technologies and as long as methods for the correlation between results using the reference spectrum and results from "real world" spectra is established. The technical basis for the direct spectra has recently been reexamined and found to have a diffuse component that is substantially greater than that concentrators would normally encounter [19, 20]. On examination of the US solar radiation database, it was found that when the global-normal irradiance is near 1000 Wm^{-2}, the direct-normal component is near 850 Wm^{-2} and not the 767 Wm^{-2} that the direct standard spectrum integrates into [20]. This difference has been attributed to an aerosol optical depth at 500 nm of 0.27 in the terrestrial reference spectra [20]. This has not been a problem for single junction PV concentrators in the past because of their relative insensitivity to the specific direct spectra [21]. Recent high-efficiency structures such as the GaInP/GaAs/Ge triple-junction solar cell exhibit a significant difference in the efficiency between the global and direct reference spectrum (>10% relative) [22, 23] as shown in Figure 16.2. It has been proposed that the direct reference spectrum be modified to have a lower aerosol optical depth of 0.066 broadband or 0.085 at 500 nm to better represent the spectral irradiance in sunny regions (average daily direct-beam energy greater than 6 kWh/m^2/day) where concentrators might be deployed [22]. This low aerosol optical depth direct beam reference spectrum was generated using the same atmospheric conditions as the current terrestrial reference spectrum [10, 12, 13, 18] and has been adopted at NREL for evaluating concentrators as of January 2003. Tabular values of this direct beam spectrum can be found at the following web sites: *http://www.nrel.gov/highperformancepv/* or *http://rredc.nrel.gov/solar/standards/am1.5/*.

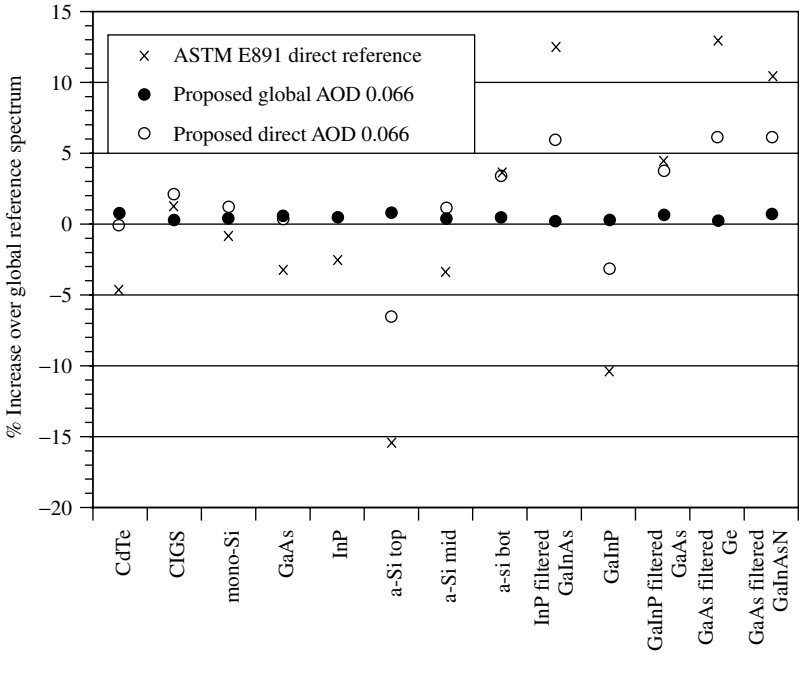

Figure 16.2 Percentage change in the normalized short-circuit current from the normalized global reference spectrum for various state-of-the-art PV technologies compared with the proposed direct reference spectra