Room temperature properties of semiconductors: III–V nitrides

Quantity	***Symbol***	***AlN***	***GaN***	***InN***	***(Unit)***
Crystal structure		W	W	W	–
Gap: Direct (*D*) / Indirect (*I*)		*D*	*D*	*D*	–
Lattice constant	$a_0 =$	3.112	3.191	3.545	Å
	$c_0 =$	4.982	5.185	5.703	Å
Bandgap energy	$E_g =$	6.28	3.425	0.77	eV
Intrinsic carrier concentration	$n_i =$	9.4×10^{-34}	1.9×10^{-10}	920	cm^{-3}
Effective DOS at CB edge	$N_c =$	6.2×10^{18}	2.3×10^{18}	$9{:}0\times10^{17}$	cm^{-3}
Effective DOS at VB edge	$N_v =$	4.9×10^{20}	1.8×10^{19}	5.3×10^{19}	cm^{-3}
Electron mobility	$\mu_n =$	300	1800	3200	cm^2/Vs
Hole mobility	$\mu_p =$	14	30	–	cm^2/Vs
Electron diffusion constant	$D_n =$	7	39	80	cm^2 / s
Hole diffusion constant	$D_p =$	0.3	0.75	–	cm^2 / s
Electron affinity	$\chi =$	1.9	4.1	–	V
Minority carrier lifetime	$\tau =$	–	10^{-8}	–	s
Electron effective mass	$m_e^* =$	0.40 m_e	0.20 m_e	0.11 m_e	–
Heavy hole effective mass	$m_{hh}^* =$	3.53 m_e	0.80 m_e	1.63 m_e	–
Relative dielectric constant	$\varepsilon_r =$	8.5	8.9	15.3	–
Refractive index near E_g	$\overline{n} =$	2.15	2.5	2.9	–
Absorption coefficient near E_g	$\alpha =$	3×10^5	10^5	6×10^4	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 $B_{GaN} \approx 10^{-10}$ cm^3/s.

© E. F. Schubert