Room temperature properties of semiconductors

Quantity	***Symbol***	***AlAs***	***GaAs***	***InAs***	***(Unit)***
Crystal structure		Z	Z	Z	–
Gap: Direct (*D*) / Indirect (*I*)		*I*	*D*	*D*	–
Lattice constant	a_0 =	5.6611	5.6533	6.0584	Å
Bandgap energy	E_g =	2.168	1.42	0.354	eV
Intrinsic carrier concentration	n_i =	10	2×10^6	7.8×10^{14}	cm^{-3}
Effective DOS at CB edge	N_c =	1.5×10^{19}	4.4×10^{17}	8.3×10^{16}	cm^{-3}
Effective DOS at VB edge	N_v =	1.7×10^{19}	7.7×10^{18}	6.4×10^{18}	cm^{-3}
Electron mobility	μ_n =	200	8500	33,000	cm^2/Vs
Hole mobility	μ_p =	100	400	450	cm^2/Vs
Electron diffusion constant	D_n =	5.2	220	858	cm^2 / s
Hole diffusion constant	D_p =	2.6	10	12	cm^2 / s
Electron affinity	χ =	3.50	4.07	4.9	V
Minority carrier lifetime	τ =	10^{-7}	10^{-8}	10^{-8}	s
Electron effective mass	m_e^* =	0.146 m_e	0.067 m_e	0.022 m_e	–
Heavy hole effective mass	m_{hh}^* =	0.76 m_e	0.45 m_e	0.40 m_e	–
Relative dielectric constant	ε_r =	10.1	13.1	15.1	–
Refractive index near E_g	$\bar{n}$ =	3.2	3.4	3.5	–
Absorption coefficient near E_g	α =	10^3	10^4	10^4	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 $B_{GaAs} = 10^{-10}$ cm^3/s.