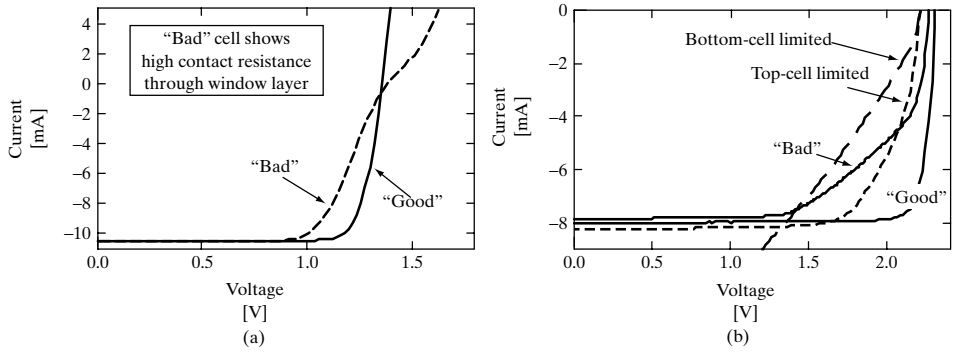

Figure 9.18 (a) Comparison of *I-V* curves for a "good" GaInP cell and a GaInP cell with an extra junction caused by the AlInP window. Transmission line measurements showed that the contact resistance was high through the window layer. (b) *I-V* curves for good and bad GaInP/GaAs tandem cells. The "bad" curve shows a shunt; measurements of the same cell under bottom-cell limited and top-cell limited conditions show that the shunt is in the bottom junction

are easiest to observe at high concentration because the V_{OC} of the Ge junction increases faster with the photocurrent than that of the intended junction. Spurious junctions in the Ge may add, subtract, or do both (in the case of back-to-back junctions) to the V_{OC}.

When a two-junction cell shows evidence of shunting, it is useful to determine which of the two junctions is shunted. This can be determined by measuring the light *I-V* curve under two different spectra, one of which reduces the photocurrent of the top junction, and the other which reduces the photocurrent of the bottom junction [120]. The example in Figure 9.18(b) shows a case in which the bottom cell is shunted. This sort of problem is often related to defects originating from particulate or poor wafer quality. Particulate exposure before or during growth is often a bigger problem for GaInP/GaAs cells than for single-junction cells.

9.8 FUTURE-GENERATION SOLAR CELLS

The GaInP/GaAs/Ge cell is close to maturity for space applications, but the efficiencies being reported by the manufacturers are continuing to increase, with champion cells measuring near 30% AM0 efficiency [122]. The efficiency reported by Spectrolab for a terrestrial concentrator version of the GaInP/GaAs/Ge solar cell [14, 123] is likely to improve. The theoretical efficiency is 45% at 500 suns under the AM1.5 global spectrum. Historically, III-V based multijunction cells have achieved 80% to 90% of their theoretical efficiencies [99].

9.8.1 Refinements to the GaInP/GaAs/Ge Cell

An improvement in the AM0 efficiency of the GaInP/GaAs/Ge cell is predicted when the GaInP band gap is increased. However, addition of aluminum to the GaInP cell has been shown to increase the band gap, but not the efficiency, of the top cell because the J_{SC} was reduced by more than 10% while the V_{OC} increased only slightly, if at all,