International Tables for Crystallography (2010). Vol. B, Table 2.5.3.12, pp. 335–343.

Table 2.5.3.12. *Dynamical extinction lines appearing in HOLZ reflections for crystal space groups that have mirror and glide planes*

Point groups m, $2/m$ (second setting, unique axis b)

Space group		Incident-beam direction $[u0w]$	
6	Pm		
7	Pc	$h0l_o$ c	A_h
8	Cm		
9	Cc	h_e0l_o c	A_h
10	$P2/m$		
11	$P2_1/m$		
12	$C2/m$		
13	$P2/c$	$h0l_o$ c	A_h
14	$P2_1/c$	$h0l_o$ c	A_h
15	$C2/c$	h_e0l_o c	A_h

Point group $mm2$

Space group		Incident-beam direction [100]		[010]		[001]		$[0vw]$		$[u0w]$	
25	$Pmm2$										
26	$Pmc2_1$	$h0l_o$ c	A			$h0l_o$ c	A			$h0l_o$ c	A_h
27	$Pcc2$	$h0l_o$ c_2	A	$0kl_o$ c_1	A	$0kl_o$ c_1 $h0l_o$ c_2	A	$0kl_o$ c_1	A_h	$h0l_o$ c_2	A_h
28	$Pma2$	h_o0l a	A			h_o0l a	A			h_o0l a	A_h
29	$Pca2_1$	h_o0l a	A	$0kl_o$ c	A	$0kl_o$ c h_o0l a	A	$0kl_o$ c	A_h	h_o0l a	A_h
30	$Pnc2$	$h0l_o$ c	A	$0kl$: $k + l = 2n + 1$ n	A	$0kl$: $k + l = 2n + 1$ n $h0l_o$ c	A	$0kl$: $k + l = 2n + 1$ n	A_h	$h0l_o$ c	A_h
31	$Pmn2_1$	$h0l$: $h + l = 2n + 1$ n	A			$h0l$: $h + l = 2n + 1$ n	A			$h0l$: $h + l = 2n + 1$ n	A_h
32	$Pba2$	h_o0l a	A	$0k_ol$ b	A	$0k_ol$ b h_o0l a	A	$0k_ol$ b	A_h	h_o0l a	A_h
33	$Pna2_1$	h_o0l a	A	$0kl$: $k + l = 2n + 1$ n	A	$0kl$: $k + l = 2n + 1$ n h_o0l a	A	$0kl$: $k + l = 2n + 1$ n	A_h	h_o0l a	A_h
34	$Pnn2$	$h0l$: $h + l = 2n + 1$ n_2	A	$0kl$: $k + l = 2n + 1$ n_1	A	$0kl$: $k + l = 2n + 1$ n_1 $h0l$: $h + l = 2n + 1$ n_2	A	$0kl$: $k + l = 2n + 1$ n_1	A_h	$h0l$: $h + l = 2n + 1$ n_2	A_h
35	$Cmm2$ $ba2$										
36	$Cmc2_1$ $bn2_1$	h_e0l_o c	A			h_e0l_o c	A			h_e0l_o c	A_h
37	$Ccc2$ $nn2$	h_e0l_o c_2	A	$0k_el_o$ c_1	A	$0k_el_o$ c_1 h_e0l_o c_2	A	$0k_el_o$ c_1	A_h	h_e0l_o c_2	A_h

Table 2.5.3.12 (*cont.*)

Space group		Incident-beam direction									
		[100]		[010]		[001]		[0*vw*]		[*u*0*w*]	
38	*Amm*2 $nc2_1$										
39	*Abm*2 $cc2_1$			$0k_ol_o$ *b*	*A*	$0k_ol_o$ *b*	*A*	$0k_ol_o$ *b*	A_h		
40	*Ama*2 $nn2_1$	h_o0l_e *a*	*A*			h_o0l_e *a*	*A*			h_o0l_e *a*	A_h
41	*Aba*2 $cn2_1$	h_o0l_e *a*	*A*	$0k_ol_o$ *b*	*A*	$0k_ol_o$ *b* h_o0l_e *a*	*A*	$0k_ol_o$ *b*	A_h	h_o0l_e *a*	A_h
42	*Fmm*2										
43	*Fdd*2 $dd2_1$	h_e0l_e: $h_e + l_e = 4n + 2$ d_2	*A*	$0k_el_e$: $k_e + l_e = 4n + 2$ d_1	*A*	$0k_el_e$: $k_e + l_e = 4n + 2$ d_1 h_e0l_e: $h_e + l_e = 4n + 2$ d_2	*A*	$0k_el_e$: $k_e + l_e = 4n + 2$ d_1	A_h	h_e0l_e: $h_e + l_e = 4n + 2$ d_2	A_h
44	*Imm*2 $nn2_1$										
45	*Iba*2 $cc2_1$	h_o0l_o *a*	*A*	$0k_ol_o$ *b*	*A*	$0k_ol_o$ *b* h_o0l_o *a*	*A*	$0k_ol_o$ *b*	A_h	h_o0l_o *a*	A_h
46	*Ima*2 $nc2_1$	h_o0l_o *a*	*A*			h_o0l_o *a*	*A*			h_o0l_o *a*	A_h

Point group *mmm*

Space group		Incident-beam direction											
		[100]		[010]		[001]		[*uv*0]		[0*vw*]		[*u*0*w*]	
47	*P*2/*m*2/*m*2/*m*												
48	*P*2/*n*2/*n*2/*n*	$h0l$: $h + l =$ $2n + 1$ n_2 $hk0$: $h + k =$ $2n + 1$ n_3	*A*	$0kl$: $k + l =$ $2n + 1$ n_1 $hk0$: $h + k =$ $2n + 1$ n_3	*A*	$0kl$: $k + l =$ $2n + 1$ n_1 $h0l$: $h + l =$ $2n + 1$ n_2	*A*	$hk0$: $h + k =$ $2n + 1$ n_3	A_h	$0kl$: $k + l =$ $2n + 1$ n_1	A_h	$h0l$: $h + l =$ $2n + 1$ n_2	A_h
49	*P*2/*c*2/*c*2/*m*	$h0l_o$ c_2	*A*	$0kl_o$ c_1	*A*	$0kl_o$ c_1 $h0l_o$ c_2	*A*			$0kl_o$ c_1	A_h	$h0l_o$ c_2	A_h
50	*P*2/*b*2/*a*2/*n*	h_o0l *a* $hk0$: $h + k =$ $2n + 1$ *n*	*A*	$0k_ol$ *b* $hk0$: $h + k =$ $2n + 1$ *n*	*A*	$0k_ol$ *b* h_o0l *a*	*A*	$hk0$: $h + k =$ $2n + 1$ *n*	A_h	$0k_ol$ *b*	A_h	h_o0l *a*	A_h
51	$P2_1/m2/m2/a$	h_ok0 *a*	*A*	h_ok0 *a*	*A*			h_ok0 *a*	A_h				
52	$P2/n2_1/n2/a$	$h0l$: $h + l =$ $2n + 1$ n_2 h_ok0 *a*	*A*	$0kl$: $k + l =$ $2n + 1$ n_1 h_ok0 *a*	*A*	$0kl$: $k + l =$ $2n + 1$ n_1 $h0l$: $h + l =$ $2n + 1$ n_2	*A*	h_ok0 *a*	A_h	$0kl$: $k + l =$ $2n + 1$ n_1	A_h	$h0l$: $h + l =$ $2n + 1$ n_2	A_h
53	$P2/m2/n2_1/a$	$h0l$: $h + l =$ $2n + 1$ *n* h_ok0 *a*	*A*	h_ok0 *a*	*A*	$h0l$: $h + l =$ $2n + 1$ *n*	*A*	h_ok0 *a*	A_h			$h0l$: $h + l =$ $2n + 1$ *n*	A_h
54	$P2_1/c2/c2/a$	$h0l_o$ c_2 h_ok0 *a*	*A*	$0kl_o$ c_1 h_ok0 *a*	*A*	$0kl_o$ c_1 $h0l_o$ c_2	*A*	h_ok0 *a*	A_h	$0kl_o$ c_1	A_h	$h0l_o$ c_2	A_h

Table 2.5.3.12 (*cont.*)

Space group	Incident-beam direction											
	[100]		[010]		[001]		[$uv0$]		[$0vw$]		[$u0w$]	
55 $P2_1/b2_1/a2/m$	h_o0l a	A	$0k_ol$ b	A	$0k_ol$ b h_o0l a	A			$0k_ol$ b	A_h	h_o0l a	A_h
56 $P2_1/c2_1/c2/n$	$h0l_o$ c_2 $hk0$: $h+k=$ $2n+1$ n	A	$0kl_o$ c_1 $hk0$: $h+k=$ $2n+1$ n	A	$0kl_o$ c_1 $h0l_o$ c_2	A	$hk0$: $h+k=$ $2n+1$ n	A_h	$0kl_o$ c_1	A_h	$h0l_o$ c_2	A_h
57 $P2/b2_1/c2_1/m$	$h0l_o$ c	A	$0k_ol$ b	A	$0k_ol$ b $h0l_o$ c	A			$0k_ol$ b	A_h	$h0l_o$ c	A_h
58 $P2_1/n2_1/n2/m$	$h0l$: $h+l=$ $2n+1$ n_2	A	$0kl$: $k+l=$ $2n+1$ n_1	A	$0kl$: $k+l=$ $2n+1$ n_1 $h0l$: $h+l=$ $2n+1$ n_2	A			$0kl$: $k+l=$ $2n+1$ n_1	A_h	$h0l$: $h+l=$ $2n+1$ n_2	A_h
59 $P2_1/m2_1/m2/n$	$hk0$: $h+k=$ $2n+1$ n	A	$hk0$: $h+k=$ $2n+1$ n	A			$hk0$: $h+k=$ $2n+1$ n	A_h				
60 $P2_1/b2/c2_1/n$	$h0l_o$ c $hk0$: $h+k=$ $2n+1$ n	A	$0k_ol$ b $hk0$: $h+k=$ $2n+1$ n	A	$0k_ol$ b $h0l_o$ c	A	$hk0$: $h+k=$ $2n+1$ n	A_h	$0k_ol$ b	A_h	$h0l_o$ c	A_h
61 $P2_1/b2_1/c2_1/a$	$h0l_o$ c h_ok0 a	A	$0k_ol$ b h_ok0 a	A	$0k_ol$ b $h0l_o$ c	A	h_ok0 a	A_h	$0k_ol$ b	A_h	$h0l_o$ c	A_h
62 $P2_1/n2_1/m2_1/a$	h_ok0 a	A	$0kl$: $k+l=$ $2n+1$ n h_ok0 a	A	$0kl$: $k+l=$ $2n+1$ n	A	h_ok0 a	A_h	$0kl$: $k+l=$ $2n+1$ n	A_h		
63 $C2/m2/c2_1/m$	h_e0l_o c	A			h_e0l_o c	A					h_e0l_o c	A_h
64 $C2/m2/c2_1/a$	h_e0l_o c h_ok_o0 a	A	h_ok_o0 a	A	h_e0l_o c	A	h_ok_o0 a	A_h			h_e0l_o c	A_h
65 $C2/m2/m2/m$												
66 $C2/c2/c2/m$	h_e0l_o c_2	A	$0k_el_o$ c_1	A	$0k_el_o$ c_1 h_e0l_o c_2	A			$0k_el_o$ c_1	A_h	h_e0l_o c_2	A_h
67 $C2/m2/m2/a$	h_ok_o0 a	A	h_ok_o0 a	A			h_ok_o0 a	A_h				
68 $C2/c2/c2/a$	h_e0l_o c_2 h_ok_o0 a	A	$0k_el_o$ c_1 h_ok_o0 a	A	$0k_el_o$ c_1 h_e0l_o c_2	A	h_ok_o0 a	A_h	$0k_el_o$ c_1	A_h	h_e0l_o c_2	A_h
69 $F2/m2/m2/m$												
70 $F2/d2/d2/d$	h_e0l_e: $h_e+l_e=$ $4n+2$ d_2 h_ek_e0: $h_e+k_e=$ $4n+2$ d_3	A	h_ek_e0: $h_e+k_e=$ $4n+2$ d_3 $0k_el_e$: $k_e+l_e=$ $4n+2$ d_1	A	$0k_el_e$: $k_e+l_e=$ $4n+2$ d_1 h_e0l_e: $h_e+l_e=$ $4n+2$ d_2	A	h_ek_e0: $h_e+k_e=$ $4n+2$ d_3	A_h	$0k_el_e$: $k_e+l_e=$ $4n+2$ d_1	A_h	h_e0l_e: $h_e+l_e=$ $4n+2$ d_2	A_h
71 $I2/m2/m2/m$												

Table 2.5.3.12 (*cont.*)

Space group	Incident-beam direction [100]		[010]		[001]		[uv0]		[0vw]		[u0w]	
72 $I2/b2/a2/m$	h_o0l_o a	A	$0k_ol_o$ b	A	$0k_ol_o$ b h_o0l_o a	A			$0k_ol_o$ b	A_h	h_o0l_o a	A_h
73 $I2_1/b2_1/c2_1/a$	h_o0l_o c h_ok_o0 a	A	h_ok_o0 a $0k_ol_o$ b	A	$0k_ol_o$ b h_o0l_o c	A	h_ok_o0 a	A_h	$0k_ol_o$ b	A_h	h_o0l_o c	A_h
74 $I2_1/m2_1/m2_1/a$	h_ok_o0 a	A	h_ok_o0 a	A			h_ok_o0 a	A_h				

Point group $4/m$

Space group	Incident-beam direction [100], [110]		[uv0]	
83 $P4/m$				
84 $P4_2/m$				
85 $P4/n$	$hk0$: $h + k = 2n + 1$ n	A	$hk0$: $h + k = 2n + 1$ n	A_h
86 $P4_2/n$	$hk0$: $h + k = 2n + 1$ n	A	$hk0$: $h + k = 2n + 1$ n	A_h
87 $I4/m$				
88 $I4_1/a$	h_ok_o0 a	A	h_ok_o0 a	A_h

Point group $4mm$. The symbol a in the column [$u0w$] is equivalent to the symbol b in the space groups of the first column.

Space group	Incident-beam direction [100]		[001]		[110]		[u0w]		[uuw]	
99 $P4mm$										
100 $P4bm$	h_o0l a_2	A	$0k_ol$ b_1 h_o0l a_2	A			h_o0l a	A_h		
101 $P4_2cm$	$h0l_o$ c_2	A	$0kl_o$ c_1 $h0l_o$ c_2	A			$h0l_o$ c	A_h		
102 $P4_2nm$	$h0l$: $h + l = 2n + 1$ n_2	A	$0kl$: $k + l = 2n + 1$ n_1 $h0l$: $h + l = 2n + 1$ n_2	A			$h0l$: $h + l = 2n + 1$ n	A_h		
103 $P4cc$	$h0l_o$ c_{12}	A	$0kl_o$ c_{11} $h0l_o$ c_{12} $hhl_o, \bar{h}hl_o$ c_2	A	hhl_o c_2	A	$h0l_o$ c_1	A_h	hhl_o c_2	A_h
104 $P4nc$	$h0l$: $h + l = 2n + 1$ n_2	A	$0kl$: $k + l = 2n + 1$ n_1 $h0l$: $h + l = 2n + 1$ n_2 $hhl_o, \bar{h}hl_o$ c	A	hhl_o c	A	$h0l$: $h + l = 2n + 1$ n	A_h	hhl_o c	A_h
105 $P4_2mc$			$hhl_o, \bar{h}hl_o$ c	A	hhl_o c	A			hhl_o c	A_h
106 $P4_2bc$	h_o0l a_2	A	$0k_ol$ b_1 h_o0l a_2 $hhl_o, \bar{h}hl_o$ c	A	hhl_o c	A	h_o0l a	A_h	hhl_o c	A_h
107 $I4mm$										

Table 2.5.3.12 (*cont.*)

Space group		Incident-beam direction									
		[100]		[001]		[110]		[$u0w$]		[uuw]	
108	$I4cm$	h_o0l_o c_2	A	$0k_ol_o$ c_1 h_o0l_o c_2	A			h_o0l_o c	A_h		
109	$I4_1md$			$hhl_e, \bar{h}hl_e$: $2h + l_e = 4n + 2$ d	A	hhl_e: $2h + l_e = 4n + 2$ d	A			hhl_e: $2h + l_e = 4n + 2$ d	A_h
110	$I4_1cd$	h_o0l_o c_2	A	$0k_ol_o$ c_1 h_o0l_o c_2 $hhl_e, \bar{h}hl_e$: $2h + l_e = 4n + 2$ d	A	hhl_e: $2h + l_e = 4n + 2$ d	A	h_o0l_o c	A_h	hhl_e: $2h + l_e = 4n + 2$ d	A_h

Point group $\bar{4}2m$. The symbol a in the column [$u0w$] is equivalent to the symbol b in the space groups of the first column.

Space group		Incident-beam direction									
		[100]		[001]		[110]		[$u0w$]		[uuw]	
111	$P\bar{4}2m$										
112	$P\bar{4}2c$			$hhl_o, \bar{h}hl_o$ c	A	hhl_o c	A			hhl_o c	A_h
113	$P\bar{4}2_1m$										
114	$P\bar{4}2_1c$			$hhl_o, \bar{h}hl_o$ c	A	hhl_o c	A			hhl_o c	A_h
115	$P\bar{4}m2$										
116	$P\bar{4}c2$	$h0l_o$ c_2	A	$0kl_o$ c_1 $h0l_o$ c_2	A			$h0l_o$ c	A_h		
117	$P\bar{4}b2$	h_o0l a_2	A	$0k_ol$ b_1 h_o0l a_2	A			h_o0l a	A_h		
118	$P\bar{4}n2$	$h0l$: $h + l = 2n + 1$ n_2	A	$0kl$: $k + l = 2n + 1$ n_1 $h0l$: $h + l = 2n + 1$ n_2	A			$h0l$: $h + l = 2n + 1$ n	A_h		
119	$I\bar{4}m2$										
120	$I\bar{4}c2$	h_o0l_o c_2	A	$0k_ol_o$ c_1 h_o0l_o c_2	A			h_o0l_o c	A_h		
121	$I\bar{4}2m$										
122	$I\bar{4}2d$			$hhl_e, \bar{h}hl_e$: $2h + l_e = 4n + 2$ d	A	hhl_e: $2h + l_e = 4n + 2$ d	A			hhl_e: $2h + l_e = 4n + 2$ d	A_h

Point group $4/mmm$. The symbol a in the column [$u0w$] is equivalent to the symbol b in the space groups of the first column.

Space group		Incident-beam direction											
		[100]		[001]		[110]		[$u0w$]		[uuw]		[$uv0$]	
123	$P4/mmm$ $P4/m2/m2/m$												
124	$P4/mcc$ $P4/m2/c2/c$	$h0l_o$ c_{12}	A	$0kl_o$ c_{11} $h0l_o$ c_{12} $hhl_o, \bar{h}hl_o$ c_2	A	hhl_o c_2	A	$h0l_o$ c_1	A_h	hhl_o c_2	A_h		
125	$P4/nbm$ $P4/n2/b2/m$	$hk0$: $h + k =$ $2n + 1$ n h_o0l a_2	A	$0k_ol$ b_1 h_o0l a_2	A	$hk0$: $h + k =$ $2n + 1$ n	A	h_o0l a	A_h			$hk0$: $h + k =$ $2n + 1$ n	A_h

Table 2.5.3.12 (*cont.*)

Space group		Incident-beam direction											
		[100]		[001]		[110]		[$u0w$]		[uuw]		[$uv0$]	
126	$P4/nnc$ $P4/n2/n2/c$	$hk0$: $h+k=$ $2n+1$ n_1 $h0l$: $h+l=$ $2n+1$ n_{22}	A	$0kl$: $k+l=$ $2n+1$ n_{21} $h0l$: $h+l=$ $2n+1$ n_{22} $hhl_o, \bar{h}hl_o$ c	A	$hk0$: $h+k=$ $2n+1$ n_1 hhl_o c	A	$h0l$: $h+l=$ $2n+1$ n_2	A_h	hhl_o c	A_h	$hk0$: $h+k=$ $2n+1$ n_1	A_h
127	$P4/mbm$ $P4/m2_1/b2/m$	h_o0l a_2	A	$0k_ol$ b_1 h_o0l a_2	A			h_o0l a	A_h				
128	$P4/mnc$ $P4/m2_1/n2/c$	$h0l$: $h+l=$ $2n+1$ n_2	A	$0kl$: $k+l=$ $2n+1$ n_1 $h0l$: $h+l=$ $2n+1$ n_2 $hhl_o, \bar{h}hl_o$ c	A	hhl_o c	A	$h0l$: $h+l=$ $2n+1$ n	A_h	hhl_o c	A_h		
129	$P4/nmm$ $P4/n2_1/m2/m$	$hk0$: $h+k=$ $2n+1$ n	A			$hk0$: $h+k=$ $2n+1$ n	A					$hk0$: $h+k=$ $2n+1$ n	A_h
130	$P4/ncc$ $P4/n2_1/c2/c$	$hk0$: $h+k=$ $2n+1$ n $h0l_o$ c_{12}	A	$0kl_o$ c_{11} $h0l_o$ c_{12} $hhl_o, \bar{h}hl_o$ c_2	A	$hk0$: $h+k=$ $2n+1$ n hhl_o c_2	A	$h0l_o$ c_1	A_h	hhl_o c_2	A_h	$hk0$: $h+k=$ $2n+1$ n	A_h
131	$P4_2/mmc$ $P4_2/m2/m2/c$			$hhl_o, \bar{h}hl_o$ c	A	hhl_o c	A			hhl_o c	A_h		
132	$P4_2/mcm$ $P4_2/m2/c2/m$	$h0l_o$ c_2	A	$0kl_o$ c_1 $h0l_o$ c_2	A			$h0l_o$ c	A_h				
133	$P4_2/nbc$ $P4_2/n2/b2/c$	$hk0$: $h+k=$ $2n+1$ n h_o0l a_2	A	$0k_ol$ b_1 h_o0l a_2 $hhl_o, \bar{h}hl_o$ c	A	$hk0$: $h+k=$ $2n+1$ n hhl_o c	A	h_o0l a	A_h	hhl_o c	A_h	$hk0$: $h+k=$ $2n+1$ n	A_h
134	$P4_2/nnm$ $P4_2/n2/n2/m$	$hk0$: $h+k=$ $2n+1$ n_1 $h0l$: $h+l=$ $2n+1$ n_{22}	A	$0kl$: $k+l=$ $2n+1$ n_{21} $h0l$: $h+l=$ $2n+1$ n_{22}	A	$hk0$: $h+k=$ $2n+1$ n_1	A	$h0l$: $h+l=$ $2n+1$ n_2	A_h			$hk0$: $h+k=$ $2n+1$ n_1	A_h
135	$P4_2/mbc$ $P4_2/m2_1/b2/c$	h_o0l a_2	A	$0k_ol$ b_1 h_o0l a_2 $hhl_o, \bar{h}hl_o$ c	A	hhl_o c	A	h_o0l a	A_h	hhl_o c	A_h		
136	$P4_2/mnm$ $P4_2/m2_1/n2/m$	$h0l$: $h+l=$ $2n+1$ n_2	A	$0kl$: $k+l=$ $2n+1$ n_1 $h0l$: $h+l=$ $2n+1$ n_2	A			$h0l$: $h+l=$ $2n+1$ n	A_h				

Table 2.5.3.12 (*cont.*)

Space group		Incident-beam direction [100]		[001]		[110]		[$u0w$]		[uuw]		[$uv0$]	
137	$P4_2/nmc$ $P4_2/n2_1/m2/c$	$hk0$: $h+k=$ $2n+1$ n	A	hhl_o, $\bar{h}hl_o$ c	A	hhl_o c $hk0$: $h+k=$ $2n+1$ n	A			hhl_o c	A_h	$hk0$: $h+k=$ $2n+1$ n	A_h
138	$P4_2/ncm$ $P4_2/n2_1/c2/m$	$hk0$: $h+k=$ $2n+1$ n $h0l_o$ c_2	A	$0kl_o$ c_1 $h0l_o$ c_2	A	$hk0$: $h+k=$ $2n+1$ n	A	$h0l_o$ c	A_h			$hk0$: $h+k=$ $2n+1$ n	A_h
139	$I4/mmm$ $I4/m2/m2/m$												
140	$I4/mcm$ $I4/m2/c2/m$	h_o0l_o c_2	A	$0k_ol_o$ c_1 h_o0l_o c_2	A			h_o0l_o c	A_h				
141	$I4_1/amd$ $I4_1/a2/m2/d$	h_ok_o0 a	A	hhl_e, $\bar{h}hl_e$: $2h+l_e=$ $4n+2$ d	A	h_ok_o0 a hhl_e: $2h+l_e=$ $4n+2$ d	A			hhl_e: $2h+l_e=$ $4n+2$ d	A_h	h_ok_o0 a	A_h
142	$I4_1/acd$ $I4_1/a2/c2/d$	h_ok_o0 a h_o0l_o c_2	A	$0k_ol_o$ c_1 h_o0l_o c_2 hhl_e, $\bar{h}hl_e$: $2h+l_e=$ $4n+2$ d	A	h_ok_o0 a hhl_e: $2h+l_e=$ $4n+2$ d	A	h_o0l_o c	A_h	hhl_e: $2h+l_e=$ $4n+2$ d	A_h	h_ok_o0 a	A_h

Point groups $3m$, $\bar{3}m$

Space group		Incident-beam direction [0001]		[$11\bar{2}0$]		[$1\bar{1}00$]		[$11\bar{2}w$]		[$1\bar{1}0w$]	
156	$P3m1$										
157	$P31m$										
158	$P3c1$	$h\bar{h}0l_o$, $0h\bar{h}l_o$, $\bar{h}0hl_o$ c	A			$h\bar{h}0l_o$ c	A			$h\bar{h}0l_o$ c	A_h
159	$P31c$	$hh\overline{2h}l_o$, $h\overline{2h}hl_o$, $\overline{2h}hhl_o$ c	A	$hh\overline{2h}l_o$ c	A			$hh\overline{2h}l_o$ c	A_h		
160	$R3m$										
161	$R3c$	$h\bar{h}0l_o$, $0h\bar{h}l_o$, $\bar{h}0hl_o$: $h+l_o=3n$ c	A_h			$h\bar{h}0l_o$: $h+l_o=3n$ c	A_h			$h\bar{h}0l_o$: $h+l_o=3n$ c	A_h
162	$P\bar{3}1m$										
163	$P\bar{3}1c$	$hh\overline{2h}l_o$, $h\overline{2h}hl_o$, $\overline{2h}hhl_o$ c	A	$hh\overline{2h}l_o$ c	A			$hh\overline{2h}l_o$ c	A_h		
164	$P\bar{3}m1$										
165	$P\bar{3}c1$	$h\bar{h}0l_o$, $0h\bar{h}l_o$, $\bar{h}0hl_o$ c	A			$h\bar{h}0l_o$ c	A			$h\bar{h}0l_o$ c	A_h
166	$R\bar{3}m$										
167	$R\bar{3}c$	$h\bar{h}0l_o$, $0h\bar{h}l_o$, $\bar{h}0hl_o$: $h+l_o=3n$ c	A_h			$h\bar{h}0l_o$: $h+l_o=3n$ c	A_h			$h\bar{h}0l_o$: $h+l_o=3n$ c	A_h

Point groups $6mm$, $\bar{6}m2$, $6/mmm$

Space group		Incident-beam direction [0001]		[$11\bar{2}0$]		[$1\bar{1}00$]		[$11\bar{2}w$]		[$1\bar{1}0w$]	
183	$P6mm$										
184	$P6cc$	$h\bar{h}0l_o$, $0h\bar{h}l_o$, $\bar{h}0hl_o$ c_1 $hh\overline{2h}l_o$, $h\overline{2h}hl_o$, $\overline{2h}hhl_o$ c_2	A	$hh\overline{2h}l_o$ c_2	A	$h\bar{h}0l_o$ c_1	A	$hh\overline{2h}l_o$ c_2	A_h	$h\bar{h}0l_o$ c_1	A_h

Table 2.5.3.12 (*cont.*)

Space group		Incident-beam direction [0001]		[11$\bar{2}$0]		[1$\bar{1}$00]		[11$\bar{2}$*w*]		[1$\bar{1}$0*w*]	
185	$P6_3cm$	$h\bar{h}0l_o, 0h\bar{h}l_o, \bar{h}0hl_o$ c	A			$h\bar{h}0l_o$ c	A			$h\bar{h}0l_o$ c	A_h
186	$P6_3mc$	$hh\overline{2h}l_o, h\overline{2h}hl_o, \overline{2h}hhl_o$ c	A	$hh\overline{2h}l_o$ c	A			$hh\overline{2h}l_o$ c	A_h		
187	$P\bar{6}m2$										
188	$P\bar{6}c2$	$h\bar{h}0l_o, 0h\bar{h}l_o, \bar{h}0hl_o$ c	A			$h\bar{h}0l_o$ c	A			$h\bar{h}0l_o$ c	A_h
189	$P\bar{6}2m$										
190	$P\bar{6}2c$	$hh\overline{2h}l_o, h\overline{2h}hl_o, \overline{2h}hhl_o$ c	A	$hh\overline{2h}l_o$ c	A			$hh\overline{2h}l_o$ c	A_h		
191	$P6/mmm$										
192	$P6/mcc$	$h\bar{h}0l_o, 0h\bar{h}l_o, \bar{h}0hl_o$ c_1 $hh\overline{2h}l_o, h\overline{2h}hl_o, \overline{2h}hhl_o$ c_2	A	$hh\overline{2h}l_o$ c_2	A	$h\bar{h}0l_o$ c_1	A	$hh\overline{2h}l_o$ c_2	A_h	$h\bar{h}0l_o$ c_1	A_h
193	$P6_3/mcm$	$h\bar{h}0l_o, 0h\bar{h}l_o, \bar{h}0hl_o$ c	A			$h\bar{h}0l_o$ c	A			$h\bar{h}0l_o$ c	A_h
194	$P6_3/mmc$	$hh\overline{2h}l_o, h\overline{2h}hl_o, \overline{2h}hhl_o$ c	A	$hh\overline{2h}l_o$ c	A			$hh\overline{2h}l_o$ c	A_h		

Point group $m3$

Space group		Incident-beam direction [100]		[110]		[*uv*0]	
200	$Pm3$ $P2/m\bar{3}$						
201	$Pn3$ $P2/n\bar{3}$	$h0l$: $h + l = 2n + 1$ n_2 $hk0$: $h + k = 2n + 1$ n_3	A	$hk0$: $h + k = 2n + 1$ n_3	A	$hk0$: $h + k = 2n + 1$ n	A_h
202	$Fm3$ $F2/m\bar{3}$						
203	$Fd3$ $F2/d\bar{3}$	h_e0l_e: $h_e + l_e = 4n + 2$ d_2 h_ek_e0: $h_e + k_e = 4n + 2$ d_3	A	h_ek_e0: $h_e + k_e = 4n + 2$ d_3	A	h_ek_e0: $h_e + k_e = 4n + 2$ d	A_h
204	$Im3$ $I2/m\bar{3}$						
205	$Pa3$ $P2_1/a\bar{3}$	$h0l_o$ c_2 h_ok0 a_3	A	h_ok0 a_3	A*	h_ok0 a	A_h
206	$Ia3$ $I2_1/a\bar{3}$	h_o0l_o c_2 h_ok_o0 a_3	A	h_ok_o0 a_3	A	h_ok_o0 a	A_h

Point group $\bar{4}3m$. The symbol a in the column [100] is equivalent to the symbol c in the space groups of the first column.

Space group		Incident-beam direction [100]		[110]		[*uuw*]	
215	$P\bar{4}3m$						
216	$F\bar{4}3m$						
217	$I\bar{4}3m$						
218	$P\bar{4}3n$	$h_okk, h_ok\bar{k}$ n	A	hhl_o n	A	hhl_o n	A_h
219	$F\bar{4}3c$	$h_ok_ok_o, h_ok_o\bar{k}_o$ a	A	$h_oh_ol_o$ c	A	$h_oh_ol_o$ c	A_h
220	$I\bar{4}3d$	$h_ekk, h_ek\bar{k}$: $2k + h_e = 4n + 2$ d	A	hhl_e: $2h + l_e = 4n + 2$ d	A	hhl_e: $2h + l_e = 4n + 2$ d	A_h

Table 2.5.3.12 (*cont.*)

Point group $m3m$. The symbol a in the column [100] is equivalent to the symbol c in the space groups of the first column.

Space group		Incident-beam direction							
		[100]		[110]		[$uv0$]		[uuw]	
221	$Pm3m$ $P4/m\bar{3}2/m$								
222	$Pn3n$ $P4/n\bar{3}2/n$	$h0l$: $h + l = 2n + 1$ n_{12} $hk0$: $h + k = 2n + 1$ n_{13} h_okk, $h_o\bar{k}k$ n_2	A	$hk0$: $h + k = 2n + 1$ n_{13} hhl_o n_2	A	$hk0$: $h + k = 2n + 1$ n_1	A_h	hhl_o n_2	A_h
223	$Pm3n$ $P4_2/m\bar{3}2/n$	h_okk, $h_o\bar{k}k$ n	A	hhl_o n	A			hhl_o n	A_h
224	$Pn3m$ $P4_2/n\bar{3}2/m$	$h0l$: $h + l = 2n + 1$ n_2 $hk0$: $h + k = 2n + 1$ n_3	A	$hk0$: $h + k = 2n + 1$ n_3	A	$hk0$: $h + k = 2n + 1$ n	A_h		
225	$Fm3m$ $F4/m\bar{3}2/m$								
226	$Fm3c$ $F4/m\bar{3}2/c$	$h_ok_ok_o$, $h_o\bar{k}_ok_o$ a	A	$h_oh_ol_o$ c	A			$h_oh_ol_o$ c	A_h
227	$Fd3m$ $F4_1/d\bar{3}2/m$	h_e0l_e: $h_e + l_e = 4n + 2$ d_2 h_ek_e0: $h_e + k_e = 4n + 2$ d_3	A	h_ek_e0: $h_e + k_e = 4n + 2$ d_3	A	h_ek_e0: $h_e + k_e = 4n + 2$ d	A_h		
228	$Fd3c$ $F4_1/d\bar{3}2/c$	h_e0l_e: $h_e + l_e = 4n + 2$ d_2 h_ek_e0: $h_e + k_e = 4n + 2$ d_3 $h_ok_ok_o$, $h_o\bar{k}_ok_o$ a	A	$h_oh_ol_o$ c h_ek_e0: $h_e + k_e = 4n + 2$ d_3	A	h_ek_e0: $h_e + k_e = 4n + 2$ d	A_h	$h_oh_ol_o$ c	A_h
229	$Im3m$ $I4/m\bar{3}2/m$								
230	$Ia3d$ $I4_1/a\bar{3}2/d$	h_ok_o0 a_3 h_o0l_o c_2 h_ekk, $h_e\bar{k}k$: $2k + h_e = 4n + 2$ d	A	hhl_e: $2h + l_e = 4n + 2$ d h_ok_o0 a_3	A	h_ok_o0 a	A_h	hhl_e: $2h + l_e = 4n + 2$ d	A_h

are no kinematically forbidden reflections. Thus, the lattice type is determined to be primitive P.

Possible space groups which satisfy point group $4/mmm$ and primitive lattice type P are those of Nos. 123–138 in Table 2.5.3.9. In Fig. 2.5.3.15(a), the dynamical extinction line A_2 is seen in the 100 disc and in the equivalent 010 disc. By consulting Table 2.5.3.9, four space groups $P4/mbm$, $P4/mnc$, $P4_2/mbc$ and $P4_2/mnm$ are selected. In Fig. 2.5.3.15(b), the dynamical extinction line A_2 is seen in the 010 disc but not in the $10\bar{1}$ disc. Two space groups $P4/mnc$ and $P4_2/mnm$ are selected from the four. To distinguish the two space groups, it is found from Table 2.5.3.9 that a CBED pattern taken with the [110] electron incidence should be examined. Fig. 2.5.3.15(e) shows a CBED pattern taken with the [110] incidence at 100 kV, where the 001 reflection is exactly excited. The $h\bar{h}1$ reflections are kinematically allowed for space group $P4_2/mnm$ but kinematically forbidden for $P4/mnc$. Since in the case of $P4/mnc$, no *Umweganregung* (multiple scattering) paths to the 001 reflection exist in the zeroth-order Laue zone, only the intensities of HOLZ lines, which are caused by *Umweganregung via* HOLZ reflections, are expected to appear in the 001 disc. If such *Umweganregung* is not practically excited, the 001 reflection must have no intensity. However, strong intensity produced by two-dimensional interaction is seen in the 001 disc of Fig. 2.5.3.15(e). This indicates that the reflection is an allowed reflection. Therefore, the space group of rutile is determined to be $P4_2/mnm$, which agrees with the space group already known.

Samarium selenide (Sm_3Se_4). Sm_3Se_4 has the Th_3P_4 structure type with space group $I\bar{4}3d$ at high temperatures. The lattice parameters are $a = b = c = 0.8885$ nm. It was expected that Sm_3Se_4 would transform to an ordered state of electrons with two valences of +2 and +3 around 150 K. The determination of the space group of the material was conducted at 100 K and room temperature. The space groups at both temperatures were determined by CBED to be the same. The following experiments were performed at 100 K.

Fig. 2.5.3.16(a) shows a CBED pattern taken with the [111] incidence at 80 kV, which clearly shows the first-order-Laue-zone reflections. The symmetry of the WP is seen to be $3m$ with the help of the enlarged insets. Possible diffraction groups are $3m$, $3m1_R$ and 6_Rmm_R from Table 2.5.3.3. Fig. 2.5.3.16(b), which is the central part of Fig. 2.5.3.16(a), shows projection symmetry $3m$, indicating that the projection diffraction group is $3m1_R$. Among the three groups $3m$, $3m1_R$ and 6_Rmm_R, diffraction groups for which the projection diffraction group is $3m1_R$ are $3m$ and $3m1_R$. Possible point groups are found to be $3m$, $\bar{4}3m$ and $\bar{6}m2$ from Fig. 2.5.3.4. Fig. 2.5.3.16(c) shows a CBED pattern taken with the [100] incidence at 80 kV. The WP is seen to have symmetry $2mm$. Allowed diffraction groups are $2mm$, $2mm1_R$ and 4_Rmm_R. Fig. 2.5.3.16(d), which is the central part of Fig. 2.5.3.16(c), shows projection WP symmetry $4mm$, indicating that the projection diffraction group is $4mm1_R$. The diffraction group among the three groups $2mm$, $2mm1_R$ and 4_Rmm_R whose projection diffraction group is $4mm1_R$ is 4_Rmm_R. Possible point groups are found to be $\bar{4}3m$ and $\bar{4}2m$ from Fig. 2.5.3.4. Thus, the point group

references