Example 3.1

Consider a chrome-silicon metal-semiconductor junction with $N_d = 10^{17}$ cm^{-3}. Calculate the barrier height and the built-in potential. Repeat for a p-type semiconductor with the same doping density.

Solution

The barrier height equals:

$$f_B = \Phi_M - c = 4.5 - 4.05 = 0.45 \text{ V}$$

Note that this value differs from the one listed in Table 3.2.1 since the work function in vacuum was used. See the discussion in the text for more details.

The built-in potential equals:

$$f_i = f_B - V_t \ln \frac{N_c}{N_d} = 0.45 - 0.0259 \times \ln \frac{2.82 \times 10^{19}}{10^{17}} = 0.30 \text{ V}$$

The barrier height for the chrome/p-silicon junction equals:

$$f_B = c + \frac{E_g}{q} - \Phi_M = 4.05 + 1.12 - 4.5 = 0.67 \text{ V}$$

And the built-in potential equals:

$$f_i = f_B - V_t \ln \frac{N_v}{N_a} = 0.67 - 0.0259 \times \ln \frac{1.83 \times 10^{19}}{10^{17}} = 0.53 \text{ V}$$