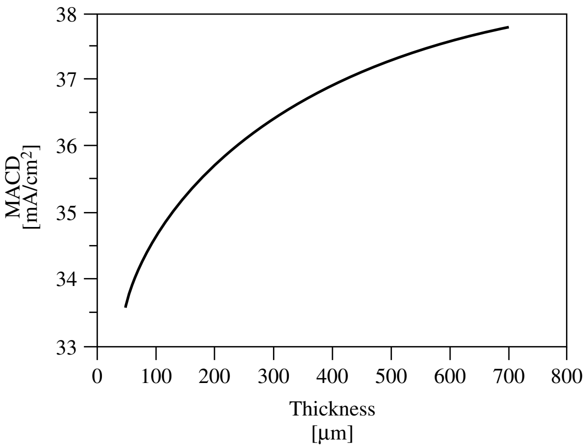

Figure 8.1 Maximum achievable current density (MACD) from a planar, AR-coated Si solar cell as a function of cell thickness. These calculations assume an optimized AR coating and AM1.5 incident spectrum. These results are obtained with *PV Optics*

performed using *photovoltaic* (*PV*) *Optics* software, which assumes the generation of one electron-hole pair per photon and a collection efficiency of unity. These assumptions are tantamount to a zero surface-recombination velocity and absence of other electronic loss mechanisms. Thus, the photocurrent in Figure 8.1 corresponds to a maximum achievable current density for the AM1.5 solar spectrum. Figure 8.1 shows that the photocurrent increases with an increase in thickness and saturates at a thickness of about 700 μm. At a thickness of ∼300 μm, the current density is within 5% of the saturation value, which implies that a thickness of 300 μm is suitable for fabricating high-efficiency solar cells on planar substrates. This is fortunate because a similar demand on wafer thickness comes from requirements for maintaining a high yield in handling and processing other semiconductor devices.

The PV industry has traditionally borrowed technological know-how of device handling and processing from the semiconductor industry, which traditionally uses thick wafers to prevent breakage through mechanical handling or generation of thermal stresses by high-temperature processing. Concomitantly, the PV community found it compelling to use wafers of similar thickness for Si solar cells. The choice of thick wafers permitted the PV community to focus on the material and device-processing issues, which helped develop the science and technology of Si solar cells to the current level.

Recently, however, there have been many advances in wafer handling and in the development of gentler processing methods to accommodate high throughput. These advances have sparked interest in using thinner substrates for two reasons: (1) To reduce the amount of Si for each watt of PV energy generation. Because the PV industry has gone through periods of Si shortage, an efficient use of Si can minimize such hardships; and (2) To improve the efficiency of solar cells fabricated on low-cost substrates using improved cell designs.