Room temperature properties of semiconductors

Quantity	*Symbol*	*Ge*	*Si*	*InAs*	*InP*	*GaAs*	*GaP*	*GaN*	*(Unit)*
Crystal structure		D	D	Z	Z	Z	Z	W	–
Gap: Direct (*D*) / Indirect (*I*)		*I*	*I*	*D*	*D*	*D*	*I*	*D*	–
Lattice constant	a_0 =	5.64613	5.43095	6.0584	5.8686	5.6533	5.4512	a_0 = 3.189 c_0 = 5.185	Å Å
Bandgap energy	E_g =	0.66	1.12	0.354	1.35	1.42	2.26	3.4	eV
Intrinsic carrier concentration	n_i =	2×10^{13}	1×10^{10}	7.8×10^{14}	1×10^{7}	2×10^{6}	1.6×10^{0}	1.9×10^{-10}	cm^{-3}
Effective DOS at CB edge	N_c =	1.0×10^{19}	2.8×10^{19}	8.3×10^{16}	5.2×10^{17}	4.4×10^{17}	1.9×10^{19}	2.3×10^{18}	cm^{-3}
Effective DOS at VB edge	N_v =	6.0×10^{18}	1.0×10^{19}	6.4×10^{18}	1.1×10^{19}	7.7×10^{18}	1.2×10^{19}	1.8×10^{19}	cm^{-3}
Electron mobility	μ_n =	3900	1500	33,000	4600	8500	110	1500	cm^2/Vs
Hole mobility	μ_p =	1900	450	450	150	400	75	30	cm^2/Vs
Electron diffusion constant	D_n =	101	39	858	120	220	2.9	39	cm^2 / s
Hole diffusion constant	D_p =	49	12	12	3.9	10	2	0.75	cm^2 / s
Electron affinity	χ =	4.0	4.05	4.9	4.5	4.07		4.1	V
Minority carrier lifetime	τ =	10^{-6}	10^{-6}		10^{-8}	10^{-8}		10^{-9}	s
Electron effective mass	m_e^* =	1.64 m_e	0.98 m_e	0.022	0.08 m_e	0.067 m_e	0.82 m_e	0.20 m_e	–
Heavy hole effective mass	m_{hh}^* =	0.28 m_e	0.49 m_e	0.40	0.56 m_e	0.45 m_e	0.60 m_e	0.80 m_e	–
Relative dielectric constant	ε_r =	16.0	11.9	15.1	12.4	13.1	11.1	8.9	–
Refractive index	$n_{optical}$ =	4.0	3.3		3.4	3.4		2.5	–
Absorption coefficient near E_g	α =	10^3	10^3	10^4	10^4	10^4	10^3	10^4	cm^{-1}

Note:

- D = Diamond. Z = Zincblende. W = Wurtzite. DOS = Density of states. VB = Valence band. CB = Conduction band
- The Einstein relation relates the diffusion constant and mobility in a nondegenerately doped semiconductor: $D = \mu\,(k\,T\,/\,e)$
- Minority carrier diffusion lengths are given by $L_n = (D_n\tau)^{1/2}$ and $L_p = (D_p\tau)^{1/2}$
- The mobilities and diffusion constants apply to low doping concentrations ($\approx 10^{15}$ cm^{-3}). As the doping concentration increases, mobilities and diffusion constants decrease.
- The minority carrier lifetime τ applies to doping concentrations of 10^{18} cm^{-3}. For other doping concentrations, the lifetime τ is given by $\tau = B^{-1}\,(n+p)^{-1}$, where $B_{GaAs} = 10^{-10}$ cm^3/s and $B_{Si} = 10^{-12}$ cm^3/s.