Appendix G

Properties of Important Semiconductors

	Lattice Constant at 300 K (Å)
	3.56683
	5.64613
	5.43095
	6.48920
	$a = 3.086$, $c = 15.117$
	5.6605
	5.4510
	6.1355
	3.6150
	4.5380
	5.6533
	$a = 3.189$, $c = 5.185$
	5.4512
	6.0959
	6.0584
	5.8686
	6.4794
	5.8320
	$a = 4.16$, $c = 6.756$
	6.050
	6.482
	4.580
	5.420
	$a = 3.82$, $c = 6.26$
	5.9362
	6.4620

Semiconductor		Bandgap (eV) 300 K	Bandgap (eV) 0 K	Mobility at 300 K (cm^2/V-s)[a] Elec.	Mobility at 300 K (cm^2/V-s)[a] Holes	Band[b]	Effective Mass m^*/m_0 Elec.	Effective Mass m^*/m_0 Holes	ϵ_s/ϵ_0
Element	C	5.47	5.48	1800	1200	I	0.2	0.25	5.7
	Ge	0.66	0.74	3900	1900	I	1.64[c]	0.04[e]	16.0
	Si	1.12	1.17	1500	450	I	0.082[d] 0.98[c]	0.28[f] 0.16[e]	11.9
	Sn		0.082	1400	1200	D	0.19[d]	0.49[f]	
IV–IV	α-SiC	2.996	3.03	400	50	I	0.60	1.00	10.0
III–V	AlSb	1.58	1.68	200	420	I	0.12	0.98	14.4
	BN	~7.5				I			7.1
	BP	2.0							
	GaN	3.36	3.50	380			0.19	0.60	12.2
	GaSb	0.72	0.81	5000	850	D	0.042	0.40	15.7
	GaAs	1.42	1.52	8500	400	D	0.067	0.082	13.1
	GaP	2.26	2.34	110	75	I	0.82	0.60	11.1
	InSb	0.17	0.23	80000	1250	D	0.0145	0.40	17.7
	InAs	0.36	0.42	33000	460	D	0.023	0.40	14.6
	InP	1.35	1.42	4600	150	D	0.077	0.64	12.4
II–VI	CdS	2.42	2.56	340	50	D	0.21	0.80	5.4
	CdSe	1.70	1.85	800		D	0.13	0.45	10.0
	CdTe	1.56		1050	100	D			10.2
	ZnO	3.35	3.42	200	180	D	0.27		9.0
	ZnS	3.68	3.84	165	5	D	0.40		5.2
IV–VI	PbS	0.41	0.286	600	700	I	0.25	0.25	17.0
	PbTe	0.31	0.19	6000	4000	I	0.17	0.20	30.0

[a] The values are for drift mobilities obtained in the purest and most perfect materials available to date.
[b] I = indirect, D = direct.
[c] Longitudinal effective mass.
[d] Transverse effective mass.
[e] Light-hole effective mass.
[f] Heavy-hole effective mass.

Appendix H

Properties of Ge, Si, and GaAs at 300 K

Properties	Ge	Si	GaAs
Atoms/cm^3	4.42×10^{22}	5.0×10^{22}	4.42×10^{22}
Atomic weight	72.60	28.09	144.63
Breakdown field(V/cm)	$\sim 10^5$	$\sim 3 \times 10^5$	$\sim 4 \times 10^5$
Crystal structure	Diamond	Diamond	Zincblende
Density (g/cm^3)	5.3267	2.328	5.32
Dielectric constant	16.0	11.9	13.1
Effective density of states in conduction band, N_C (cm^{-3})	1.04×10^{19}	2.8×10^{19}	4.7×10^{17}
Effective density of states in valence band, N_V (cm^{-3})	6.0×10^{18}	1.04×10^{19}	7.0×10^{18}
Effective Mass, m^*/m_0			
Electrons	$m_l^* = 1.64$ $m_t^* = 0.082$	$m_l^* = 0.98$ $m_t^* = 0.19$	0.067
Holes	$m_{lh}^* = 0.044$ $m_{hh}^* = 0.28$	$m_{lh}^* = 0.16$ $m_{hh}^* = 0.49$	$m_{lh}^* = 0.082$ $m_{hh}^* = 0.45$
Electron affinity, χ(V)	4.0	4.05	4.07
Energy gap (eV) at 300 K	0.66	1.12	1.424
Intrinsic carrier concentration (cm^{-3})	2.4×10^{13}	1.45×10^{10}	1.79×10^6
Intrinsic Debye length (μm)	0.68	24	2250
Intrinsic resistivity (Ω-cm)	47	2.3×10^5	10^8
Lattice constant (Å)	5.64613	5.43095	5.6533

Properties	Ge	Si	GaAs
Linear coefficient of thermal expansion, $\Delta L/L\Delta T$ (°C^{-1})	5.8×10^{-6}	2.6×10^{-6}	6.86×10^{-6}
Melting point (°C)	937	1415	1238
Minority carrier lifetime (s)	10^{-3}	2.5×10^{-3}	$\sim10^{-8}$
Mobility (drift) (cm^2/V-s)			
	3900	1500	8500
	1900	450	400
Optical-phonon energy (eV)	0.037	0.063	0.035
Phonon mean free path λ_0 (Å)	105	76 (electron) 55 (hole)	58
Specific heat (J/g-°C)	0.31	0.7	0.35
Thermal conductivity at 300 K (W/cm-°C)	0.6	1.5	0.46
Thermal diffusivity (cm^2/s)	0.36	0.9	0.44
Vapor pressure (Pa)	1 at 1330°C 10^{-6} at 760°C	1 at 1650°C 10^{-6} at 900°C	100 at 1050°C 1 at 900°C

GaAs
4.42×10^{22}
144.63
$\sim4\times10^5$
Zincblende
5.32
13.1
4.7×10^{17}
7.0×10^{18}
0.067
$m^*_h = 0.082$ $m^*_h = 0.45$
4.07
1.424
1.79×10^6
2250
10^8
5.6533