Figure 8.16 shows that the MACDs in FTBP and DT cells are much higher than that of FPBT cells, although the metal loss of DT cells is not too different from those of FPBT cells. It can be seen that, with proper optical design, the MACD tends to saturate when the cell is in excess of 10 ~ 15 μm. Thus, from the view of the optical designer, the thickness of thin-film solar cells should be around 10 ~ 20 μm to obtain maximum benefit. Indeed, it is expected that 10 ~ 20-μm-thick cells with proper light-trapping will generate the same J_{SC} as 300-μm-thick cells.

Several processing techniques that can produce texturing in the silicon solar cells were mentioned earlier. They can produce texture with vastly different shapes. We will now briefly discuss the influence of different texture shapes on the properties of thin-film solar cells. For the pyramid-shaped texture pits, three parameters will control the properties of the texture structure: the depth, the bottom angle, and the density of the texture pits. A set of calculations is performed on the cell structure shown in Figure 8.13 using different texture configurations. The terminology used in the text is as follows: the pyramid-shaped pits on the textured surface are simply called *texture pits*. The geometry parameters of the texture pits, such as the depth and the bottom angle, are illustrated in Figure 8.17. When the density of the texture pits is investigated, the ratio between the area of the textured part and the whole area is called area ratio (in which the "area" of a region is actually the length of the corresponding region).

8.3.2.1 Influence of the texture height on MACD

As pointed out earlier in this chapter, texture is typically generated by exposure of (111) crystallographic planes that subtend an angle of 70.4° with each other. To investigate the effect of the texture height on the photocurrent generation, we will assume that pits, having a texture angle of 70.4°, cover the whole surface of the cell. Calculated MACD for a solar cell having a 10-μm-thick Si absorber is about 31 mA/cm^2. This value is nearly independent of the texture height (between 0.1 and 2 μm), when the bottom angle remains unchanged. This indicates that very shallow texture pits can be used in the device without degrading performance. This conclusion is important to the thin-film cell structure, which will not accommodate deep pits.

8.3.2.2 Influence of the bottom angle of the texture pits on MACD

In a previous section, we mentioned that texturing produced by chemical etching will result in a fixed texture angle. Many other ways of texturing have been developed recently for

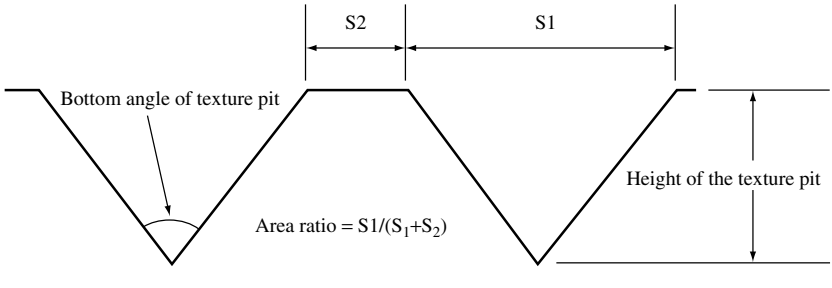

Figure 8.17 The geometry and the terminology used in the texture shape study [19]