conduction in the emitters of the other subcells, so only the top-cell emitter conductivity is important). This may be accomplished by raising the emitter doping and/or the thickness. Because doing so may decrease the quantum efficiency of the top subcell, increasing the conductivity is a trade-off that must be made carefully. Achieving a sufficiently high emitter conductivity is easier for n/p than for p/n devices, because of the higher *majority*-carrier mobility in n-type material than in otherwise comparable p-type material.

At least as important to the concentrator operation of monolithic two-terminal multijunction devices is the necessity for tunnel-junction interconnects (TJICs) with low series resistance, high peak tunneling currents, and low absorption losses. These considerations are discussed in more detail later in this chapter.

9.5.9.4 Measured performance of GaInP/GaAs/Ge concentrator cell

The considerations of device performance versus concentration that we have just described are well illustrated by the plot of efficiency versus concentration for the GaInP/GaAs/Ge three-junction concentrator device, as shown in Figure 9.10. For concentrator operation, this device incorporated adaptations to the top-subcell emitter conductivity, the grid-finger spacing, and the top-subcell current-matching thickness. The V_{OC} of the resulting device increases with concentration at a rate quite near the ideal 60 mV/junction/decade. Because of the low one-sun current and the low series resistance, the fill factor remains virtually unaffected by series-resistance losses until several hundred suns concentration. At higher concentration, the increasingly dominant series resistance causes the efficiency to roll off. Note, however, that at 1000 suns, the efficiency is still well in excess of 30%.

9.5.9.5 Linearity

In measuring the concentration dependence of device performance, it is usually assumed that J_{SC} is linear with concentration, so that J_{SC} can be used as the measure of the concentration level. The assumption of linearity is generally considered to be quite good

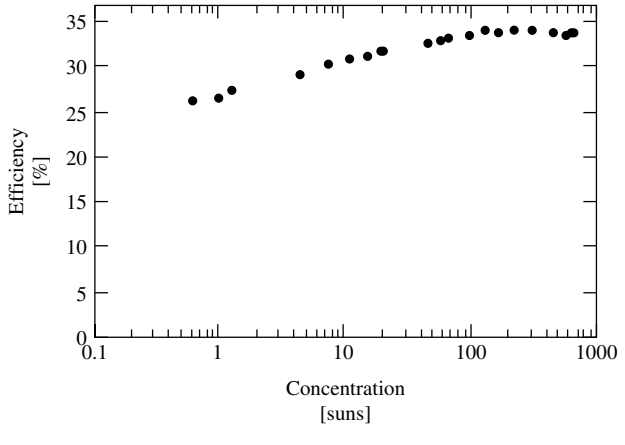

Figure 9.10 Efficiency versus concentration of a state-of-the-art GaInP/GaAs/Ge cell under the AM1.5 global spectrum [14]