12.2 BAND BENDING AND THE EFFECT OF BIAS VOLTAGES

To simplify the presentation of the picture of energy band bending in semiconductors, we initially assume that the work function difference between the metal and the semiconductor is zero. As a result of this assumption, and for zero applied voltage, the Fermi levels of the metal and the silicon are aligned and there are no voltage drops in the oxide and in the silicon. Later on, and when it becomes necessary, we will take account of the work function difference together with other similar effects in our analytical relationships.

When a voltage is applied to the MOS diode of Fig. 12.1, the energy levels E_C, E_i, and E_V are bent, as shown by the drawings in Fig. 12.4, because some of the applied voltage is dropped in the semiconductor at the interface with the oxide. Since there is no current in the MOS diode, the position of the Fermi level in silicon does not change, but that of E_C, E_V, and E_i changes. When E_i is above E_F, the majority carriers are holes, and when E_i is below E_F, the majority carriers are electrons.

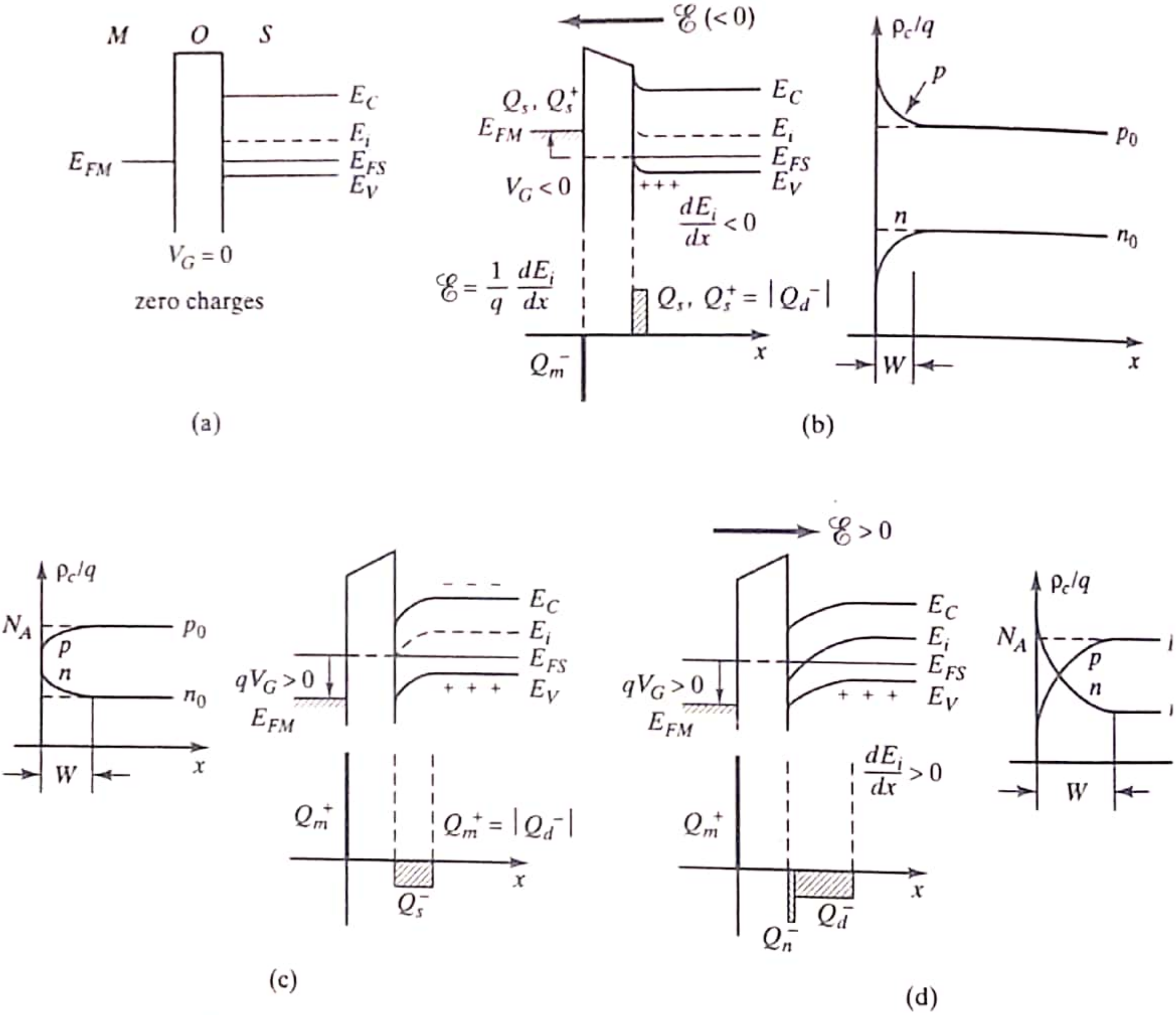

Figure 12.4 Energy band diagrams and charge distributions for (a) zero bias, (b) accumulation, (c) depletion, and (d) inversion.