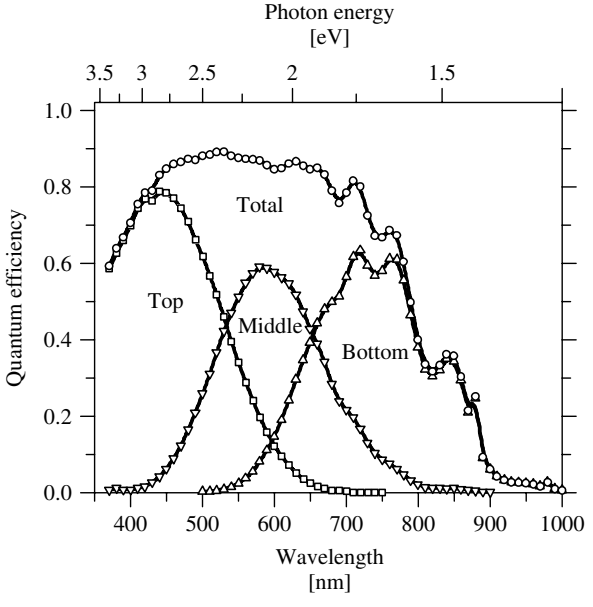

Short-circuit current J_{SC} [mA/cm^2]

	AM1.5	Xenon
Top	6.87	7.19
Middle	7.84	7.98
Bottom	8.62	7.34
Total	23.33	22.51

Figure 12.26 Quantum efficiency curves of component cells of a typical triple-junction solar cell. The table indicates the short-circuit current densities J_{SC} for the component cells measured for AM1.5 illumination and with a xenon illuminator [158]

12.5.3.5 Matching component cells in multijunction designs

In matching component cell currents in the triple cell design, researchers usually take the following steps. Take the triple cell in Figure 12.26 as an example. The design is largely dictated by the bottom a-SiGe component cell. If this component cell were fabricated on the back reflector as a stand-alone single-junction cell, it would have a short-circuit current around 23 mA/cm^2 and a *QE* curve similar to the one labeled "Total" in Figure 12.26. In order to achieve current matching in the triple cell, a stand-alone, single-junction version of the middle a-SiGe component cell (without a back reflector) needs to generate about two-third of the bottom cell's current. The band gap and/or the thickness of the a-SiGe middle component cell's *i*-layer are then adjusted to accomplish this. Finally, the top component cell's thickness is adjusted to obtain one-third of the bottom cell's current (again, without a back reflector). In this way, all three cells would have the same current when they are stacked in series.

In Figure 12.26, the long-wavelength behavior of the *QE* curves for each of the component cells is determined by the component cell's *i*-layer thickness and band gap, and (for the bottom component cell) by the back reflector performance. However, the short-wavelength behaviors for the middle and bottom component cell's *QE* curves are largely determined by the thicknesses and band gaps of the top and middle cells, respectively, since these component cells act as filters for the shorter wavelength (higher energy) photons. The short-wavelength behavior of *QE* for the top cell is sensitive to the absorption of ITO and top cell *p*-layer as well as the loss of electrons that are diffused back to the *p*-layer and get trapped.