

Wel-Come



Solar cell

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What is a solar cell?

- A structure that converts solar energy directly to DC electric energy.
 - It supplies a voltage and a current to a resistive load (light, battery, motor).
- It is like a battery because it supplies DC power.
- It is different from a battery in the sense that the voltage supplied by the cell changes with changes in the resistance of the load.

Basic Physics of Solar Cells

- Silicon (Si) is from group 4 of the period table. When many Si atoms are in close proximity, the energy states form bands of forbidden energy states.
- One of these bands is called the band gap(E_g) and the absorption of light in Si is a strong function of E_g .

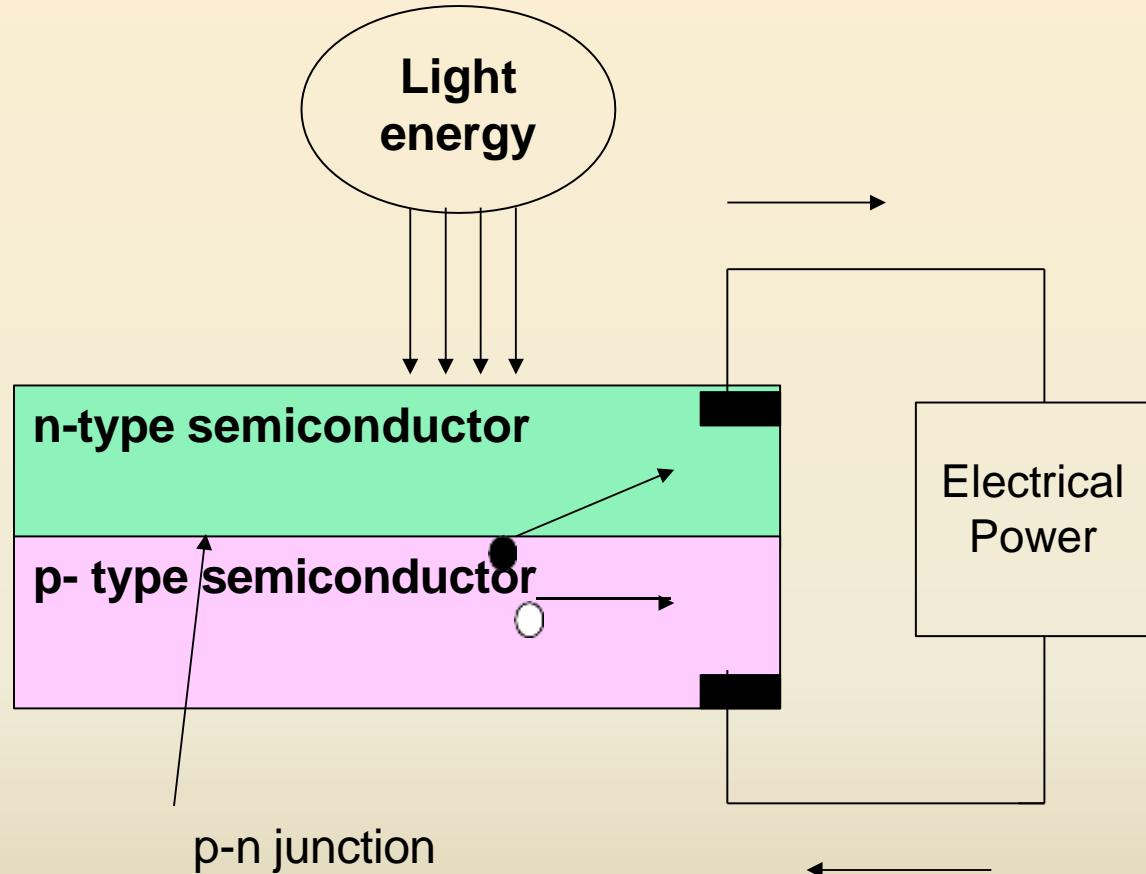
Basic Physics of Solar Cells

- Si is covalently bonded: It shares electrons.
 - When a Si atom is replaced with a group 3 (Al, B) it forms a positive particle called a hole that can move around the crystal through diffusion or drift (electric field).
 - When a Si atom is replaced with a group 5 (As, P) it forms an electron that can move around the crystal.
 - By selectively doping the Si Crystal when can change the resistivity and which type of carrier transfers charge (carries current). Because we can selectively dope a Si crystal it is called a semiconductor.

Photovoltaic effect

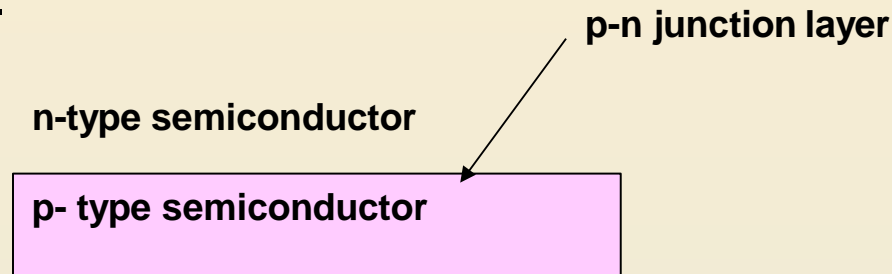
Definition:

The generation of voltage across the PN junction in a semiconductor due to the absorption of light radiation is called photovoltaic effect. The Devices based on this effect is called photovoltaic device.

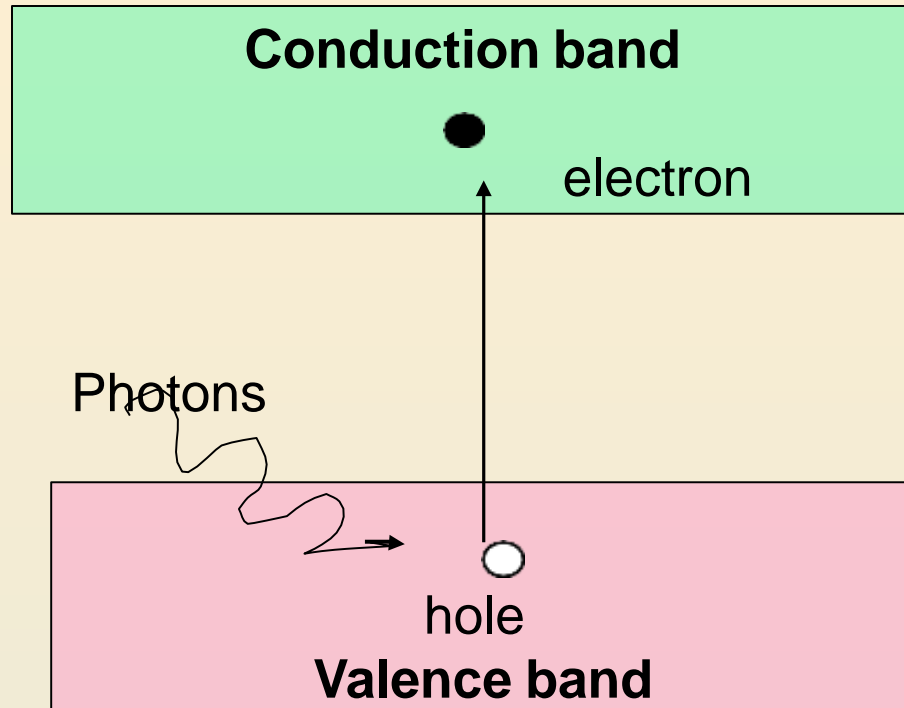


Basics of solar cells

- If *two differently* contaminated semiconductor *layers* are combined, then a so-called *p-n-junction results* on the boundary of the layers.



- By doping *trivalent* element, we get p-type semiconductor. (with excess amount of hole)
- By doping *pentavalent* element, we get n-type semiconductor (with excess amount of electron)



- Therefore, a *vacant is created* in the valence band and it is called hole.
- Now, the electron in the conduction band and hole in valence band *combine together* and forms *electron-hole pairs*.

Comparison of Types of solar cell

| Material | Efficiency (%) |
|-------------------------|----------------|
| Monocrystalline silicon | 14-17 |
| Polycrystalline silicon | 13-15 |
| Amorphous silicon | 5-7 |

Solar Cell Efficiency

- AM1.5 Solar Intensity (Incident power density) 1000 W/m² or 100 mW/cm²
 - Losses
 - Photon Energy -47% of photons have $eV < 1.1$, 30% goes to heat
 - Voltage factor – ratio of energy given to energy required to produce electron 0.65
 - Recombination – electron/holes that recombine 10%
 - Reflection – reduced to 4%
 - Overall Efficiency $\eta_c = (0.47)(0.65)(.90)(.96) = .26$
 - 26% Maximum efficiency using current technologies

Uses of Solar Cells

- Renewable power
- Power for remote locations



Advantages of Solar Cells

- Consumes no fuel
- No pollution
- Wide power-handling capabilities
- High power-to-weight ratio

DISADVANTAGES

- The main disadvantage of solar cell is the initial cost. Most types of solar cell require large areas of land to achieve average efficiency.
- Air pollution and weather can also have a large effect on the efficiency of the cells.
- The silicon used is also very expensive and the solar cells can only ever generate electricity during the daytime.

Thank you...