Benha University

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Undergraduate Course

Solar Cells Fundamental

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Lecture (2)

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Solar Energy

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What is the solar energy?

- Most renewable energy comes either directly or indirectly from the sun.
- Sunlight, or solar energy, can be used directly for heating and lighting homes and other buildings, for generating electricity, and for hot water heating, solar cooling, and a variety of commercial and industrial uses.

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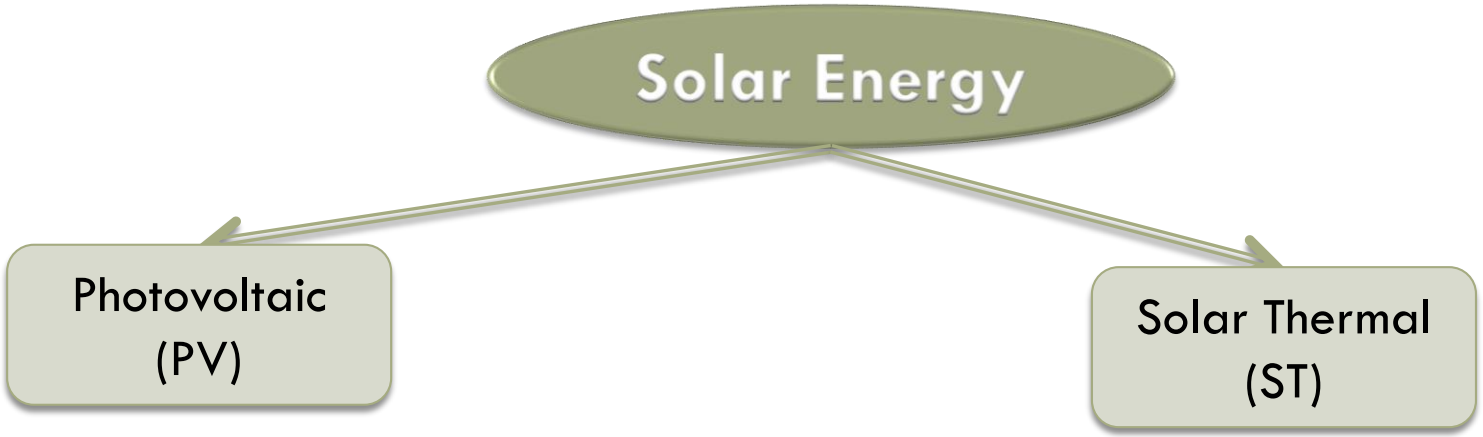
Types

- **There are two basic technologies of solar energy**



1. Photovoltaic (PV)

- These are the most common form and have always been, and now increasingly common on top of our homes, Each cell converts the light of the sun into electrical energy, which can then be used to power electrical devices.
- Solar Cell often made from semiconductors material such as silicon materials.

2. Solar Thermal

- This type of technology is known as Concentrated Solar Power (CSP).
- May look similar to PV, but they work differently in that they draw in a concentrated beam of sunlight, reflecting it through a system of mirrors.
- The resulting heat generated by the process activates a turbine that produces electricity through a conventional generator. Where PV produces energy from light, this produces energy from heat.

First

Solar Photovoltaic's

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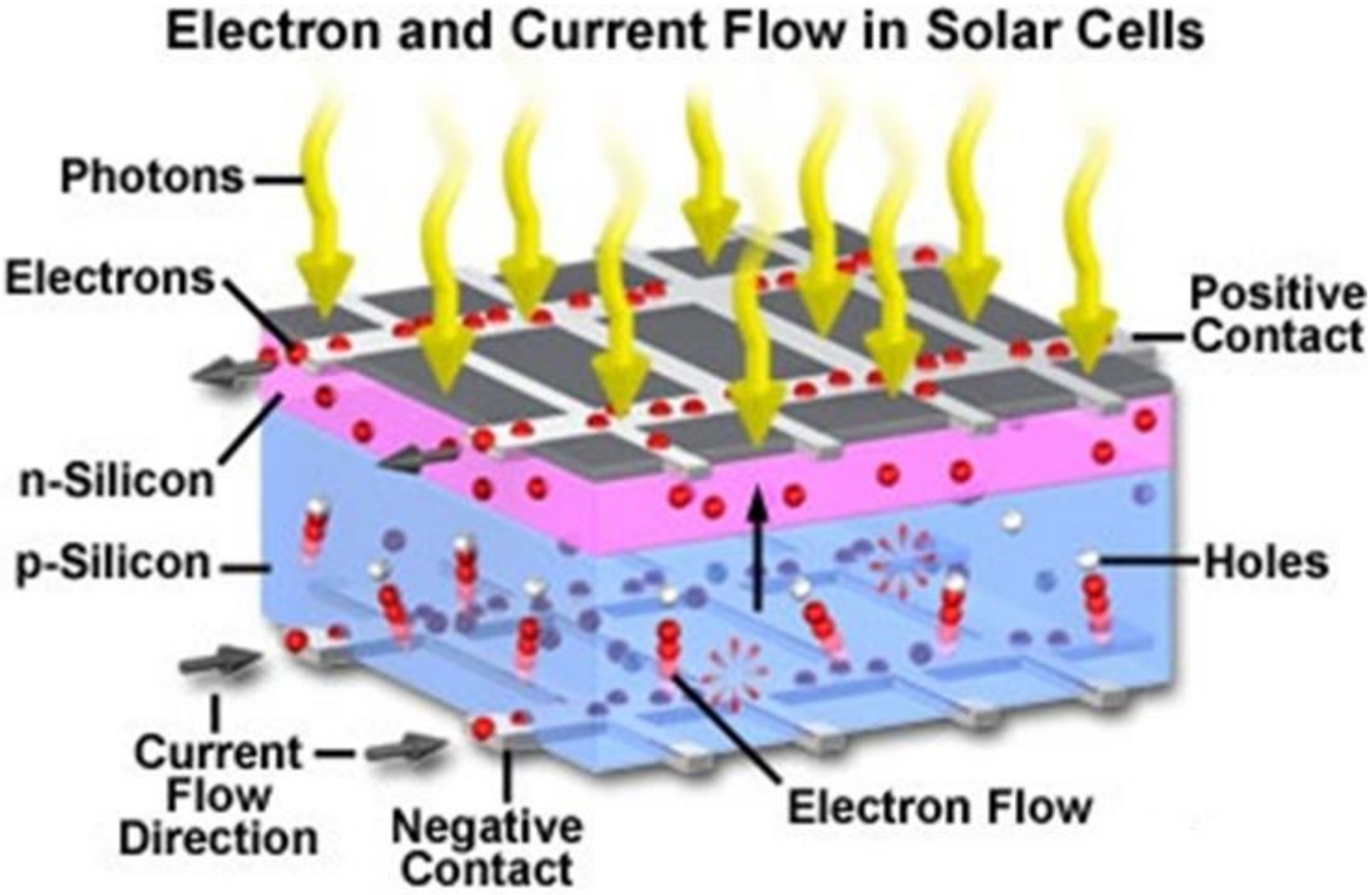
1. PV General overview

- PV was recognized as an important source of space power in the 1950s.
- Terrestrial PV development began in response to the 1970s oil crises.
- Concern for the environment, as well as global efforts to seek indigenous sources of energy, drives the investment in PV research and deployment.
- Today, PV is a several-billion-dollar industry worldwide, with more than 520 MW of PV modules shipped in 2002.

- These include large, multi-megawatt installations feeding into the utility grid, kilowatt rooftop systems supplying power to a home or business, and single 50- or 100-W PV modules on homes in developing countries.

2. Solar cells are semiconductor devices

- That produce electricity from sunlight via the photovoltaic effect.
- Sunlight strikes the cell, photons with energy above the semiconductor band gap impart enough energy to create electron-hole pairs.
- A junction between dissimilarly doped semiconductor layers sets up a potential barrier in the cell, which separates the light-generated charge carriers.
- This separation induces a fixed electric current and voltage in the device. The electricity is collected and transported by metallic contacts on the top and bottom surfaces of the cell.



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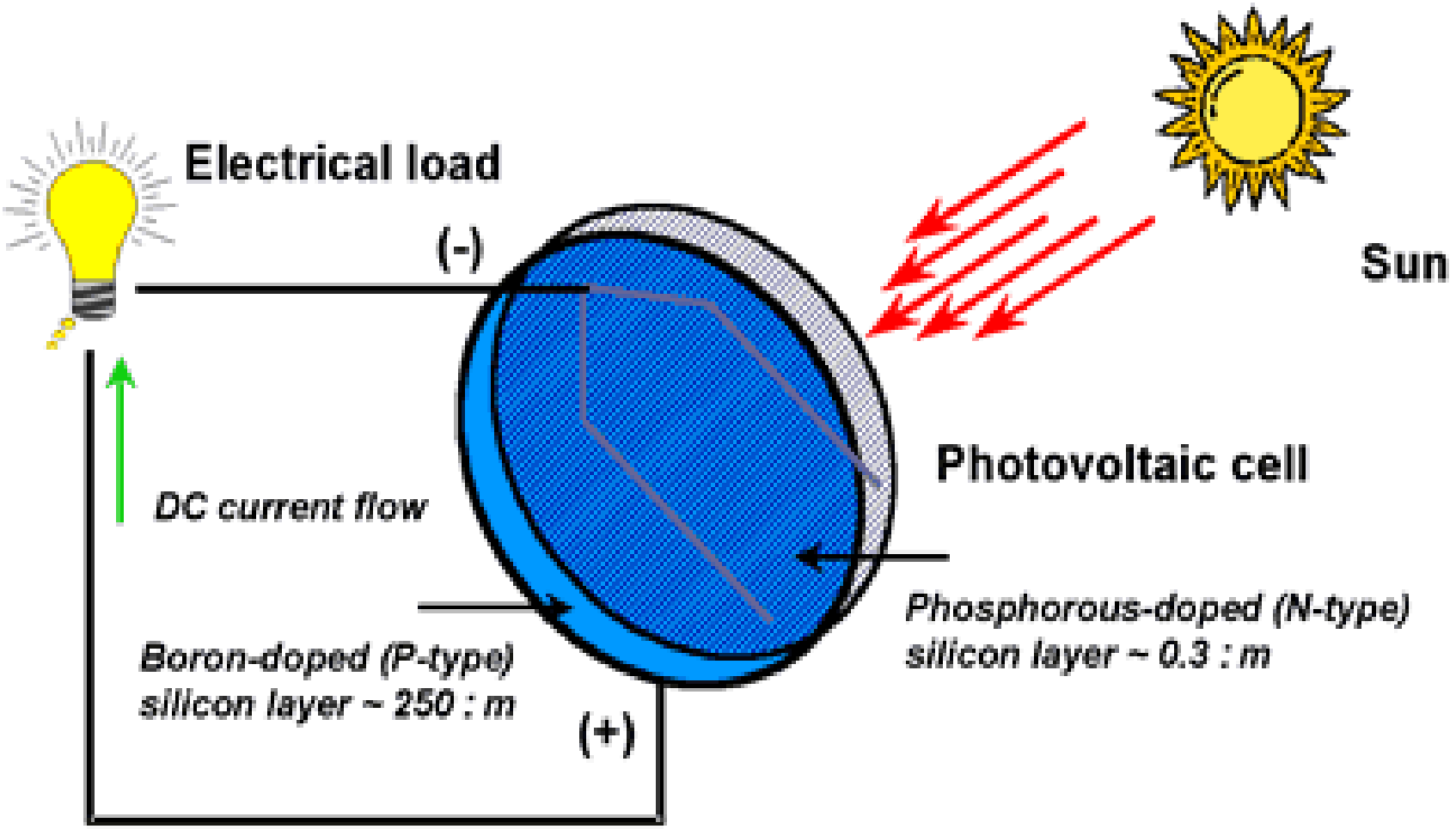
How PV Cells Work ?

- A typical silicon PV cell is composed of a thin wafer consisting of an ultra-thin layer of phosphorus-doped (N-type) silicon on top of a thicker layer of boron-doped (P-type) silicon.
- An electrical field is created near the top surface of the cell where these two materials are in contact, called the P-N junction.
- When sunlight strikes the surface of a PV cell, this electrical field provides momentum and direction to light-stimulated electrons, resulting in a flow of current when the solar cell is connected to an electrical load.

How PV Cells Work ?



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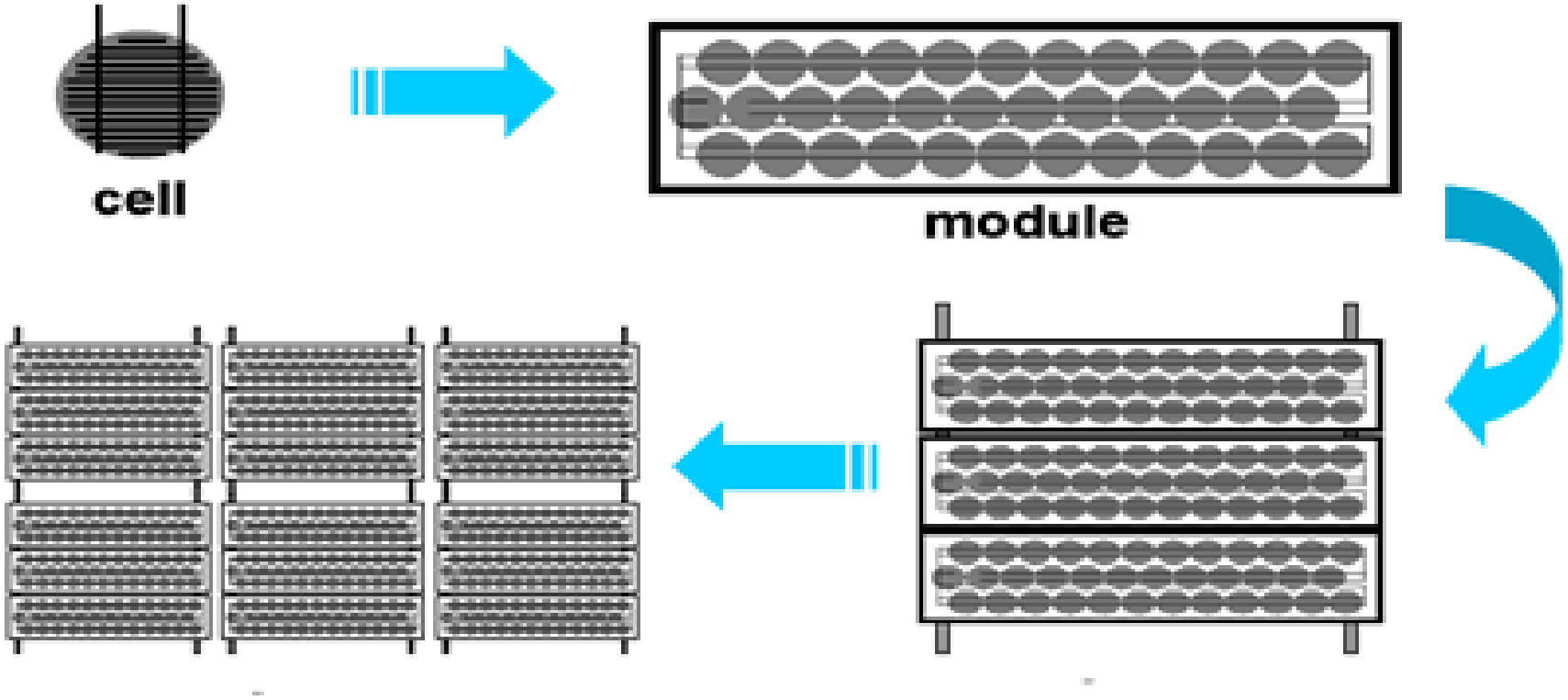
4. Photovoltaic Hierarchy (Components)

Cell < Module < Array



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• Photovoltaic cells are connected electrically in series and/or parallel circuits to produce higher voltages, currents and power levels.

• Photovoltaic modules consist of PV cell circuits sealed in an environmentally protective laminate, and are the fundamental building block of PV systems.

•Photovoltaic panels include one or more PV modules assembled as a pre-wired, field-installable unit. A photovoltaic array is the complete power-generating unit, consisting of any number of PV modules and panels.