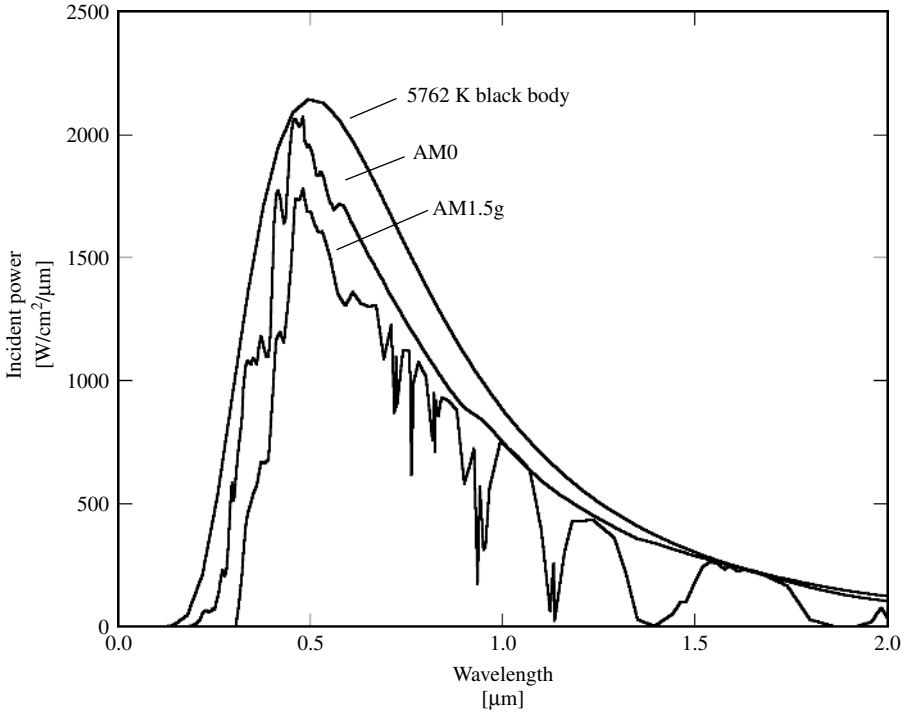

Figure 3.2 The radiation spectrum for a black body at 5762 K, an AM0 spectrum, and an AM1.5 global spectrum

cell. The Air Mass number is therefore further defined by whether or not the measured spectrum includes the diffuse component. An AM1.5g (global) spectrum includes the diffuse component, while an AM1.5d (direct) does not. Black body ($T = 5762$ K), AM0, and AM1.5g radiation spectrums are shown in Figure 3.2. The Air Mass and solar radiation are described in more detail in Chapters 16 and 20.

The physical principles underlying the operation of solar cells are the subject of this chapter. First, a brief review of the fundamental properties of semiconductors is given that includes an overview of semiconductor band structure and carrier generation, recombination, and transport. Next, the electrostatic properties of the *pn*-junction diode are reviewed, followed by a description of the basic operating characteristics of the solar cell, including the derivation (based on the solution of the minority-carrier diffusion equation) of an expression for the current–voltage characteristic of an idealized solar cell. This is used to define the basic solar cell figures of merit, namely, the open-circuit voltage, V_{OC}; the short-circuit current, I_{SC}; the fill factor, FF; the conversion efficiency, η; and the collection efficiency, η_C. Much of the discussion here centers on how carrier recombination is the primary factor controlling solar cell performance. Finally, some additional topics relevant to solar cell operation, design, and analysis are presented. These include the relationship between band gap and efficiency, the solar cell spectral response, parasitic resistive effects, temperature effects, a brief introduction to some modern cell design concepts, and a short overview of detailed numerical modeling of solar cells.