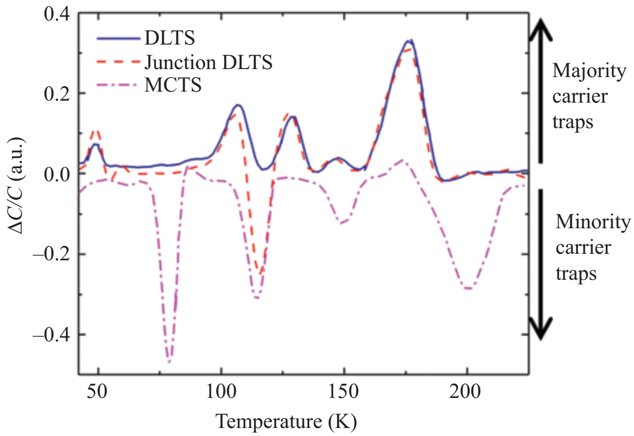

Figure 1.6 The figure shows a DLTS, a junction DLTS and an MTCS spectrum, where the DLTS only exhibits majority carrier traps, MCTS only minority carrier traps, while the junction DLTS spectrum comprises both majority and minority carrier traps

assuming that the optical emission dominates over thermal emission rates. In general, the steady-state occupancy within the depletion region will be given by

$$n_t^o(\infty) = \frac{e_p^o + e_p^{th}}{e_p^o + e_p^{th} + e_n^o + e_n^{th}} \cdot N_t$$

If the temperature is sufficiently low so that thermal emission rates can be neglected, the capture rate at the depletion edge can be defined as $c_n(x^o) = e_n^o + e_p^o$.

The capture rate will fall exponentially with distance moving into the depletion region from the depletion edge. Thus, the change in occupancy will be sufficiently abrupt, so that it can be represented as a step in the charge carrier concentration, with a distance λ^o from the depletion edge. The transition region can then be described by $\lambda^o = L_D\left[2\ln\left(n\langle v_n\rangle\sigma_n/e_n^o + e_p^o\right)\right]^{1/2}$, where $\langle v_n\rangle$ is the average drift velocity of electrons and L_D is the Debye length. When the photon energy is less than half the band gap, carrier emission to the nearest band edge is likely to dominate and only one optical emission rate applies to the equation above.

These considerations can be utilized in different techniques and applications. A steady-state approach is to measure the capacitance as a function of photon energy at a given temperature. This method is labeled steady-state photocapacitance (SSPC) and can be considered as an optical equivalent to thermal admittance spectroscopy. Although we are here concerned with transient techniques, it is instructive to discuss SSPC briefly in order to better understand the transient version of deep-level optical spectroscopy (DLOS).

SSPC measurements use optical excitation to probe deep levels in a semiconductor. The sample temperature is reduced to a temperature where optical