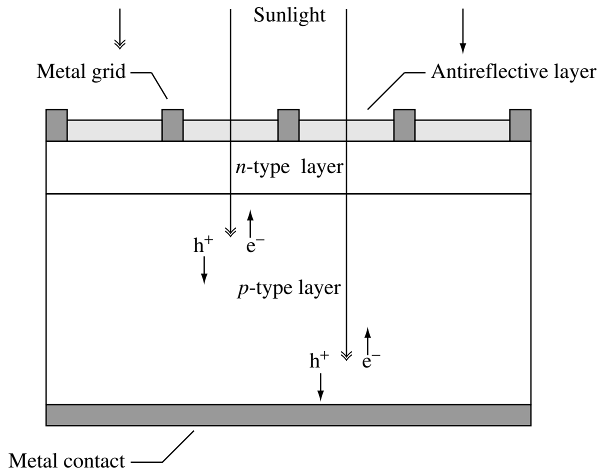

Figure 3.1 A schematic of a simple conventional solar cell. Creation of electron–hole pairs, e^- and h^+, respectively, is depicted

band gap (E_G), will contribute to the energy conversion process. Thus, the spectral nature of sunlight is an important consideration in the design of efficient solar cells.

The sun has a surface temperature of 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) means that only those photons emitted directly in the direction of the Earth contribute to the solar spectrum as observed from Earth. Therefore, for practical purposes, the light falling on the Earth can be thought of as parallel streams of photons. Just above the Earth's atmosphere, the radiation intensity, or Solar Constant, is about 1.353 kW/m^2 [1] and the spectral distribution is referred to as an *air mass zero* (AM0) radiation spectrum. The Air Mass is a measure of how absorption in the atmosphere affects the spectral content and intensity of the solar radiation reaching the Earth's surface. The Air Mass number is given by

$$\text{Air Mass} = \frac{1}{\cos\theta} \tag{3.2}$$

where θ is the angle of incidence ($\theta = 0$ when the sun is directly overhead). The Air Mass number is always greater than or equal to one at the Earth's surface. An easy way to estimate the Air Mass has been given by Green [1] as

$$\text{Air Mass} = \sqrt{1 + (S/H)^2} \tag{3.3}$$

where S is the length of a shadow cast by an object of height H. A widely used standard for comparing solar cell performance is the AM1.5 spectrum normalized to a total power density of 1 kW/m^2. The spectral content of sunlight at the Earth's surface also has a diffuse (indirect) component owing to scattering and reflection in the atmosphere and surrounding landscape and can account for up to 20% of the light incident on a solar