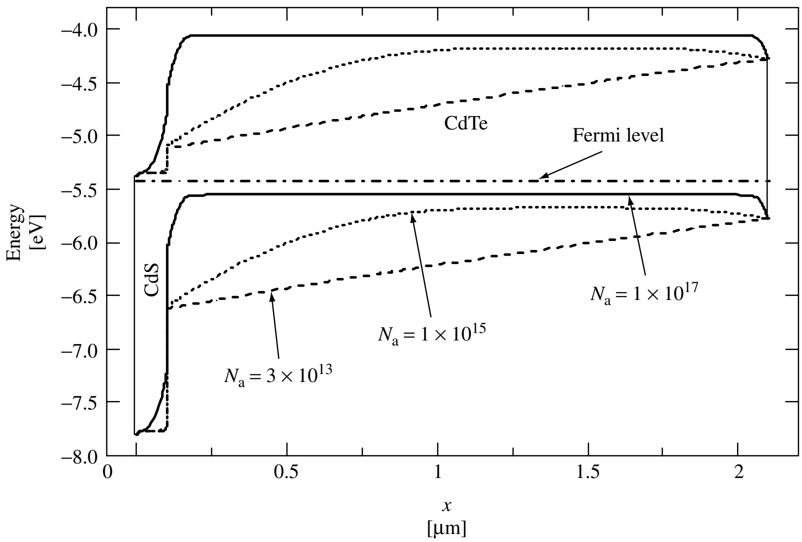

Figure 14.20 CdTe/CdS junction band diagrams at V = 0 for three values of CdTe acceptor density and a back-contact barrier = 0.3 eV

contact have generally involved the use of other tellurides, such as ZnTe:N [158] and Sb_2Te_3 [159], that can make reasonable contact to the CdTe and form only modest barriers with an appropriate metal. To date, however, contacts demonstrably free of Cu have not shown significant promise.

One consequence of a back-contact barrier, and the value of keeping it small, can be seen in the band diagrams of Figure 14.20 calculated by Alan Fahrenbruch for a 2-μm-thick CdTe layer [160]. The back contact is essentially a second diode with opposite polarity and smaller barrier than the primary junction. For a thick absorber, or one with reasonably large carrier density (solid curve), the bands are flat over most of the absorber thickness, the primary junction effectively blocks modest forward currents, and the back barrier has only a minor effect on the current–voltage curves. For carrier densities more typical of CdTe (between dashed and dotted lines), however, the depletion widths of the primary and back-contact diodes overlap. The effective reduction in the barrier for electrons means that forward current can flow more easily, reducing the open-circuit voltage.

14.3.5 Solar Cell Characterization

Considerable information about the electrical properties of CdTe solar cells has been deduced from straightforward measurements of current versus voltage ($J-V$), quantum efficiency (QE) and capacitance versus frequency ($C-f$) and voltage ($C-V$). More detailed information can be obtained from the temperature dependence or the time evolution of these curves.

The $J-V$ curve (Figure 14.2) for the record-efficiency cell follows a standard diode equation with additional factors included to take account of circuit resistance and