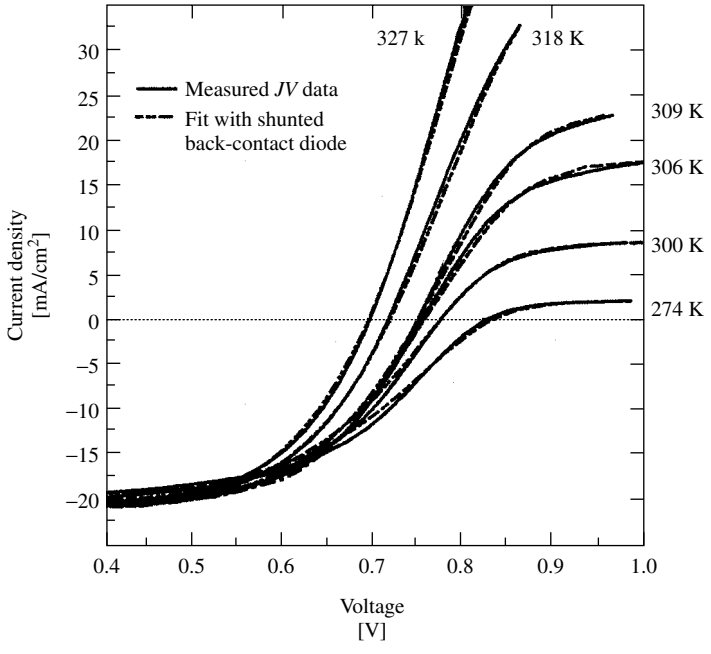


**Figure 14.22** Measured and calculated curves for a CdTe cell with a back-contact barrier [162]

The effect of a back-contact barrier on the device band diagram was shown earlier in Figure 14.20. The effect on measured $J-V$ curves is illustrated in Figure 14.22. Assuming the two depletion regions do not overlap, the two diodes can be treated as independent circuit elements. The calculated fit to the curves, with a back-diode barrier height of 0.3 eV, is in fact quite good. The impact of the back barrier becomes larger as the temperature is lowered. This impact is very dramatic in the first quadrant, where the shape of the $J-V$ curves is commonly described as "rollover" [163–165]. The degree of "rollover" of $J-V$ curves such as those illustrated in Figure 14.22 has been shown to be related to the amount of copper used in the fabrication of the back contact [166]. With smaller amounts of copper, "rollover" is observed at higher temperatures implying a larger back-contact barrier, and it has a greater impact on cell performance.

The addition of large amounts of copper to reduce the back-contact barrier, and hence inhibit "rollover", however, can lead to a decrease is CdTe cell stability, at least for cells held at elevated temperatures. Several authors have seen significant performance changes when CdTe cells were held at high temperatures (typically 60–110°C) for extended periods of time [167–171]. Such studies, often referred to as "stress" tests, generally first see a decrease in fill factor and next in $V_{OC}$. Only in extreme cases is $J_{SC}$ affected. Figure 14.23 shows the illuminated $J-V$ curves for an NREL-manufactured CdTe cell soon after it was fabricated, and at different periods of time following light soaking at 100°C under open-circuit bias. Such curves are typical of those seen with cells from different manufacturers. The dark $J-V$ curves for these and other CdTe cells also show a progressive increase in "rollover" with continuing temperature stress. Qualitatively similar $J-V$ characteristics are measured for the devices of Figures 14.22 and 14.23,