

# SG No. 90 $D_4^2$ $P4_212$ [ tetragonal ]

\* plus set:  $+ [0, 0, 0]$

\* Wyckoff site: **2a**, site symmetry: 2.22

Table 1: Wyckoff bond: **2a@2a**

No.	vector	center	mapping
1	$[X, X, 0]$	$[0, 0, 0]$	$[1, -2, 7, -8]$
2	$[-X, X, 0]$	$[\frac{1}{2}, \frac{1}{2}, 0]$	$[3, -4, 5, -6]$

Table 2: Wyckoff bond: **2b@2a**

No.	vector	center	mapping
1	$[X, -X, 0]$	$[0, 0, 0]$	$[1, -2, -7, 8]$
2	$[X, X, 0]$	$[\frac{1}{2}, \frac{1}{2}, 0]$	$[3, -4, -5, 6]$

Table 3: Wyckoff bond: **2c@2a**

No.	vector	center	mapping
1	$[0, 0, Z]$	$[0, 0, 0]$	$[1, 2, -7, -8]$
2	$[0, 0, Z]$	$[\frac{1}{2}, \frac{1}{2}, 0]$	$[3, 4, -5, -6]$

Table 4: Wyckoff bond: **4d@2a**

No.	vector	center	mapping
1	$[X, X, Z]$	$[0, 0, 0]$	$[1, -8]$
2	$[-X, -X, Z]$	$[0, 0, 0]$	$[2, -7]$
3	$[-X, X, Z]$	$[\frac{1}{2}, \frac{1}{2}, 0]$	$[3, -6]$
4	$[X, -X, Z]$	$[\frac{1}{2}, \frac{1}{2}, 0]$	$[4, -5]$

Table 5: Wyckoff bond: **4e@2a**

No.	vector	center	mapping
1	$[X, -X, Z]$	$[0, 0, 0]$	$[1, -7]$
2	$[-X, X, Z]$	$[0, 0, 0]$	$[2, -8]$
3	$[X, X, Z]$	$[\frac{1}{2}, \frac{1}{2}, 0]$	$[3, -5]$
4	$[-X, -X, Z]$	$[\frac{1}{2}, \frac{1}{2}, 0]$	$[4, -6]$

Table 6: Wyckoff bond: **4f@2a**

No.	vector	center	mapping
1	$[X, Y, 0]$	$[0, 0, 0]$	$[1, -2]$
2	$[-Y, X, 0]$	$[\frac{1}{2}, \frac{1}{2}, 0]$	$[3, -4]$
3	$[-X, Y, 0]$	$[\frac{1}{2}, \frac{1}{2}, 0]$	$[5, -6]$
4	$[Y, X, 0]$	$[0, 0, 0]$	$[7, -8]$

Table 7: Wyckoff bond: **8g@2a**

No.	vector	center	mapping
1	$[X, Y, Z]$	$[0, 0, 0]$	$[1]$
2	$[-X, -Y, Z]$	$[0, 0, 0]$	$[2]$
3	$[-Y, X, Z]$	$[\frac{1}{2}, \frac{1}{2}, 0]$	$[3]$
4	$[Y, -X, Z]$	$[\frac{1}{2}, \frac{1}{2}, 0]$	$[4]$
5	$[-X, Y, -Z]$	$[\frac{1}{2}, \frac{1}{2}, 0]$	$[5]$
6	$[X, -Y, -Z]$	$[\frac{1}{2}, \frac{1}{2}, 0]$	$[6]$
7	$[Y, X, -Z]$	$[0, 0, 0]$	$[7]$
8	$[-Y, -X, -Z]$	$[0, 0, 0]$	$[8]$

\* Wyckoff site: **2b**, site symmetry: **2.22**

Table 8: Wyckoff bond: **2a@2b**

No.	vector	center	mapping
1	$[X, X, 0]$	$[0, 0, \frac{1}{2}]$	$[1, -2, 7, -8]$
2	$[-X, X, 0]$	$[\frac{1}{2}, \frac{1}{2}, \frac{1}{2}]$	$[3, -4, 5, -6]$

Table 9: Wyckoff bond: **2b@2b**

No.	vector	center	mapping
1	$[X, -X, 0]$	$[0, 0, \frac{1}{2}]$	$[1, -2, -7, 8]$
2	$[X, X, 0]$	$[\frac{1}{2}, \frac{1}{2}, \frac{1}{2}]$	$[3, -4, -5, 6]$

Table 10: Wyckoff bond: **2c@2b**

No.	vector	center	mapping
1	$[0, 0, Z]$	$[0, 0, \frac{1}{2}]$	$[1, 2, -7, -8]$
2	$[0, 0, Z]$	$[\frac{1}{2}, \frac{1}{2}, \frac{1}{2}]$	$[3, 4, -5, -6]$

Table 11: Wyckoff bond: **4d@2b**

No.	vector	center	mapping
1	$[X, X, Z]$	$[0, 0, \frac{1}{2}]$	$[1, -8]$
2	$[-X, -X, Z]$	$[0, 0, \frac{1}{2}]$	$[2, -7]$
3	$[-X, X, Z]$	$[\frac{1}{2}, \frac{1}{2}, \frac{1}{2}]$	$[3, -6]$
4	$[X, -X, Z]$	$[\frac{1}{2}, \frac{1}{2}, \frac{1}{2}]$	$[4, -5]$

Table 12: Wyckoff bond: **4e@2b**

No.	vector	center	mapping
1	$[X, -X, Z]$	$[0, 0, \frac{1}{2}]$	$[1, -7]$
2	$[-X, X, Z]$	$[0, 0, \frac{1}{2}]$	$[2, -8]$
3	$[X, X, Z]$	$[\frac{1}{2}, \frac{1}{2}, \frac{1}{2}]$	$[3, -5]$
4	$[-X, -X, Z]$	$[\frac{1}{2}, \frac{1}{2}, \frac{1}{2}]$	$[4, -6]$

Table 13: Wyckoff bond: **4f@2b**

No.	vector	center	mapping
1	$[X, Y, 0]$	$[0, 0, \frac{1}{2}]$	$[1, -2]$
2	$[-Y, X, 0]$	$[\frac{1}{2}, \frac{1}{2}, \frac{1}{2}]$	$[3, -4]$
3	$[-X, Y, 0]$	$[\frac{1}{2}, \frac{1}{2}, \frac{1}{2}]$	$[5, -6]$
4	$[Y, X, 0]$	$[0, 0, \frac{1}{2}]$	$[7, -8]$

Table 14: Wyckoff bond: **8g@2b**

No.	vector	center	mapping
1	$[X, Y, Z]$	$[0, 0, \frac{1}{2}]$	$[1]$
2	$[-X, -Y, Z]$	$[0, 0, \frac{1}{2}]$	$[2]$
3	$[-Y, X, Z]$	$[\frac{1}{2}, \frac{1}{2}, \frac{1}{2}]$	$[3]$
4	$[Y, -X, Z]$	$[\frac{1}{2}, \frac{1}{2}, \frac{1}{2}]$	$[4]$
5	$[-X, Y, -Z]$	$[\frac{1}{2}, \frac{1}{2}, \frac{1}{2}]$	$[5]$
6	$[X, -Y, -Z]$	$[\frac{1}{2}, \frac{1}{2}, \frac{1}{2}]$	$[6]$
7	$[Y, X, -Z]$	$[0, 0, \frac{1}{2}]$	$[7]$
8	$[-Y, -X, -Z]$	$[0, 0, \frac{1}{2}]$	$[8]$

\* Wyckoff site: **2c**, site symmetry: **4** .

Table 15: Wyckoff bond: **2a@2c**

No.	vector	center	mapping
1	$[0, 0, Z]$	$[0, \frac{1}{2}, z]$	$[1, 2, 3, 4]$
2	$[0, 0, -Z]$	$[\frac{1}{2}, 0, -z]$	$[5, 6, 7, 8]$

Table 16: Wyckoff bond: **4b@2c**

No.	vector	center	mapping
1	$[X, Y, 0]$	$[0, \frac{1}{2}, z]$	$[1, -2]$
2	$[-Y, X, 0]$	$[0, \frac{1}{2}, z]$	$[3, -4]$
3	$[-X, Y, 0]$	$[\frac{1}{2}, 0, -z]$	$[5, -6]$
4	$[Y, X, 0]$	$[\frac{1}{2}, 0, -z]$	$[7, -8]$

Table 17: Wyckoff bond: **8c@2c**

No.	vector	center	mapping
1	$[X, Y, Z]$	$[0, \frac{1}{2}, z]$	$[1]$
2	$[-X, -Y, Z]$	$[0, \frac{1}{2}, z]$	$[2]$
3	$[-Y, X, Z]$	$[0, \frac{1}{2}, z]$	$[3]$
4	$[Y, -X, Z]$	$[0, \frac{1}{2}, z]$	$[4]$
5	$[-X, Y, -Z]$	$[\frac{1}{2}, 0, -z]$	$[5]$
6	$[X, -Y, -Z]$	$[\frac{1}{2}, 0, -z]$	$[6]$
7	$[Y, X, -Z]$	$[\frac{1}{2}, 0, -z]$	$[7]$
8	$[-Y, -X, -Z]$	$[\frac{1}{2}, 0, -z]$	$[8]$

\* Wyckoff site: **4d**, site symmetry:  $2..$

Table 18: Wyckoff bond: **4a@4d**

No.	vector	center	mapping
1	$[X, Y, 0]$	$[0, 0, z]$	$[1, -2]$
2	$[-Y, X, 0]$	$[\frac{1}{2}, \frac{1}{2}, z]$	$[3, -4]$
3	$[-X, Y, 0]$	$[\frac{1}{2}, \frac{1}{2}, -z]$	$[5, -6]$
4	$[Y, X, 0]$	$[0, 0, -z]$	$[7, -8]$

Table 19: Wyckoff bond: **4b@4d**

No.	vector	center	mapping
1	$[0, 0, Z]$	$[0, 0, z]$	$[1, 2]$

*continued ...*

Table 19

No.	vector	center	mapping
2	$[0, 0, Z]$	$[\frac{1}{2}, \frac{1}{2}, z]$	$[3, 4]$
3	$[0, 0, -Z]$	$[\frac{1}{2}, \frac{1}{2}, -z]$	$[5, 6]$
4	$[0, 0, -Z]$	$[0, 0, -z]$	$[7, 8]$

Table 20: Wyckoff bond:  $8c@4d$ 

No.	vector	center	mapping
1	$[X, Y, Z]$	$[0, 0, z]$	$[1]$
2	$[-X, -Y, Z]$	$[0, 0, z]$	$[2]$
3	$[-Y, X, Z]$	$[\frac{1}{2}, \frac{1}{2}, z]$	$[3]$
4	$[Y, -X, Z]$	$[\frac{1}{2}, \frac{1}{2}, z]$	$[4]$
5	$[-X, Y, -Z]$	$[\frac{1}{2}, \frac{1}{2}, -z]$	$[5]$
6	$[X, -Y, -Z]$	$[\frac{1}{2}, \frac{1}{2}, -z]$	$[6]$
7	$[Y, X, -Z]$	$[0, 0, -z]$	$[7]$
8	$[-Y, -X, -Z]$	$[0, 0, -z]$	$[8]$

\* Wyckoff site:  $4e$ , site symmetry:  $\dots 2$

Table 21: Wyckoff bond:  $4a@4e$ 

No.	vector	center	mapping
1	$[X, -X, Z]$	$[x, x, 0]$	$[1, -7]$
2	$[-X, X, Z]$	$[-x, -x, 0]$	$[2, -8]$
3	$[X, X, Z]$	$[\frac{1}{2} - x, x + \frac{1}{2}, 0]$	$[3, -5]$
4	$[-X, -X, Z]$	$[x + \frac{1}{2}, \frac{1}{2} - x, 0]$	$[4, -6]$

Table 22: Wyckoff bond:  $4b@4e$ 

No.	vector	center	mapping
1	$[X, X, 0]$	$[x, x, 0]$	$[1, 7]$
2	$[-X, -X, 0]$	$[-x, -x, 0]$	$[2, 8]$
3	$[-X, X, 0]$	$[\frac{1}{2} - x, x + \frac{1}{2}, 0]$	$[3, 5]$
4	$[X, -X, 0]$	$[x + \frac{1}{2}, \frac{1}{2} - x, 0]$	$[4, 6]$

Table 23: Wyckoff bond: **8c@4e**

No.	vector	center	mapping
1	$[X, Y, Z]$	$[x, x, 0]$	[1]
2	$[-X, -Y, Z]$	$[-x, -x, 0]$	[2]
3	$[-Y, X, Z]$	$[\frac{1}{2} - x, x + \frac{1}{2}, 0]$	[3]
4	$[Y, -X, Z]$	$[x + \frac{1}{2}, \frac{1}{2} - x, 0]$	[4]
5	$[-X, Y, -Z]$	$[\frac{1}{2} - x, x + \frac{1}{2}, 0]$	[5]
6	$[X, -Y, -Z]$	$[x + \frac{1}{2}, \frac{1}{2} - x, 0]$	[6]
7	$[Y, X, -Z]$	$[x, x, 0]$	[7]
8	$[-Y, -X, -Z]$	$[-x, -x, 0]$	[8]

\* Wyckoff site: **4f**, site symmetry:  $\cdot \cdot 2$

Table 24: Wyckoff bond: **4a@4f**

No.	vector	center	mapping
1	$[X, -X, Z]$	$[x, x, \frac{1}{2}]$	[1,-7]
2	$[-X, X, Z]$	$[-x, -x, \frac{1}{2}]$	[2,-8]
3	$[X, X, Z]$	$[\frac{1}{2} - x, x + \frac{1}{2}, \frac{1}{2}]$	[3,-5]
4	$[-X, -X, Z]$	$[x + \frac{1}{2}, \frac{1}{2} - x, \frac{1}{2}]$	[4,-6]

Table 25: Wyckoff bond: **4b@4f**

No.	vector	center	mapping
1	$[X, X, 0]$	$[x, x, \frac{1}{2}]$	[1,7]
2	$[-X, -X, 0]$	$[-x, -x, \frac{1}{2}]$	[2,8]
3	$[-X, X, 0]$	$[\frac{1}{2} - x, x + \frac{1}{2}, \frac{1}{2}]$	[3,5]
4	$[X, -X, 0]$	$[x + \frac{1}{2}, \frac{1}{2} - x, \frac{1}{2}]$	[4,6]

Table 26: Wyckoff bond: **8c@4f**

No.	vector	center	mapping
1	$[X, Y, Z]$	$[x, x, \frac{1}{2}]$	[1]
2	$[-X, -Y, Z]$	$[-x, -x, \frac{1}{2}]$	[2]
3	$[-Y, X, Z]$	$[\frac{1}{2} - x, x + \frac{1}{2}, \frac{1}{2}]$	[3]
4	$[Y, -X, Z]$	$[x + \frac{1}{2}, \frac{1}{2} - x, \frac{1}{2}]$	[4]
5	$[-X, Y, -Z]$	$[\frac{1}{2} - x, x + \frac{1}{2}, \frac{1}{2}]$	[5]
6	$[X, -Y, -Z]$	$[x + \frac{1}{2}, \frac{1}{2} - x, \frac{1}{2}]$	[6]
7	$[Y, X, -Z]$	$[x, x, \frac{1}{2}]$	[7]
8	$[-Y, -X, -Z]$	$[-x, -x, \frac{1}{2}]$	[8]

\* Wyckoff site: 8g, site symmetry: 1

Table 27: Wyckoff bond: 8a@8g

No.	vector	center	mapping
1	$[X, Y, Z]$	$[x, y, z]$	[1]
2	$[-X, -Y, Z]$	$[-x, -y, z]$	[2]
3	$[-Y, X, Z]$	$[\frac{1}{2} - y, x + \frac{1}{2}, z]$	[3]
4	$[Y, -X, Z]$	$[y + \frac{1}{2}, \frac{1}{2} - x, z]$	[4]
5	$[-X, Y, -Z]$	$[\frac{1}{2} - x, y + \frac{1}{2}, -z]$	[5]
6	$[X, -Y, -Z]$	$[x + \frac{1}{2}, \frac{1}{2} - y, -z]$	[6]
7	$[Y, X, -Z]$	$[y, x, -z]$	[7]
8	$[-Y, -X, -Z]$	$[-y, -x, -z]$	[8]