higher efficiencies. This approach is limited by the availability of high band gap materials that are lattice matched to InP and by the weight and current cost of the InP substrates.

9.8.4 Spectrum Splitting

Over the years, a number of groups have proposed to separate the light, shining each portion on a solar cell optimized for that wavelength range. If four or five single-junction solar cells are used, the theoretical efficiency is quite high. However, the balance-of-system issues imply that this approach only makes sense for space missions for which high efficiency is essential, and the economics allow for the added cost of multiple substrates without requiring a high concentration ratio.

9.9 IMPLEMENTATION INTO TERRESTRIAL SYSTEMS

The implementation of multijunction III-V cells into terrestrial concentrator systems will require appropriate design of the optics, optical coupling between the optics and cells, avoidance of chromatic aberration problems, heat sinking of the cells, electrical connections/isolation, and large-scale production to reduce the cost to an acceptable range.

9.9.1 Economic Issues

The current economics imply that the cells should be implemented in a system with a concentration of about 400X or higher. The cell cost is estimated to be in the range of \$3 to 10/cm^2 [146]. Swanson estimates that the cost of electricity from a medium-sized dish-concentrator PV plant in Albuquerque, New Mexico, would be 7 to 15 cents/kWh [13]. He assumed that the cell cost would be \$3 to 10/cm^2, with an efficiency of 28.5 to 33.25% and a concentration ratio of 1000 [13].

9.9.2 Concentrator Systems

Several point-focus designs are available or are being developed. Amonix is installing Si-based concentrators using Fresnel lenses and concentration near 250X [147]. Solar Systems is installing reflective dishes using Si solar cell receivers [148]. Spectrolab and Concentrating Technologies are designing a III-V multijunction solar cell receiver for a dish [149]. With the dishes, a key issue is uniformity of the illumination. The solar cells must be connected in series to boost the voltage, but the current that comes out will be determined by the cell illuminated by the smallest amount of sunlight. SunPower is developing a high-concentration, thin (flat-plate-like) concentrator [150]. ENTECH is redesigning their terrestrial concentrator for use with III-V multijunction cells. The Ioffe and Fraunhofer Institutes have joined to design a 130X glass-Fresnel concentrator using III-V cells [151]. A more complete description of concentrator systems is included in Chapter 11. A number of designs for using multijunction cells under low concentration for space applications are reviewed in Chapter 10.