



Figure 14.7 Basic CdTe solar cell structure. The polycrystalline nature of the CdS and CdTe layers are indicated schematically and are not to scale

that found for CuInSe₂/CdS and a-Si thin-film cells [120]. Materials used for the resistive layer include SnO₂ [121], In₂O₃ [122, 123], Ga₂O₃ [105], and Zn₂SnO₄ [124].

Most CdTe cells utilize *n*-type CdS for the window layer immediately adjacent to the CdTe. The processing possibilities for depositing good-quality CdS are nearly as varied as those shown in Figure 14.6 for CdTe and include chemical bath deposition, sputter deposition, and physical vapor deposition. The choice is usually driven by compatibility with the other deposition processes in a fabrication line. It is generally desirable to keep the CdS layer as thin as possible to allow a high fraction of the photons with energy above its band gap to reach the CdTe absorber and hence produce a high photocurrent.

In practice, as will be discussed in more detail later, cell-processing conditions often promote interdiffusion between CdTe and CdS. The resulting band gap shift in CdS reduces the window-layer transmission and lowers the short-wavelength quantum efficiency [125, 126]. This effect can be minimized either by heat treatment of the CdS with CdCl₂ to recrystallize the film or by judicious control of device processing to reduce the remaining CdS thickness [124] effectively to zero [116]. Thin-film CdTe cells with the CdS layer omitted altogether, however, have not performed well as of this writing (see, for example, Table 2 in Reference [122]).

Another strategy to reduce window absorption has been to mix CdS with ZnS to increase the band gap of the layer, and hence the photon transmission, but simple mixing has not produced net performance gains. The highest-efficiency CdTe cells to date have used Cd₂SnO₄ TCO and Zn₂SnO₄ HRT bilayer superstrates to take advantage of their wide optical band gaps and inherent conductive properties, with the Cd₂SnO₄ serving as the TCO layer and Zn₂SnO₄ as the HRT layer. An additional feature of this strategy is that the Zn₂SnO₄ HRT layer contributes to CdS consumption during processing [127].