

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	$\mu_n =$	3900	1500	33,000	4600	8500	110	1500	cm^2/Vs
Hole mobility	$\mu_p =$	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	$\chi =$	4.0	4.05	4.9	4.5	4.07		4.1	V
Minority carrier lifetime	$\tau =$	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	$\epsilon_r =$	16.0	11.9	15.1	12.4	13.1	11.1	8.9	–
Refractive index	$n_{\text{optical}} =$	4.0	3.3		3.4	3.4		2.5	–
Absorption coefficient near E_g	$\alpha =$	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 ($\approx 10^{15} \text{ cm}^{-3}$). 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 $B_{\text{GaAs}} = 10^{-10} \text{ cm}^3/\text{s}$ and $B_{\text{Si}} = 10^{-12} \text{ cm}^3/\text{s}$.