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"Diffusion Data for Semiconductors"

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DIFFUSION DATA FOR SEMICONDUCTORS

Derek W. Palmer and B. L. Sharma

The diffusion coefficient D in many semiconductors may be expressed by an Arrhenius-type relation

$$D = D_0 \exp(-Q/kT)$$

where D_0 is a frequency factor, Q is the activation energy for diffusion, k is the Boltzmann constant, and T is the absolute temperature (K). In Tables 1 to 8, either D or the combination D_0 and Q are given for various diffusants in common semiconductors. Note in the tables, the temeprature range is given in °C.

Table No.	Semiconductors covered
1	Silicon-based
2	Germanium-based
3	Gallium-based
4	Indium-based
5	Cadmium-based
6	Zinc-based
7	Aluminum-based
8	Mercury-based and lead-based

Abbreviations used in the tables are as follows.

Abbreviation	Definition
AES	Auger electron spectroscopy
C-V	Capacitance-voltage profiling
CL	Cathode luminescence
$D(c)$	Concentration dependent diffusion coefficient
D_{max}	Maximum diffusion coefficient
DLTS	Deep-level transient spectroscopy
EPMA	Electron probe microanalysis
FP	Flame photometry
SEM	Scanning electron microscopy
SR	Spreading resistance
SIMS	Secondary ion mass spectrometry
TEM	Transmission electron microscopy
XRD	X-ray diffraction
XRF	X-ray fluorescence
(f)	Fast diffusion component
(i)	Interstitial diffusion component
(s)	Slow diffusion component
(‖)	Parallel to c direction
(⊥)	Perpendicular to c direction

Column definitions for Tables 1 to 8 are as follows.

Column heading	Definition
Semiconductor	Chemical symbol for semiconductor
Diffusant	Chemical symbol for diffusing species
Temp. range	Temperature range for applicability of Arrhenius-type diffusion relation, in °C
D	Diffusion coefficient, in $cm^2\ s^{-1}$
D_0	Frequency factor, in $cm^2\ s^{-1}$
Q	Activation energy, in eV
Method	Measurement method; refer to abbreviation list above
Ref.	Reference source of data
Year	Year of publication of reference (when applicable)

TABLE 1. Diffusion Data for Silicon-Based Semiconductors

Semiconductor	Diffusant	Temp. range/ °C	$D/cm^2\ s^{-1}$	$D_0/cm^2\ s^{-1}$	Q/eV	Method	Ref.	Year
Si	H	120–1207		6×10^{-1}	1.03	Electrical and SIMS	1	
	Li	25–1350		2.5×10^{-3}	0.65	Electrical	2	1960
	Na	530–800		1.65×10^{-3}	0.72	Electrical and FP	3	1967
	K	740–800		1.1×10^{-3}	0.76	Electrical and FP		
	Cu	800–1100		4×10^{-2}	1	Radioactive	4	1958
	Cu	300–700		4.7×10^{-3}	0.43 (i)	Radioactive	5	1964
	Ag	1100–1350		2×10^{-3}	1.6	Radioactive	6	1961
	Au	700–1300		2.4×10^{-4}	0.39 (i)	Radioactive	7	1964
	Au			2.75×10^{-3}	2.05 (s)			
	Be	1050	$\sim 10^{-7}$			Electrical	8	1970
	Ca	1100	$\sim 6 \times 10^{-14}$			Electrical and SIMS	1	
	Zn	980–1270		1×10^{-1}	1.4	Electrical	9	1963
	B	1100–1250		2.46	3.59	Electrical	10	1972
	B	840–1250		2.4×10^{1}	3.87	Electrical	11	1981
	B	810-1050		$(6 \pm 2) \times 10^{-2}$	3.12 ± 0.04	Electrical	98	2003
	Al	1119–1390		1.38	3.41	Electrical	12	1971
	Al	1025–1175		1.8	3.2	Electrical	13	1978
	Ga	1143–1393		3.74×10^{-1}	3.39	Electrical	12	1971
	Ga	900–1050		6×10^{1}	3.89	Radioactive	14	1971
	In	1180–1389		7.85×10^{-1}	3.63	Electrical	12	1971
	In	1150–1242		1.94×10^{1}	3.86	Radioactive	15	1965
	Tl	1244–1338		1.37	3.7	Electrical	12	1971
	Tl	1105–1360		1.65×10^{1}	3.9	Electrical	16	1956

Semiconductor	Diffusant	Temp. range/ °C	D/cm² s⁻¹	D_0/cm² s⁻¹	Q/eV	Method	Ref.	Year
	Sc	1100–1250		8×10^{-2}	3.2	Radioactive	1	
	Ce	1050	$\sim 3.9 \times 10^{-13}$			SIMS	1	
	Pr	1100–1280		2.5×10^{-7}	1.74	Electrical	1	
	Pm	730–1270		7.5×10^{-9}	1.2 (s)	Radioactive	1	
	Pm			4.2×10^{-12}	0.13 (f)			
	Er	1100–1250		2×10^{-3}	2.9	Radioactive	1	
	Tm	1100–1280		8×10^{-3}	3	Radioactive	1	
	Yb	947–1097		2.8×10^{-5}	0.95	Neutron activation	1	
	Ti	950–1200		1.45×10^{-2}	1.79	DLTS	17	1988
	C substitutional	1070–1400		3.3×10^{-1}	2.92	Radioactive	18	1961
	C interstititial	-269–20		0.44	0.88	EPR	89	1976
	C interstititial	900–1300		0.44	0.88	Using data from Ref. 89	92	2000
	C substitutiomal	903–1385		1.99	3.1	Radioactive	90	1989
	C substitutiomal	903–1385		1.99	3.1	Quoting from Ref. 90	91	1994
	Si (self)	855–1175		1.54×10^{2}	4.65	SIMS	19	1979
	Si (self)	1200–1400		1.6×10^{3}	4.77	Radioactive	20	1966
	Ge	855–1000		3.5×10^{-1}	3.92	Radioactive	21	1979
	Ge	1030–1302		2.5×10^{3}	4.97	Radioactive	21	1979
	Ge	1100–1300		7.55×10^{3}	5.08	SIMS	22	1982
	Sn	1050–1294		3.2×10^{1}	4.25	Neutron activation	23	1968
	N	800–1200		2.7×10^{-3}	2.8	Out diffusion; SIMS	1	
	P	1100–1250		2.02×10^{1}	3.87	Electrical	10	1972
	P	900–1200		1.1	3.4	Radioactive	24	1971
	P	1130–1405		7.4×10^{-2}	3.3	Electrical	25	1971
	P	810–1100		$(8 \pm 5) \times 10^{-4}$	2.74 ± 0.07	Electrical	98	2003
	As	950–1350		6.0×10^{1}	4.2	Radioactive	26	1969
	As	1167–1394		6.55×10^{-2}	3.44	Electrical	27	1971
	As	900–1250		2.29×10^{1}	4.1	Electrical	28	1975
	Sb	1190–1398		1.29×10^{1}	3.98	Radioactive	29	1969
	Sb	1190–1405		2.14×10^{-1}	3.65	Electrical	27	1971
	Bi	1220–1380		1.03×10^{3}	4.64	Electrical	16	1956
	Bi	1190–1394		1.08	3.85	Electrical	27	1971
	Cr	1100–1250		1×10^{-2}	1	Radioactive	30	1974
	Mo	1000	$\sim 2 \times 10^{-10}$			DLTS	1	
	W	1100	$\sim 10^{-12}$			DLTS	1	
	O	700–1250		7×10^{-2}	2.44	SIMS	31	1982
	O	700–1160		1.4×10^{-1}	2.53	SIMS	32	1986
	S	975–1200		5.95×10^{-3}	1.83	Radioactive	33	1974
	Se	1050–1250		9.5×10^{-1}	2.6	Electrical	34	1975
	Te	900–1250		5×10^{-1}	3.34	SIMS	1	
	Mn	900–1200		6.9×10^{-4}	0.63	Radioactive	35	1986
	Fe	30–1250		1.3×10^{-3}	0.68	Radioactive	36	1983
	Co	700–1300		2×10^{-3}	0.69	Radioactive	37	1988
	Co	900–1200		9.2×10^{-4}	2.8		73	1977
	Ni	800–1300		2×10^{-3}	0.47	Radioactive	38	1980
	Ru	1000–1280	$\sim 5 \times 10^{-7} - 5 \times 10^{-6}$			Electrical	1	
	Rh	1000–1200	$\sim 10^{-6} - 10^{-4}$			Electrical	39	1975
	Pd	702–1320		2.95×10^{-4}	0.22 (i)	Nuclear activation	1	
	Pt	800–1000		1.5×10^{2}	2.22	Electrical	1	
	Os	1280	$\sim 2 \times 10^{-6}$			Electrical	40	1978
	Ir	950–1250		4.2×10^{-2}	1.3	Electrical	41	1976

TABLE 2. Diffusion Data for Germanium-Based Semiconductors

Semiconductor	Diffusant	Temp. range/ °C	D/cm² s⁻¹	D_0/cm² s⁻¹	Q/eV	Method	Ref.	Year
Ge	Li	350–800		1.3×10^{-3}	0.46	Electrical	42	1953
	Li	800–500		9.1×10^{-3}	0.57	Electrical	43	1966
	Na	700–850		3.95×10^{-1}	2.03	Radioactive	44	1976
	Cu	750–900		1.9×10^{-4}	0.18 (i)	Radioactive	45	1963

Solids

Semiconductor	Diffusant	Temp. range/ °C	D/cm² s⁻¹	D_0/cm² s⁻¹	Q/eV	Method	Ref.	Year
	Cu	600–700		4×10^{-2}	0.99 (s)			
	Cu	350–750		4×10^{-3}	0.33 (i)	Radioactive	5	1964
	Ag	700–900		4.4×10^{-2}	1.0 (i)	Radioactive	46, 47	1957/1961
	Ag	800–900		4×10^{-2}	2.23 (s)	Radioactive	48	1962
	Au	600–900		2.25×10^{2}	2.5	Radioactive	49	1955
	Be	720–900		5×10^{-1}	2.5	Electrical	50	1961
	Mg	900	$\sim 8 \times 10^{-9}$			Electrical	1	
	Zn	600–900		5	2.7	Radioactive and electrical	51	1954
	Cd	760–915		1.75×10^{9}	4.4	Radioactive	52	1960
	B	600–900		1.8×10^{9}	4.55	Electrical	51	1954
	Al	554–905		1.0×10^{3}	3.45	SIMS	53	1982
	Al	750–850		$\sim 1.6 \times 10^{2}$	~3.24	Electrical	54	1967
	Ga	554–916		1.4×10^{2}	3.35	SIMS	55	1986
	Ga	600–900		3.4×10^{1}	3.1	Electrical	51	1954
	In	554–919		1.8×10^{4}	3.67	SIMS	56	1982
	In	700–855		3.3×10^{1}	3.02	Radioactive	57	1967
	In	550–900		$(5 \pm 4) \times 10^{3}$	3.51 ± 0.06 eV	SIMS & SR	102	2009
	Tl	800–930		1.7×10^{3}	3.4	Radioactive	58	1962
	Si	650–900		2.4×10^{-1}	2.9	(γ) Resonance	59	1981
	Si	550–900		~ 42	3.32 ± 0.03	SIMS	96	2006
	Ge (self)	549–891		2.48×10^{1}	3.14	Radioactive	60	1983
	Ge (self)	766–928		7.8	2.95	Radioactive	61	1956
	Ge (self)	429–904		25.4	3.13 ± 0.03	Neutron reflecometry	97	2008
	Sn			1.7×10^{-2}	1.9	Radioactive	45	1963
	P	600–900		3.3	2.5	Electrical	51	1954
	P	600–920		9.1 ± 4.4	2.85 ± 0.04	SIMS & SR	74, 101	2008, 2008
	As	700–900		2.1	2.39	Electrical	62	1955
	As	600–920		32 ± 17	2.71 ± 0.06	SIMS & SR	74, 101	2008, 2008
	Sb	700–855		3.2	2.41	Radioactive	57	1967
	Sb	600–900		1.0×10^{1}	2.5	Radioactive & Electrical	51	1954
	Sb	600–920		16.7 ± 5.7	2.55 ± 0.03	SIMS & SR	74, 101	2008, 2008
	Bi	650–850		3.3	2.57	–	63	1968
	O	–		4×10^{-1}	2.08	Optical	64	1964
	S	920	$\sim 10^{-9}$			–	65	1959
	Se	920	$\sim 10^{-10}$			–	65	1959
	Te	750–900		5.6	2.43	Radioactive	66	1962
	Fe	750–900		1.3×10^{-1}	1.08	Radioactive	67	1957
	Co	750–850		1.6×10^{-1}	1.12	Radioactive	47	1961
	Ni	670–900		8×10^{-1}	0.9	Electrical	68	1954

TABLE 3. Diffusion Data for Gallium-Based Semiconductors

Semiconductor	Diffusant	Temp. range/ °C	D/cm² s⁻¹	D_0/cm² s⁻¹	Q/eV	Method	Ref.	Year
GaN (Mg)	H	350–500	As large as H^+ in p-GaN			SIMS	87	2001
	H by release from Mg-H	200–310		1.2×10^{-3}	2.03	C-V Profiling	88	2002
GaN	Be	1450	$\le 2 \times 10^{-13}$			SIMS	82	1999
	C	1450	$\le 2 \times 10^{13-}$			SIMS	82	1999
	O	1125	$\le 2.7 \times 10^{-13}$			SIMS	84	1996
	Mg	1150	$\le 6.7 \times 10^{-13}$	>		SIMS	83	1997
	Mg	1100			1.3	PL and SIMS	77	1999
	Mg	1450	$\le 2 \times 10^{-13}$			SIMS	82	1999
	Ca	1125	$\le 2.7 \times 10^{-13}$			SIMS	84	1996
	Mn	900–1100		2.0×10^{-4}	1.8	SIMS	76	2019
	Si	1050	$\le 2.7 \times 10^{-13}$			SIMS	83	1997
	Si	900–1200		6.5×10^{-11}	0.89	SIMS	80	2006
	Si	900–1200		9.1×10^{-8}	1.55	SIMS	81	2006
	S	1450	$\le 2 \times 10^{-13}$			SIMS	82	1999

Solids

Semiconductor	Diffusant	Temp. range/ °C	D/cm² s⁻¹	D_0/cm² s⁻¹	Q/eV	Method	Ref.	Year
	Se	1450	$\leq 2 \times 10^{-13}$			SIMS	82	1999
	Te	1450	$\leq 2 \times 10^{-13}$			SIMS	82	1999
GaP	Ga	1000–1190		2.0	4.5	SIMS	78	1997
	Ag	1000–1300		–		Radioactive	69	
	Au	1050–1250		8	2.5 (I)	Radioactive	69	
	Au	1100–1250		20	2.4 (II)	Diffusion (I) A face and (II) B face		
	Be	900–1000	$D_{max} \sim 2.4 \times 10^{-9} - 8.5 \times 10^{-8}$			Atomic absorption analysis	69	
	Mg	700–1050		5×10^{-5}	1.4	Electrical	69	
	Zn	700–1300		1	2.1	Radioactive	69	
	Ge	900–1000		–		Radioactive	69	
	Cr	900–1130		6.2×10^{-4}	1.2	Radioactive; ESR	69	
	S	1120–1305		3.2×10^{3}	4.7	Radioactive	69	
	Mn	T < 950		2.1×10^{9}	4.7	Radioactive; ESR	69	
	Mn	950–1130		1.1×10^{-6}	0.9			
	Fe	980–1180		1.6×10^{-1}	2.3	Radioactive	69	
	Co	850–1100		2.8×10^{-3}	2.9	Radioactive	69	
GaAs	Li	250–500		5.3×10^{-1}	1	Electrical and chemical	69	
	Cu	100–500		3×10^{-2}	0.53	Radioactive	69	
	Cu	450–750		6×10^{-2}	0.98	Ultrasonic	69	
	Cu	800–1000		1.5×10^{-3}	0.6	Radioactive	69	
	Ag	500–1150		4×10^{-4}	0.8	Radioactive	69	
	Au	740–1025		1×10^{-3}	1	Radioactive	69	
	Be	800–990		7.3×10^{-6}	1.2	Electrical	69	
	Mg	800–1200		4×10^{-5}	1.22	Electrical	69	
	Zn	600–980		1.5×10^{1}	2.49	Radioactive	69	
	Zn	750–1000		2.5×10^{-1}	3	Radioactive	69	
	Cd	800–1100		1.3×10^{-3}	2.2	Radioactive	69	
	Cd	868–1149		5×10^{-2}	2.43	Radioactive	69	
	Hg	1100	$\sim 5 \times 10^{-14}$			Radioactive	69	
	Al	850–1100	$\sim 4 \times 10^{-18} - 10^{-14}$		4.3	AES	70	1976
	Ga (self)	1025–1100		4×10^{-5}	2.6	Radioactive	69	
	Ga (self)	1125–1230		1×10^{7}	5.6	Radioactive	69	
	In	1000	$\sim 7 \times 10^{-11}$			Radioactive	69	
	C	825	$\sim 1.04 \times 10^{-16}$			SIMS	69	
	Si	850–1050		1.1×10^{-1}	2.5	SIMS	69	
	Ge	650–850		1.6×10^{-5}	2.06	SIMS	69	
	Sn	1060–1200		6×10^{-4}	2.5	Radioactive	69	
	Sn	800–1000		1×10^{-5}	2	Radioactive	69	
	P	800–1150	$\sim 10^{-12} - 10^{-10}$		2.9	Reflectance measurements	69	
	As (self)	–		7×10^{-1}	3.2	Radioactive	69	
	Cr	750–1000		2.04×10^{-6}	0.83 (f)	SIMS	69	
	Cr	700–900			1.7 (s)			
	Cr	800–1100		7.9×10^{-3}	2.2	Chemical analysis	69	
	O	700–900		2×10^{-3}	1.1	Mass spectroscopy	69	
	S	1000–1300		1.85×10^{-2}	2.6	Radioactive	69	
	S	750–900		1.1×10^{1}	2.95	Electrical	69	
	Se	1025–1200		3×10^{3}	4.16	Radioactive	69	
	Te	1000–1150		1.5×10^{-1}	3.5	Radioactive	69	
	Mn	850–1100		6.5×10^{-1}	2.49	Radioactive	69	
	Mn	700–900	Diffusion is concentration dependent			SIMS	75	2006
	Fe	850–1150		4.2×10^{-2}	1.8	Radioactive	69	
	Fe	750–1050		2.2×10^{-3}	2.32	Radioactive	69	
	Co	800–1000		5×10^{2}	2.5	Radioactive	69	
	Co	750–1050		1.2×10^{-1}	2.64	Radioactive	69	
	Tm	800–1000		2.3×10^{-16}	1	Radioactive	69	
	Li	527–657		2.3×10^{-4}	1.9 (s)	Electrical and flame photometry	69	
GaSb	Li	277–657		1.2×10^{-1}	0.7 (f)			
	Cu	470–650		4.7×10^{-3}	0.9	Radioactive	69	

Semiconductor	Diffusant	Temp. range/ °C	D/cm² s⁻¹	D_0/cm² s⁻¹	Q/eV	Method	Ref.	Year
	Zn	510–600	~ 2×10^{-13} – 1×10^{-11}		2	Radioactive	69	
	Cd	640–800		1.5×10^{-6}	0.72	Electrical	69	
	Ga (self)	658–700		3.2×10^{3}	3.15	Radioactive	69	
	Ga (self)	5707–00		82 ± 60	3.24 ± 0.10	SIMS	99, 100	2000, 2001
	In	320–650		1.2×10^{-7}	0.53	Radioactive	69	
	Sn	320–650		2.4×10^{-5}	0.8	Radioactive	69	
	Sn	500–650		1.3×10^{-5}	1.1	Radioactive	69	
	Sb (self)	658–700		3.4×10^{4}	3.45	Radioactive	69	
	Sb (self)	570–700		~ 2×10^{-10}	1.59 ± 0.17	SIMS	99, 100	2000,2001
	Se	400–500	~ 2.4×10^{-13} – 1.37×10^{-11}			Radioactive	69	
	Te	320–650		3.8×10^{-4}	1.2	Radioactive	69	
	Fe	500–650		5×10^{-2}	1.9 (I)	Radioactive	69	
	Fe	500–650		5×10^{2}	2.3 (II)			
	Cu	600–900		3.8×10^{-3}	0.69	Radioactive	69	

TABLE 4. Diffusion Data for Indium-Based Semiconductors

Semiconductor	Diffusant	Temp. range/ °C	D/cm² s⁻¹	D_0/cm² s⁻¹	Q/eV	Method	Ref.	Year
InP	Ag	500–900		3.6×10^{-4}	0.59	Radioactive	69	
	Au	600–820		1.32×10^{-5}	0.48	Radioactive	69	
	Au	600–900		1.37×10^{-4}	0.73	Radioactive	69	
	Zn (undoped)	550–875		4.9×10^{-2}	1.52	SIMS	93	1987
	Zn (S doped)	550–675		1.4×10^{3}	2.34	SIMS	93	1987
	Zn	750–900		1.6×10^{-8}	0.3	Electrical	69	
	Zn	700–900	~ 2×10^{-9} – 4×10^{-8}			Radioactive	69	
	Cd	700–900		1.8	1.9	Radioactive	69	
	Cd	700–900		1.1×10^{-7}	0.72	Electrical	69	
	Cd	450–650	~ 7×10^{-13} – 2×10^{-10}			Electrical	69	
	In (self)	830–990		1×10^{5}	3.85	Radioactive	69	
	Sn	550	~ 3×10^{-8}			Etching and cathodo-luminescence	69	
	P (self)	900–1000		7×10^{10}	5.65	Radioactive	69	
	Cr	600–900		–		Radioactive	69	
	S	585–708		3.6×10^{-4}	1.94	Electrical	69	
	Se	550	~ 2×10^{-8}			Cathodoluminescence	69	
	Mn	650–750		–	2.9	SIMS	69	
	Fe	600–950		3	2	Radioactive	69	
	Fe	600–700		6.8×10^{5}	3.4	SIMS	69	
	Co	600–950		9×10^{-1}	1.8	Radioactive	69	
	Cu	342–875		3.6×10^{-3}	0.52	Radioactive	69	
InAs	Cu	525–890		2.2×10^{-2}	0.54	Radioactive	69	
	Ag	450–900		7.3×10^{-4}	0.26	Radioactive	69	
	Au	600–900		5.8×10^{-3}	0.65	Radioactive	69	
	Mg	600–900		1.98×10^{-6}	1.17	Electrical	69	
	Zn	600–900		4.2×10^{-3}	0.96	Radioactive	69	
	Zn	600–900		3.11×10^{-3}	1.17	Electrical	69	
	Cd	650–900		7.4×10^{-4}	1.15	Radioactive	69	
	Hg	650–850		1.45×10^{-5}	1.32	Radioactive	69	
	In (self)	740–900		6×10^{5}	4	Radioactive	69	
	Ge	600–900		3.74×10^{-6}	1.17	Electrical	69	
	Sn	600–900		1.49×10^{-6}	1.17	Electrical	69	
	As (self)	740–900		3×10^{7}	4.45	Radioactive	69	
	S	600–900		6.78	2.2	Electrical	69	
	Se	600–900		12.6	2.2	Electrical	69	
	Te	600–900		3.43×10^{-5}	1.28	Electrical	69	
	Li	0–210		7×10^{-4}	0.28	Electrical	69	
InSb	Cu	200–500		9×10^{-4}	1.08	Radioactive	69	
	Cu	230–490		3×10^{-5}	0.37	Radioactive	69	
	Ag	440–510		1×10^{-7}	0.25	Radioactive	69	
	Au	140–510		7×10^{-4}	0.32	Radioactive	69	

Semiconductor	Diffusant	Temp. range/ °C	D/cm² s⁻¹	D_0/cm² s⁻¹	Q/eV	Method	Ref.	Year
	Zn	362–508		5×10^{-1}	1.35	Radioactive	69	
	Zn	355–455		–	1.5	SIMS	69	
	Cd	250–500		1×10^{-5}	1.1	Radioactive	69	
	Cd	360–500		1.3×10^{-4}	1.2	Electrical	69	
	Hg	425–500		4×10^{-6}	1.17	Radioactive	69	
	In (self)	400–500		6×10^{-7}	1.45	Radioactive	69	
	In (self)	475–517		1.8×10^{13}	4.3	Radioactive	69	
	Sn	390–512		5.5×10^{-8}	0.75	Radioactive	69	
	Pb	500	$\sim 2.7 \times 10^{-15}$			Radioactive	71	
	Sb (self)	400–500		5.35×10^{-4}	1.91	Radioactive	69	
	Sb (self)	475–517		3.1×10^{13}	4.3	Radioactive	69	
	S	360–500		9×10^{-2}	1.4	Electrical	69	
	Se	380–500		1.6	1.87	Electrical	69	
	Te	300–500		1.7×10^{-7}	0.57	Radioactive	69	
	Fe	440–510		1×10^{-7}	0.25	Radioactive	69	
	Co	420–500		2.7×10^{-11}	0.39	Radioactive	69	
	Ga	850–1100	$\sim 2 \times 10^{-18} - 10^{-15}$		3.6	AES	70	1976

TABLE 5. Diffusion Data for Cadmium-Based Semiconductors

Semiconductor	Diffusant	Temp. range/ °C	D/cm² s⁻¹	D_0/cm² s⁻¹	Q/eV	Method	Ref.	Year
CdS	Na	800	$\sim 3 \times 10^{-7}$			Radioactive	69	
	Cu	400–700		1.5×10^{-3}	0.76	Radioactive	69	
	Cu	300–700		1.2×10^{-2}	1.05	Ultrasonic	69	
	Cu	20–200		8×10^{-5}	0.72	Electrical	69	1998
	Ag	300–500		2.5×10^{1}	1.2 (s)	Radioactive	69	
	Ag			2.4×10^{-1}	0.8 (f)			
	Au	500–800		2×10^{2}	1.8	Radioactive	69	
	Zn	720–1000		1.27×10^{-9}	0.86 (s)	Radioactive	69	
	Zn			1.22×10^{-8}	0.66 (f)			
	Cd (self)	700–1100		3.4	2	Radioactive	69	
	Ga	667–967		–		Optical and microprobe	69	
	In	650–930		6×10^{1}	2.3 (‖)	Radioactive, optical, and microprobe	69	
	In			1×10^{1}	2.03 (⊥)			
	P	800–1100		6.5×10^{-4}	1.6	Radioactive	69	
	S (self)	800–900		1.6×10^{-2}	2.05	Radioactive	69	
	S (self)	750–1050		–	2.4	Radioactive	69	
	Se	900	$\sim 1.2 \times 10^{-9}$			Radioactive	69	
	Te	700–1000		1.3×10^{-7}	10.4	Radioactive	69	
	Cl	800	$\sim 3 \times 10^{-10}$			Electrical	69	
	I	1000	$\sim 5 \times 10^{-12}$			Radioactive	69	
	Ni	570–900		6.75×10^{-3}	10.9	Luminescence	69	
	Yb	960	$\sim 1.3 \times 10^{-9}$			Photo-luminescence	69	
	Ag	22–400		2×10^{-4}	0.53	Ultrasonic	69	
CdSe	Cd (self)	700–1000		1.6×10^{-3}	1.5	Radioactive	69	
	Cd (self)	600–900		$6.3 \times 10^{-}$[illegible]	1.25 (I)	Radioactive	69	
	Cd (self)	600–900		4.12×10^{-2}	2.18 (II)	(I) Saturated Cd and (II) saturated Se pressure		
	P	900–1000	$\sim 5.3 \times 10^{-12} - 6 \times 10^{-11}$			Radioactive	69	
	Se (self)	700–1000		2.6×10^{3}	1.55	Radioactive; saturated Se pressure	69	
	Li	300	$\sim 1.5 \times 10^{-10}$			Ion microprobe	69	
CdTe	Cu	97–300		3.7×10^{-4}	0.67	Radioactive	69	
	Cu	290–350		8.2×10^{-8}	0.64	Ion backscattering	69	
	Ag	700–800		–		Electrical and photo-luminescence	69	
	Au	600–1000		6.7×10^{1}	2	Radioactive	69	
	Cd (self)	700–1000		1.26	2.07	Radioactive	69	
	Cd (self)	650–900		3.26×10^{2}	2.67 (I)	Radioactive	69	
	Cd (self)			1.58×10^{1}	2.44 (II)	(I) Saturated Cd and (II) saturated Te pressure	69	
	In	650–1000		8×10^{-2}	1.61	Radioactive		

Semiconductor	Diffusant	Temp. range/ °C	D/cm^2 s^{-1}	D_0/cm^2 s^{-1}	Q/eV	Method	Ref.	Year
	In	500–850		1.17×10^{2}	2.21 (I)	Radioactive; (I) saturated		
	In			6.48×10^{-4}	1.15 (II)	Cd and (II) saturated Te pressure	69	
	Sn	700–925		8.3×10^{-2}	2.2	Radioactive	69	
	P	900	$\sim 1.2 \times 10^{-10}$			Radioactive	69	
	As	850		–		–	69	
	O	200–650		5.6×10^{-9}	1.22	Mass spectrometry	69	
	O	650–900		6.0×10^{-10}	0.29			
	Se	700–1000		1.7×10^{-4}	1.35	Radioactive	69	
	Te (self)	600–900		8.54×10^{-7}	1.42 (I)	Radioactive; (I) saturated Cd and (II) saturated Te pressure	69	
	Te (self)	500–800		1.66×10^{-4}	1.38 (II)			
	Cl	520–800		7.1×10^{-2}	1.6	Radioactive	69	
	Fe	900	$\sim 4 \times 10^{-8}$		0.77	Radioactive	69	
	Sb	540–630		6.3×10^{-5}	0.85	Radioactive	69	

TABLE 6. Diffusion Data for Zinc-Based Semiconductors

Semiconductor	Diffusant	Temp. range/ °C	D/cm^2 s^{-1}	D_0/cm^2 s^{-1}	Q/eV	Method	Ref.	Year
ZnS	Cu	250–1200		4.3×10^{-4}	0.64	Electroluminescence	69	
	Cu	400–800		9.75×10^{-3}	1.04	Luminescence	69	
	Cu	80–400		1.4×10^{-10}	0.18	XRF	95	2004
	Ag	80–400		8×10^{-9}	0.10	XRF	94	2007
	Au	500–800		1.75×10^{-4}	1.16	Radioactive	69	
	Zn (self)	$925<T<940$		3×10^{-4}	1.5	Radioactive	69	
	Zn (self)	$940<T<1030$		1.5×10^{4}	3.26			
	Zn (self)	$1030<T<1075$		1×10^{16}	6.5			
	Cd	1100	$\sim 10^{-10}$			Luminescence	72	
	Al	800–1000		5.69×10^{-4}	1.28	Luminescence	69	
	In	750–1000		3×10^{1}	2.2	Radioactive	69	
	S (self)	600–800		2.16×10^{4}	3.15	Radioactive	69	
	S (self)	740–1100		8×10^{-5}	2.2	Radioactive	69	
	Se	1070	$\sim 5 \times 10^{-13}$			X-ray microprobe	69	
	Mn	500–800		2.3×10^{3}	2.46	Radioactive	69	
	Li	950–980		2.66×10^{-6}	0.49	Electrical	69	
ZnSe	Cu	400–800		1×10^{-4}	0.66	Luminescence	69	
	Cu	200–570		1.7×10^{-5}	0.56	Radioactive	69	
	Ag	400–800		2.2×10^{-2}	1.18	Luminescence	69	
	Zn (self)	760–1150		9.8	3	Radioactive	69	
	Cd	700–950		6.39×10^{-4}	1.87	Photoluminescence	69	
	Al	800–1100		2.3×10^{-2}	1.8	Luminescence	69	
	Ga	900–1100		1.81×10^{-2}	3	Luminescence	69	
	Ga	700–850		–	1.3	Electron probe	69	
	In	940	$\sim 2 \times 10^{-12}$			–	69	
	S	1060	$\sim 8 \times 10^{-12}$			X-ray microprobe	69	
	Se (self)	860–1020		1.3×10^{1}	2.5	Radioactive	69	
	Se (self)	1000–1050		2.3×10^{-2}	2.7	Radioactive	69	
	Ni	740–910	$\sim 1.5 \times 10^{-8} - 1.7 \times 10^{-7}$			Luminescence	69	
	Li	400–700		2.9×10^{-2}	1.22 (s)	Nuclear and chemical analysis	69	
ZnTe	Li			1.7×10^{-4}	0.78 (f)			
	Zn (self)	760–860		2.34	2.56	Radioactive	69	
	Zn (self)	667–1077		1.4×10^{1}	2.69	Radioactive	69	
	Al	700–1000		–	2	Electrical and optical	69	
	In	1100–1300		4	1.96	Radioactive	69	
	Te (self)	727–977		2×10^{4}	3.8	Radioactive	69	
	Li	610–960		3×10^{-6}	0.68	Microhardness	69	

TABLE 7. Diffusion Data for Aluminum-Based Semiconductors

Semiconductor	Diffusant	Temp. range/ °C	D/cm² s⁻¹	D_0/cm² s⁻¹	Q/eV	Method	Ref.	Year
AlN	O	1600–1700		2.09×10^{-2}	4.44	SIMS	79	1994
	O-N interdiffusion	1500–1900		$\sim 10^{-8}$	2.50 ± 0.41	SIMS & EELS	85	1994
	O (Oxidation of AlN)	1050–1350		1.36×10^{5}	6.00	EPMA, TEM, & XRD	86	2017
AlAs	Zn	557	$\sim 9 \times 10^{-11}$			SEM	69	
	Cu	150–500		3.5×10^{-3}	0.36	Radioactive	69	
AlSb	Zn	660–860		3.3×10^{-1}	1.93	Radioactive	69	
	Cd	900	$D(c) \sim 4 \times 10^{-12} - 3 \times 10^{-10}$			Radioactive	69	
	Al (self)	570–620		2	1.88	X-ray	69	
	Sb (self)	570–620		1	1.7	X-ray	69	
	Cu	470–750		2.6×10^{-3}	0.79	Radioactive	69	

TABLE 8. Diffusion Data for Mercury-Based and Lead-Based Semiconductors

Semiconductor	Diffusant	Temp. range/ °C	D/cm² s⁻¹	D_0/cm² s⁻¹	Q/eV	Method	Ref.
HgSe	Se (self)	200–400		–		Radioactive	69
	Ag	250–350		6×10^{-4}	0.8	Radioactive	69
HgTe	Zn	250–350		5×10^{-8}	0.6	Radioactive	69
	Cd	250–350		3.1×10^{-4}	0.66	Radioactive	69
	Hg (self)	200–350		2×10^{-8}	0.6	Radioactive	69
	In	200–300		6×10^{-6}	0.9	Radioactive	69
	Sn	200–300		1.72×10^{-6}	0.66 (s)	Radioactive	69
	Sn			1.8×10^{-3}	0.80 (f)		
	Te (self)	200–400		10^{-6}	1.4	Radioactive	69
	Mn	250–350		1.5×10^{-4}	1.3	Radioactive	69
	Cu	150–450		4.6×10^{-4}	0.36	Electrical	69
PbS	Cu	100–400		5×10^{-3}	0.31	Electrical	69
	Pb (self)	500–800		8.6×10^{-5}	1.52	Radioactive	69
	S (self)	500–750		6.8×10^{-5}	1.38	Radioactive	69
	Ni	200–500		1.78×10^{1}	0.95	Electrical	69
	Na	400–850		1.5×10^{1}	1.74 (s)	Radioactive	69
PbSe	Na			5.6×10^{-6}	0.4 (f)		
	Cu	93–520		2×10^{-5}	0.31	Radioactive	69
	Ag	400–850		7.4×10^{-4}	0.35	Radioactive	69
	Pb (self)	400–800		4.98×10^{-6}	0.83	Radioactive	69
	Sb	650–850		3.4×10^{-1}	2	Radioactive	69
	Se (self)	650–850		2.1×10^{-5}	1.2	Radioactive	69
	Cl	400–850		1.6×10^{-8}	0.45	Radioactive	69
	Ni	700	$\sim 1 \times 10^{-10}$			Radioactive	69
	Na	600–850		1.7×10^{-1}	1.91	Radioactive	69
PbTe	Sn	500–800		3.1×10^{-2}	1.56	Radioactive	69
	Pb (self)	250–500		2.9×10^{-5}	0.6	Radioactive	69
	Sb	500–800		4.9×10^{-2}	1.54	Radioactive	69
	Te	500–800		2.7×10^{-6}	0.75	Radioactive	69
	Cl	700	$> 2.3 \times 10^{-10}$			Radioactive	69
	Ni	700	$< 1 \times 10^{-6}$			Radioactive	69

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