جلسه ۲۶

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The Physics of the Solar Cell

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- Semiconductor solar cells are fundamentally quite simple devices.
- Semiconductors have the capacity to absorb light and to deliver a portion of the energy of the absorbed photons to carriers of electrical current (electrons and holes).
- A semiconductor diode separates and collects the carriers and conducts the generated electrical current preferentially in a specific direction.
- Thus, a solar cell is simply a semiconductor diode that has been carefully designed and constructed to efficiently absorb and convert light energy from the sun into electrical energy.

- A simple conventional solar cell structure is depicted in Figure 3.1.
- Sunlight is incident from the top, on the front of the solar cell.
- A metallic grid forms one of the electrical contacts of the diode and allows light to fall on the semiconductor between the grid lines and thus be absorbed and converted into electrical energy.
- An antireflective layer between the grid lines increases the amount of light transmitted to the semiconductor.

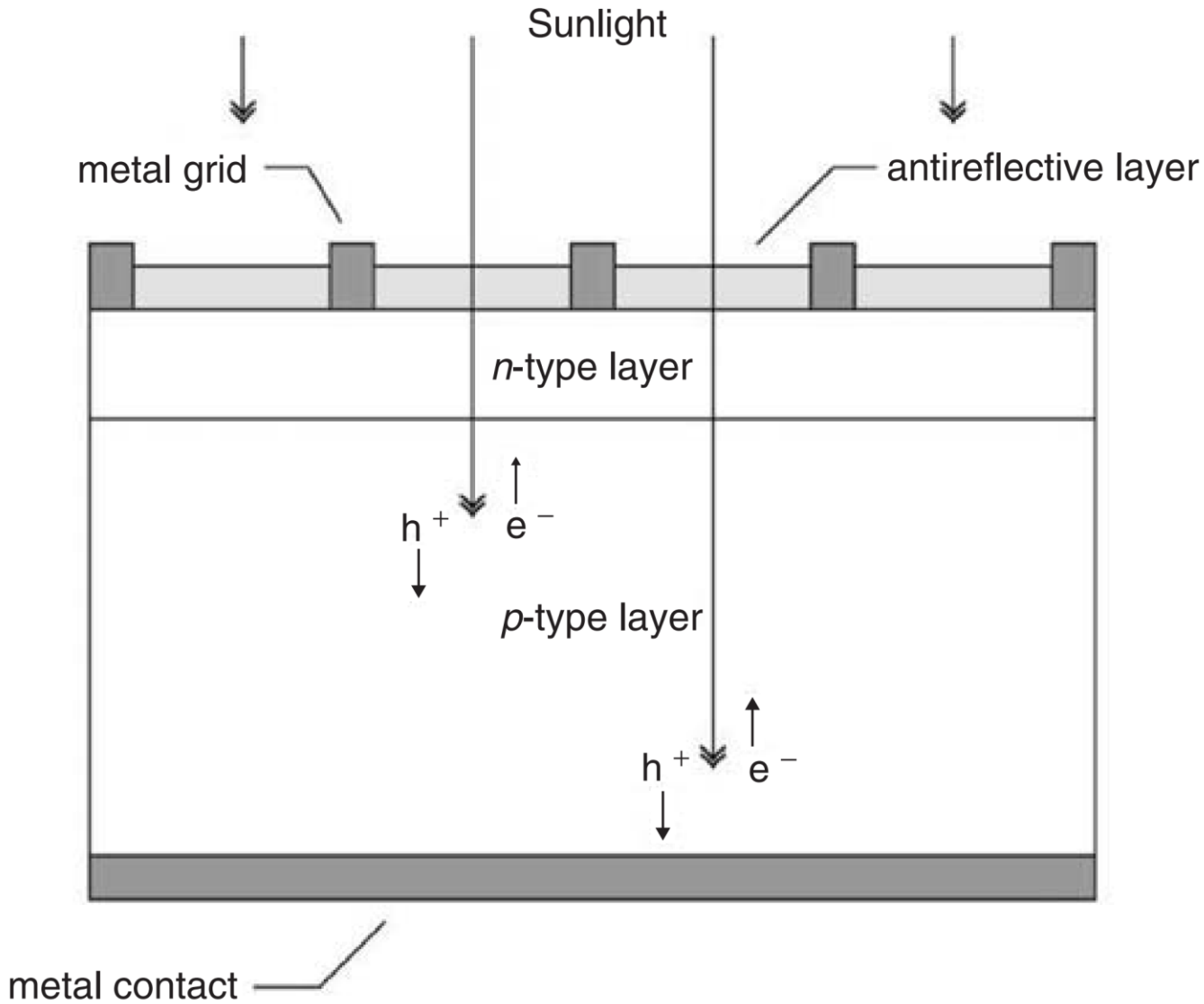

Figure 3.1 A schematic of a simple conventional solar cell. Creation of electron–hole pairs, e^- and h^+, respectively, is depicted

- All electromagnetic radiation, including sunlight, can be viewed as being composed of particles called photons which carry specific amounts of energy determined by the spectral properties of their source.

- Photons also exhibit a wavelike character with the wavelength, λ, being related to the photon energy E_λ by

$$E_\lambda = \frac{hc}{\lambda} \tag{3.1}$$

where h is Plank's constant and c is the speed of light.

- Only photons with sufficient energy to create an electron–hole pair, that is, those with energy greater than the semiconductor bandgap (E_G), will contribute to the energy conversion process.
- Thus, the spectral composition of sunlight is an important consideration in the design of efficient solar cells.
- The sun has a surface temperature of approximately *5762 K* and its radiation spectrum can be approximated by a black body radiator at that temperature.
- Emission of radiation from the sun, as with all black body radiators, is isotropic.

- However, the Earth's great distance from the sun (approximately 93 million miles or 150 million kilometers) means that only those photons emitted directly at the Earth contribute to the solar spectrum as observed from the Earth.
- Therefore, for most practical purposes, the light falling on the Earth can be thought of as parallel streams(جريان) of photons (because of great distance).
- Just above the Earth's atmosphere, the radiation intensity, or solar constant, is about 1.353 kW/m^2

نمایش فیلم

۱- سلول و پنل خورشیدی چیست؟ (به زبان فارسی- زمان: ۹ دقیقه)

۲- اساس کار سلول های خورشیدی(به زبان اصلی و با زیرنویس فارسی- زمان: ۵ دقیقه)

دو فیلم در بخشهایی مشترکند که در خلاصه نویسی نیازی به تکرار آنها نیست.