Example 2.4b

Calculate the intrinsic carrier density in germanium, silicon and gallium arsenide at 300, 400, 500 and 600 K.

Solution

The intrinsic carrier density in silicon at 300 K equals:

$$n_i(300\text{ K}) = \sqrt{N_c N_v}\,\exp\left(\frac{-E_g}{2kT}\right)$$

$$= \sqrt{2.81\times10^{19}\times1.83\times10^{19}}\,\exp\left(\frac{-1.12}{2\times0.0258}\right)$$

$$= 8.72\times10^{9}\ \text{cm}^{-3}$$

Similarly one finds the intrinsic carrier density for germanium and gallium arsenide at different temperatures, yielding:

	Germanium	Silicon	Gallium Arsenide
300 K	2.02 x 10^{13}	8.72 x 10^{9}	2.03 x 10^{6}
400 K	1.38 x 10^{15}	4.52 x 10^{12}	5.98 x 10^{9}
500 K	1.91 x 10^{16}	2.16 x 10^{14}	7.98 x 10^{11}
600 K	1.18 x 10^{17}	3.07 x 10^{15}	2.22 x 10^{13}