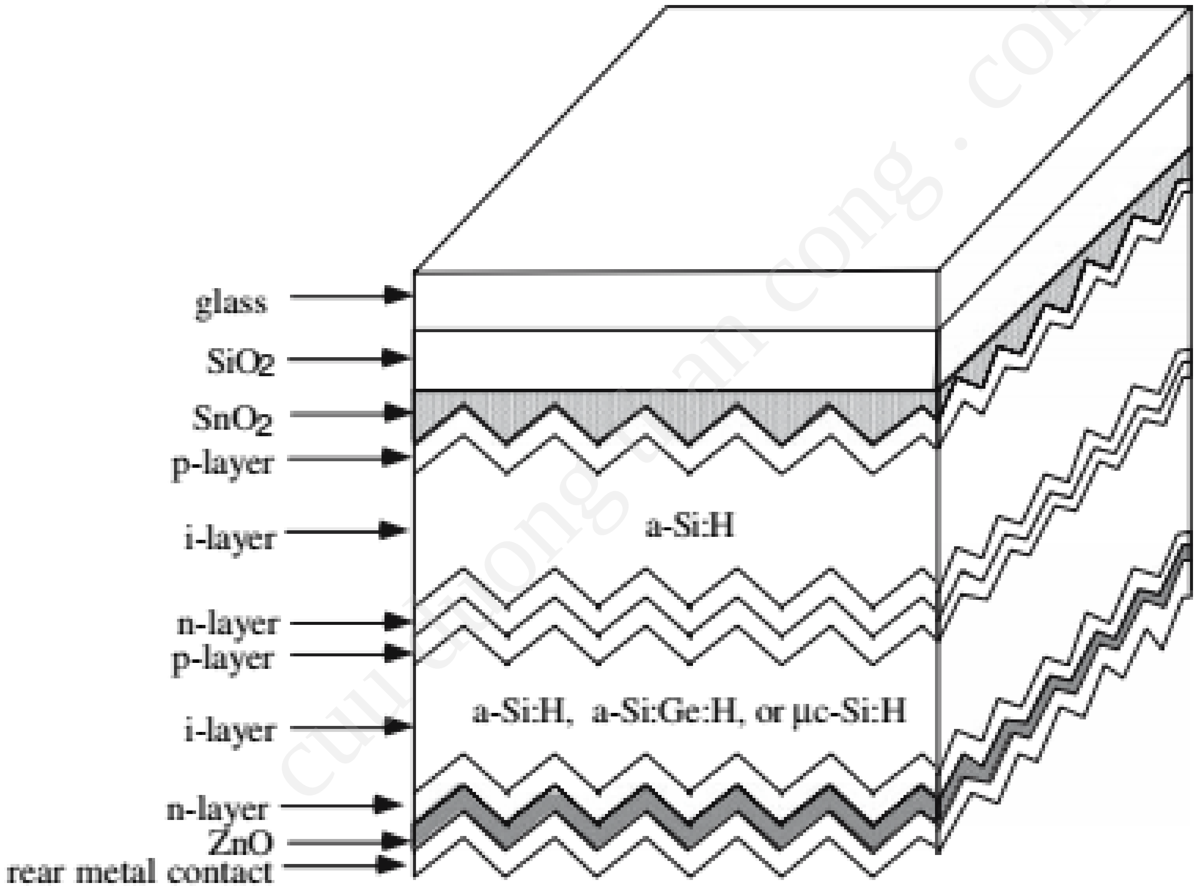


Fig. 3 Multiple-junction stacked or tandem solar cells where two or more current-matched cells are stacked on top of one another

Inorganic thin film solar cells

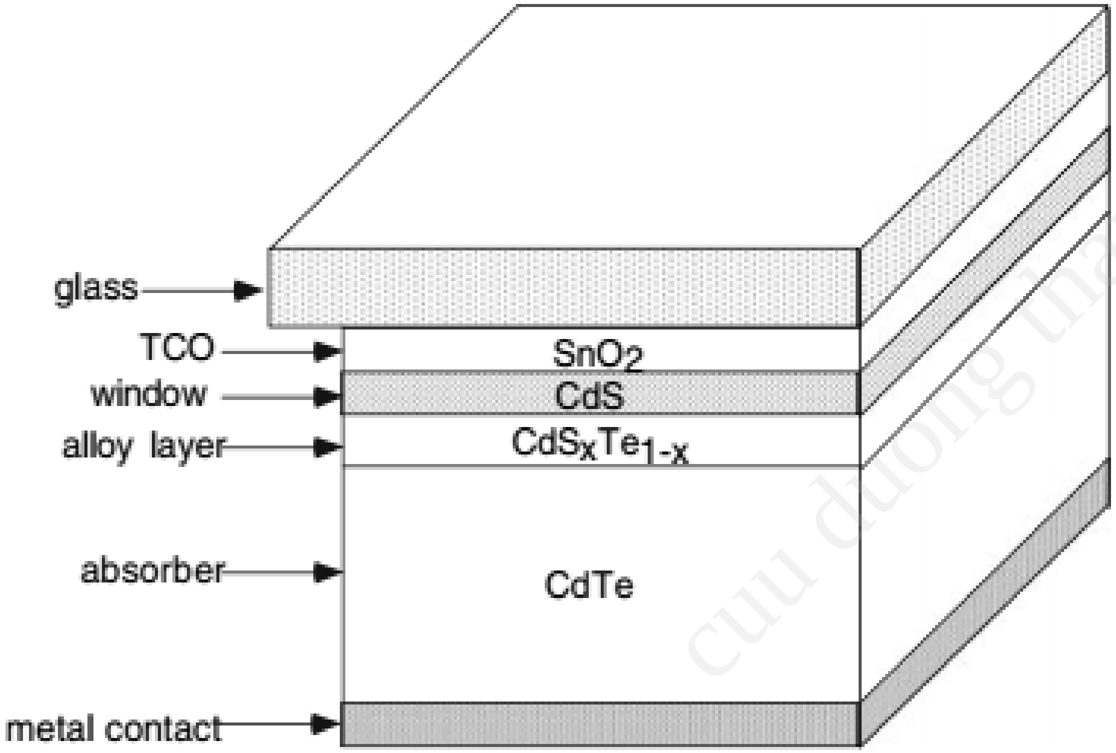


Fig. 6 Device schematic for a cadmium telluride cell

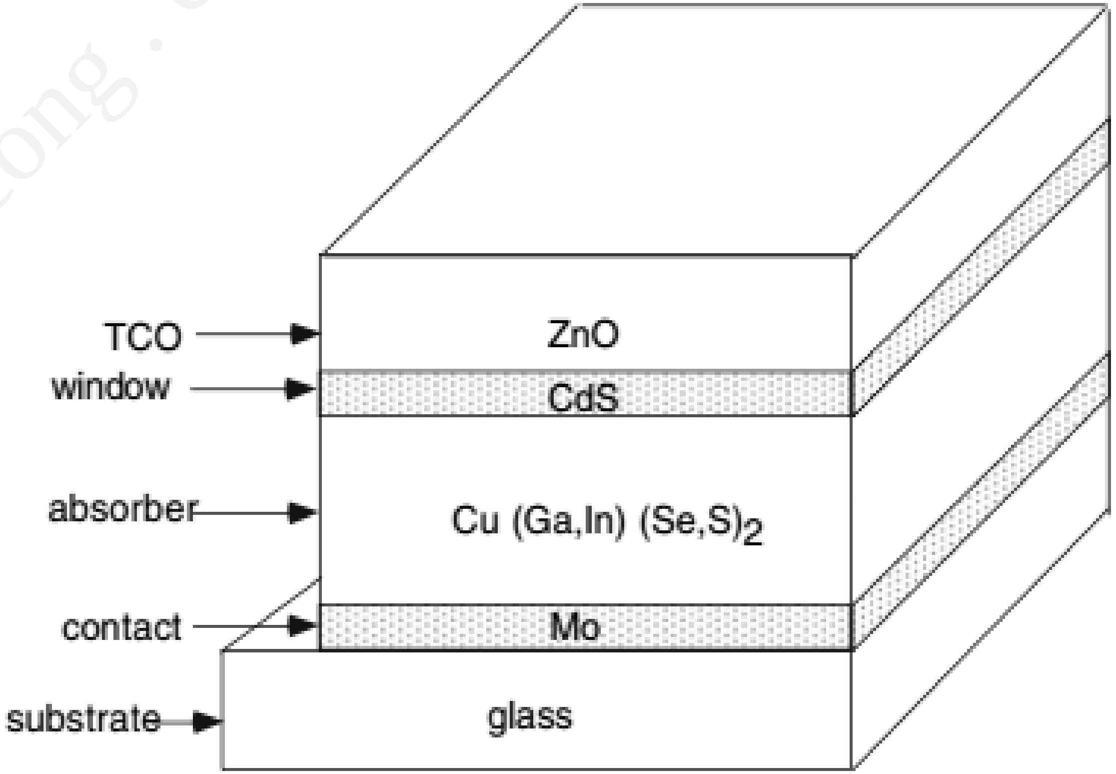


Fig. 7 Basic CIS (copper indium diselenide) cell structure

Inorganic thin film solar cells

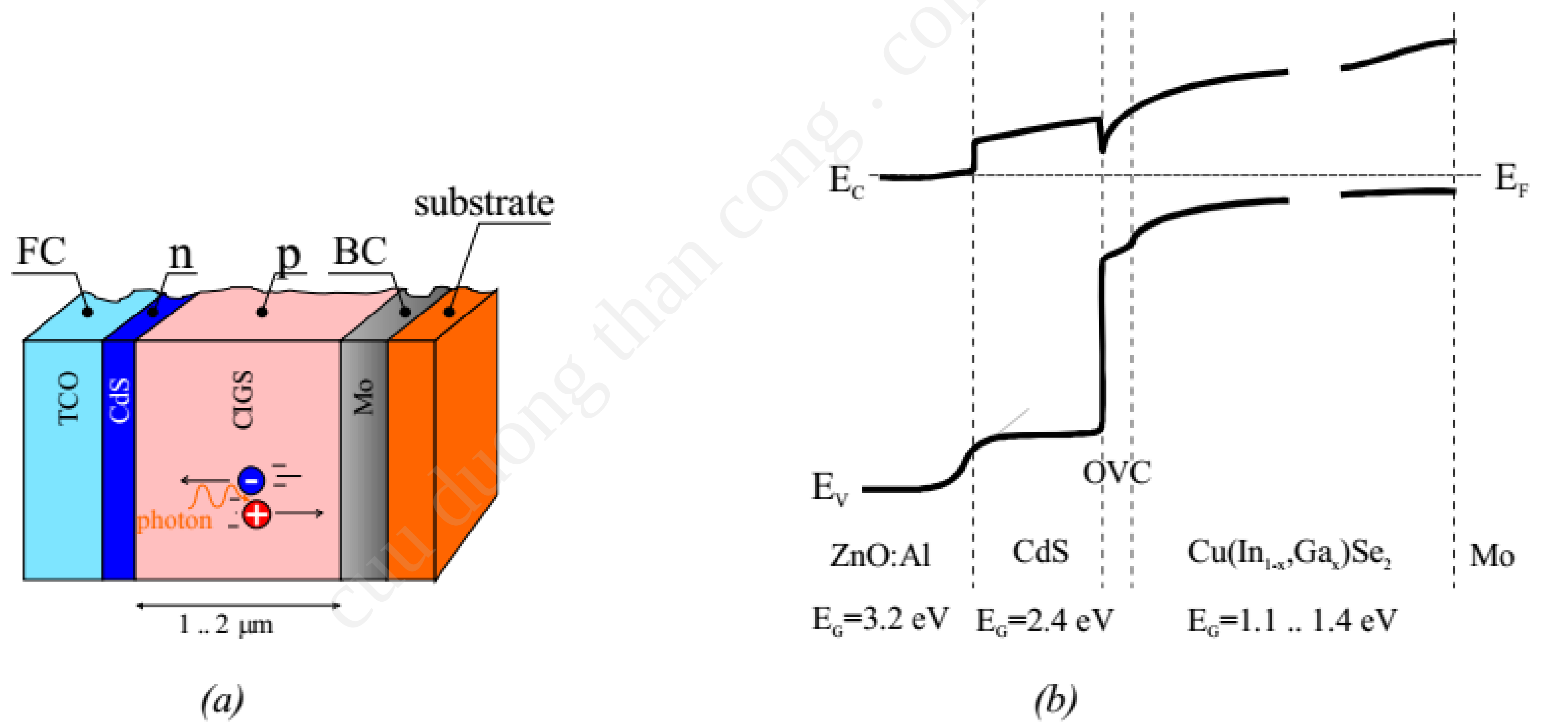


Figure 4. Schematic view of (a) substrate heterojunction np CdS/CIGS solar cell and (b) band-diagram of ZnO/CdS/CIGS structure.

Inorganic thin film solar cells

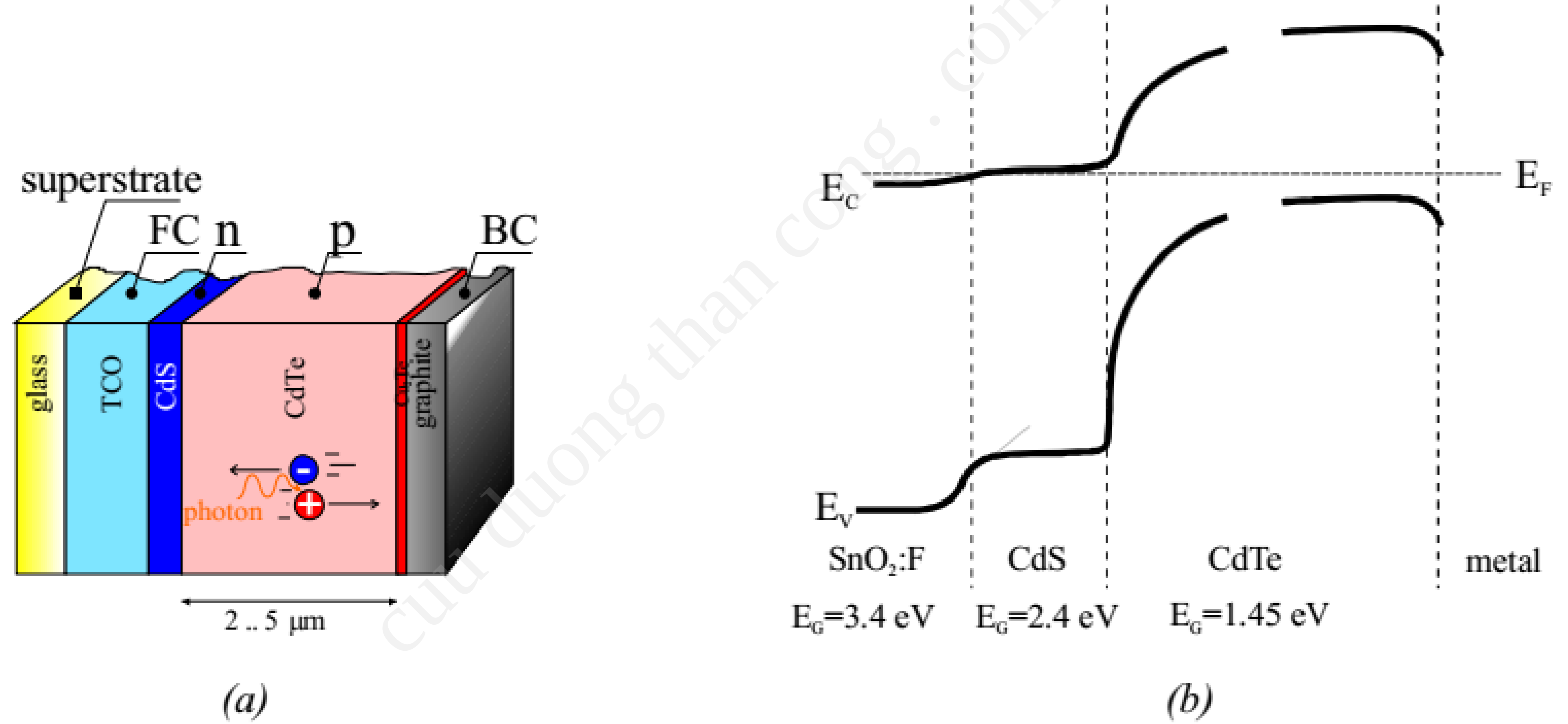


Figure 5. Schematic view of (a) superstrate heterojunction np CdS/CdTe solar cell and (b) band-diagram of ZnO/CdS/CdTe/metal structure.

Hybrid solar cells

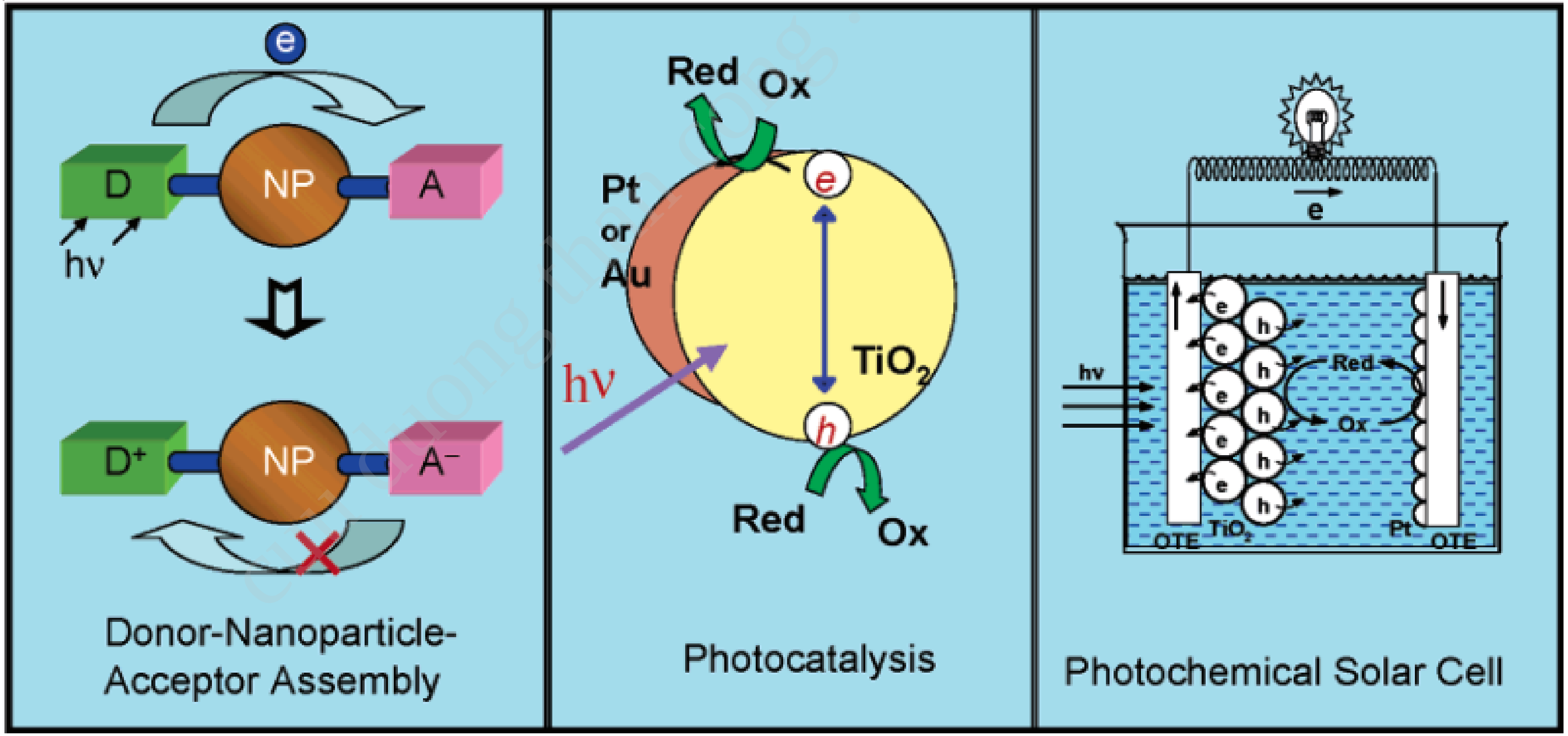


Figure 3. Strategies to employ nanostructured assemblies for light energy conversion.

Hybrid solar cells
Dye-sensitized Solar cells