

Errata and Corrections: C. Hamaguchi: <i>Basic Semiconductor Physics</i> , 3rd Edition (November, 2017)			
Page	Equation, Line, Figure	Incorrect	Corrected
33	Section 1.6.6 lines 2 to 13	and GaAs in Fig.1.14(b) with 118 ...	Corrections are given in [A] below
34	Fig. 1.14	Figure and caption	replace as given below
49	Eq.(1.144), matrix element (10, 8)	$-(R'/\sqrt{2}k_y$	$-(R'/\sqrt{2})k_y$
52	Eq.(1.151b)	$\langle X(\Gamma_{25'}^l) \uparrow H_{\text{so}} z(\Gamma_{15}) \uparrow \rangle$	$\langle X(\Gamma_{25'}^l) \uparrow H_{\text{so}} z(\Gamma_{15}) \downarrow \rangle$
57	lines 9 ~ 17 below Fig.1.20	and the result obtained from ...	Corrections are given in [B] below
58	Fig.1.21(b) Figure caption	65 plane waves 130 plane waves with ...	113 plane waves 226 plane waves with ...
115	Fig.2.22	results of 6×6 Luttinger in Fig.2.22 is not correct	To be replaced by the attached Fig.2.22
131	(3.35)	$+H_1(\mathbf{R}_j)R(\mathbf{r})$	$+H_1(\mathbf{r})R(\mathbf{r})$
448	2nd line from the top	$J_{nn} = 1$	$I_{nn} = 1$
448	Eq.(8.119)	$\simeq An_{\text{ion}}W$	$= An_{\text{ion}}W$
448	Eq.(8.124) & (8.125)	$d\theta \cdot u(D)$	$d\theta \cdot \frac{m^*}{\hbar^2} \cdot u(D)$
460	5 lines below (8.190)	$\langle k \rangle = [2m^* k_{\text{B}}T/\hbar^2]^{1/2}$	$\langle k \rangle = [2m^* k_{\text{B}}T/\hbar^2]^{1/2}$
460	5 lines above the bottom	$N_{\text{i}} = 10^{18} \text{ cm}^{-3}$	$N_{\text{i}} = 10^{18} \text{ cm}^{-3}$.
460	4 lines above the bottom	$N_{\text{i}} = 1.5^{17} \text{ cm}^{-3}$	$N_{\text{i}} = 1.5 \times 10^{17} \text{ cm}^{-3}$
511	Fig. 8.54: Figure caption	$m^* = 0.067m$	$m^* = 0.067m$ (italic m)
513	Fig.8.86: Vertical axis	σ_{xy}	$-\sigma_{xy}$
615	Eq.(9.205)	$ \mathbf{G} ^2 = \dots\dots$	$ \mathbf{G} ^2 = 2 \left[l^2 + \frac{2m-l}{3} + \frac{3}{8}n^2 \right]$
615	2 lines below Eq.(9.206)	$ \mathbf{G} ^2$ of (9.205),	$ \mathbf{G} ^2$ of (9.205), (put $q^2 = \mathbf{G} ^2$ or $q^2 = 2 \mathbf{G} ^2$ with $ \mathbf{G} ^2$ of (9.198b))
616	Table 9.3	pseudopotential form factors	to be corrected as given below
617	Table 9.4	The coefficients a_i	to be corrected as given below
618	Table 9.5	the values of b_{ps}	$b_{\text{ps}} = 0.05, 0.40, 0.20$ (list order)
621	Eq.(9.217)	$m^* = \mathcal{E} \left(1 + \frac{\mathcal{E}}{\mathcal{E}_{\text{G}}} \right) = \frac{\hbar^2 k^2}{2m^*}$	$m^* = \mathcal{E} \left(1 + \frac{\mathcal{E}}{\mathcal{E}_{\text{G}}} \right) = \frac{\hbar^2 k^2}{2m^*}$
622	11 lines above the bottom	$\Delta_{\text{cr}} = 0.0213 \text{ eV}$	$\Delta_{\text{cr}} = 0.0093 \text{ eV}$
622	9 lines above the bottom	$m_{\parallel} = m_{\perp} = 0.155m$	$m_{\text{hh}\parallel} = m_{\text{lh}\parallel} = 0.86m, m_{\text{hh}\perp} = 0.75m, m_{\text{lh}\perp} = 0.165m, 0.10m$
622	7 lines above the bottom	$m_{\text{ch}\parallel} = m_{\text{ch}\perp} = 0.160m$	$m_{\text{cr}\parallel} = 0.165m, m_{\text{cr}\perp} = 0.155m, 2.50m$ (see revised Fig.9.54)

Page	Equation, Line, Figure	Incorrect	Corrected
624	Fig. 9.54	Fig. 9.54 and caption	to be replaced by the revised Fig. 9.54 and caption
644	Lines 7 and 8	$\left(\frac{\hbar}{2\mu}\right)^{-1}$	$\left(\frac{\hbar^2}{2\mu}\right)^{-1}$
651	Problem (6.5) line 2	for lo impurity	for low impurity
654	Equation above (8.3)	$mu_{ac} = \dots$	$\mu_{ac} = \dots$
655	Answer (8.6)	Since $Q = \sqrt{2}k(1 - \cos \theta)$	Since $Q = \sqrt{2}k\sqrt{1 - \cos \theta}$
655	7 lines above the bottom: Equation of $1/\tau_{ion}$	missing a factor m^*/\hbar^2	to be multiplied by m^*/\hbar^2
655	second line of Equation of $1/\tau_{ion}$	$\left(\frac{e^4}{2\hbar(\kappa\epsilon_0)^2}\right) \frac{\hbar^2 N_{ion}}{2m^*} \mathcal{E}^{-1}$	$\left(\frac{e^4}{4\hbar(\kappa\epsilon_0)^2}\right) N_{ion} \mathcal{E}^{-1}$
655	Equation of μ_{ion}	4π	8
660	Fig. 10.16	missing data points	replace by the attached Fig. 10.16

[A] and GaAs in Fig. 1.14(b) with 113×2 ($0 \leq K^2 \leq \mathcal{E}_1 = 20$) with spin-up and spin-down are used. Local pseudopotentials of Table 1.3 reported by Chelikowsky and Cohen [7] are modified by replacing by $V_3^S = -0.254$ and $V_{11}^A = 0.017$ and the spin-orbit interaction parameters are $(2\pi/a)^2 \lambda^S = 0.00080$ and $(2\pi/a)^2 \lambda^A = 0.00020$. Obtained energy gap is $\mathcal{E}_G = 1.515$ eV and spin-orbit splitting is $\Delta = 0.346$ eV. These results are not best fitted, but more detailed calculations using larger number of plane waves and Löwdin's perturbation method will give better results as described later [B]. There exist only slight difference from the nonlocal pseudopotential method.

[B] ... and the results obtained from the empirical pseudopotential method with 113 plane waves (113×2 plane waves with spin-up and spin-down) are shown in Fig.1.21b. In the calculations of the local pseudopotential method, we used the following parameters replacing the pseudopotentials V_3^S and V_{11}^A in Table 1.3 by $V_3^S = -0.254$ and $V_{11}^A = 0.017$, and $(2\pi/a)^2 \lambda^S = 0.00080$ and $(2\pi/a)^2 \lambda^A = 0.00021$ in atomic units. Total number of the free electron waves is 2×113 and the higher lying free electron waves $20 < K^2 \leq \mathcal{E}_2 = 24$ are included by Löwdin's perturbation method. These parameters give $\mathcal{E}_G = 1.517$ eV and spin-orbit splitting is $\Delta = 0.342$ eV.

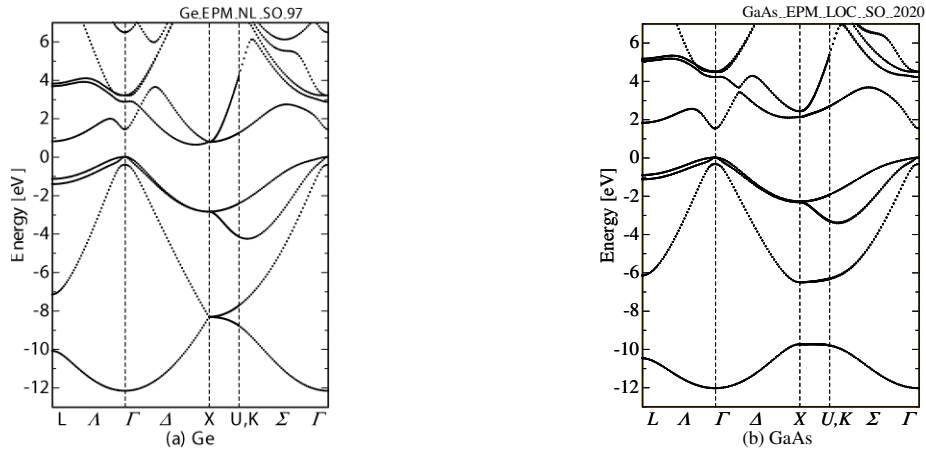


Fig. 1.14. Energy band structures of Ge calculated by the nonlocal pseudopotential method with spin-orbit interaction $(2\pi/a)^2 \lambda^S = 0.00097$ and (b) GaAs calculated by the local pseudopotential methods with plane waves 113×2 ($0 \leq K^2 \leq \mathcal{E}_1 = 20$) with spin-up and spin-down are used. Pseudopotentials of Table 1.3 reported by Chelikowsky and Cohen [7] are used, replacing by $V_3^S = -0.254$ and $V_{11}^A = 0.017$ for GaAs, and the spin-orbit interaction parameters are $(2\pi/a)^2 \lambda^S = 0.00080$ and $(2\pi/a)^2 \lambda^A = 0.00020$.

Fig. 1.14(a) and **Fig. 1.14(b)** are newly calculated, where there is no apparent difference between the two. It means that the contribution from higher lying bands is very small in the

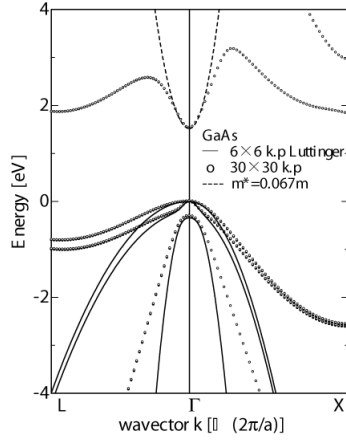


Fig. 2.22. Comparison of the valence band dispersion between the 30-band $\mathbf{k} \cdot \mathbf{p}$ (dotted curves) and 6-band Luttinger Hamiltonian (solid-curves). Conduction band of the effective mass $m^* = 0.067m$ is plotted by dashed curve for comparison.

energy band calculations. **Fig. 2.22** should be replaced by revised **Fig. 2.22**. **Fig. 9.54** is to be replaced by revised **Fig. 9.54** calculated with spin-orbit interaction, $\lambda^S = 0.00025[\text{a.u.}]$ and $\lambda^A = 0.00019[\text{a.u.}]$. **Fig. 10.16** is replaced by the attached **Fig. 10.16**. **Table 9.3** and **Table 9.4** should be replaced by the revised Tables given below.

Note for evaluation of the pseudopotentials:

Pseudopotentials are evaluated by the following relation with $q^2 = |\mathbf{G}|^2$ with newly defined $|\mathbf{G}|^2$ of Eq.(9.205) or $q^2 = 2|\mathbf{G}|^2$ with $|\mathbf{G}|^2$ of Eq.(9.198b).

$$V^{S,A}(q) = \frac{a_1(2q^2 - a_2)}{1 + \exp[a_3(2q^2 - a_4)]}, \quad (9.210)$$

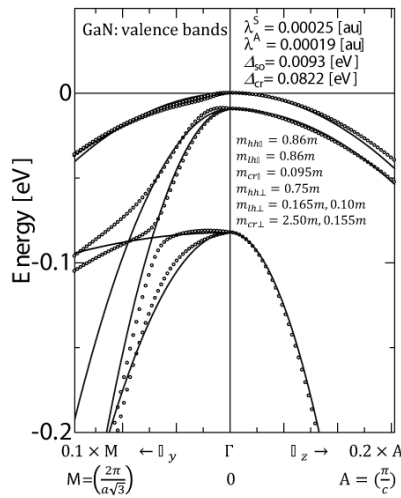


Fig. 9.54. Valence band structure of GaN (\circ) calculated by pseudopotential method with spin-orbit interaction. The solid curves represent parabolic approximation with the effective masses given by $m_{hh||} = 0.86m$, $m_{hh\perp} = 0.75m$, $m_{lh||} = 0.860m$, $m_{lh\perp} = 0.165m$, $0.10m$, $m_{cr||} = 0.095m$, $m_{cr\perp} = 0.155m$, $2.50m$.

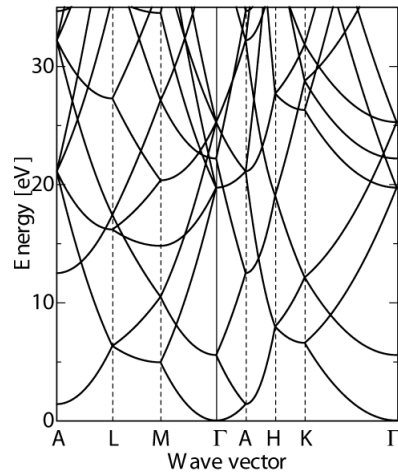


Fig. 10.16. Free electron full bands of GaN (Wurtzite), where the critical points are shown in the horizontal axis

Table 9.3. Table 9.3. Reciprocal lattice vectors \mathbf{G} and $2|\mathbf{G}|^2$, structure factors $S^S(\mathbf{G})$ and $S^A(\mathbf{G})$, and pseudopotential form factors $V^S(|\mathbf{G}|^2)$ and $V^A(|\mathbf{G}|^2)$ in units of [Ry] of wurtzite semiconductors GaN, InN, and AlN. The pseudopotential form factors are estimated from Rezaie *et al.*[†]

\mathbf{G}				GaN		InN		AlN	
(l, m, n)	$2 \mathbf{G} ^2$	$ S^S(\mathbf{G}) $	$ S^A(\mathbf{G}) $	V^S	V^A	V^S	V^A	V^S	V^A
000	0	1	0						
001	$\frac{3}{4}$	0	0						
100	$2\frac{2}{3}$	$\frac{1}{2}$	0	-0.315		-0.316		-0.236	
002	3	0.71	0.71	-0.286	0.247	-0.285	0.183	-0.212	0.412
101	$3\frac{5}{12}$	0.33	0.80	-0.251	0.238	-0.247	0.180	-0.181	0.385
102	$5\frac{2}{3}$	0.35	0.35	-0.065	0.192	-0.047	0.161	-0.021	0.266
003	$6\frac{3}{4}$	0	0						
210	8	1	0	0.090		0.097		0.119	
211	$8\frac{3}{4}$	0	0						
103	$9\frac{5}{12}$	0.80	0.33	0.142	0.128	0.117	0.128	0.172	0.141
200	$10\frac{2}{3}$	$\frac{1}{2}$	0	0.155		0.099		0.188	
212	11	0.71	0.71	0.154	0.106	0.092	0.115	0.187	0.107
201	$11\frac{5}{12}$	0.33	0.80	0.150	0.101	0.082	0.112	0.183	0.100
004	12	0.00	1.00		0.094		0.107		0.090
202	$13\frac{2}{3}$	0.35	0.35	0.103	0.077	0.035	0.095	0.130	0.067
104	14	0.00	0.50		0.068		0.088		0.056
213	$14\frac{3}{4}$	0	0						

[†] B. Rezaei, A. Asgari, and M. Kalafi: Physica B **371** (2006) 107.

Table 9.4. The coefficients a_i of the pseudopotential form factor $V^S(q)$ and $V^A(q)$ functions. The functions are defined by (9.210) after Rezaei *et al.*[†]

	$V^S(q)$				$V^A(q)$			
	a_1	a_2	a_3	a_4	a_1	a_2	a_3	a_4
GaN	0.04198	13.079	0.226	20.393	0.5114	-20.122	0.0835	-41.557
InN	0.0449	12.542	0.299	17.691	0.0221	-35.605	0.0574	-18.261
AlN	0.0363	11.960	0.234	22.233	0.0323	-145.212	0.0947	-19.160

[†] B. Rezaei, A. Asgari, and M. Kalafi: Physica B **371** (2006) 107.



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