Room temperature properties of semiconductors

Quantity	***Symbol***	***Si***	***Ge***	***(Unit)***
Crystal structure		D	D	–
Gap: Direct (*D*) / Indirect (*I*)		*I* *I*		–
Lattice constant	a_0 =	5.43095	5.64613	Å
Bandgap energy	E_g =	1.12	0.66	eV
Intrinsic carrier concentration	n_i =	1×10^{10}	2×10^{13}	cm^{-3}
Effective DOS at CB edge	N_c =	2.8×10^{19}	1.0×10^{19}	cm^{-3}
Effective DOS at VB edge	N_v =	1.0×10^{19}	6.0×10^{18}	cm^{-3}
Electron mobility	μ_n =	1500	3900	cm^2/Vs
Hole mobility	μ_p =	450	1900	cm^2/Vs
Electron diffusion constant	D_n =	39	101	cm^2 / s
Hole diffusion constant	D_p =	12	49	cm^2 / s
Electron affinity	χ =	4.05	4.0	V
Minority carrier lifetime	τ =	10^{-6}	10^{-6}	s
Electron effective mass	m_e* =	0.98 m_e	1.64 m_e	–
Heavy hole effective mass	m_{hh}* =	0.49 m_e	0.28 m_e	–
Relative dielectric constant	ε_r =	11.9	16.0	–
Refractive index near E_g	$\bar{n}$ =	3.3	4.0	–
Absorption coefficient near E_g	α =	10^3	10^3	cm^{-1}

- 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 non-degenerately doped semiconductor: $D = \mu\,(k\,T / e)$
- Minority carrier diffusion lengths are given by $L_n = (D_n\tau_n)^{1/2}$ and $L_p = (D_p\tau_p)^{1/2}$
- 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 is given by $\tau = B^{-1}\,(n + p)^{-1}$, where $B_{Si} = 10^{-12}$ cm^3/s.

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