# $C_{4v}^1$ $P4mm$ No. 99 $P4mm$

**Generators selected** (1); $t(1,0,0)$; $t(0,1,0)$; $t(0,0,1)$; (2); (3); (5)

**General position**

| Multiplicity, Wyckoff letter, Site symmetry | | Coordinates | | | |
|---|---|---|---|---|---|
| 8 | $g$ | 1 | (1) $x,y,z$ | (2) $\bar{x},\bar{y},z$ | (3) $\bar{y},x,z$ | (4) $y,\bar{x},z$ |
| | | | (5) $x,\bar{y},z$ | (6) $\bar{x},y,z$ | (7) $\bar{y},\bar{x},z$ | (8) $y,x,z$ |

## I Maximal *translationengleiche* subgroups

| | | |
|---|---|---|
| [2] $P411$ (75, $P4$) | 1; 2; 3; 4 | |
| [2] $P21m$ (35, $Cmm2$) | 1; 2; 7; 8 | $\mathbf{a}-\mathbf{b},\mathbf{a}+\mathbf{b},\mathbf{c}$ |
| [2] $P2m1$ (25, $Pmm2$) | 1; 2; 5; 6 | |

## II Maximal *klassengleiche* subgroups

- **Enlarged unit cell**

| | | | |
|---|---|---|---|
| [2] $\mathbf{c}'=2\mathbf{c}$ | | | |
| $P4_2mc$ (105) | $\langle 2;\ 5;\ 3+(0,0,1)\rangle$ | $\mathbf{a},\mathbf{b},2\mathbf{c}$ | |
| $P4cc$ (103) | $\langle 2;\ 3;\ 5+(0,0,1)\rangle$ | $\mathbf{a},\mathbf{b},2\mathbf{c}$ | |
| $P4_2cm$ (101) | $\langle 2;\ (3;\ 5)+(0,0,1)\rangle$ | $\mathbf{a},\mathbf{b},2\mathbf{c}$ | |
| $P4mm$ (99) | $\langle 2;\ 3;\ 5\rangle$ | $\mathbf{a},\mathbf{b},2\mathbf{c}$ | |
| [2] $\mathbf{a}'=2\mathbf{a},\ \mathbf{b}'=2\mathbf{b}$ | | | |
| $C4md$ (100, $P4bm$) | $\langle 2;\ 3;\ 5+(0,1,0)\rangle$ | $\mathbf{a}-\mathbf{b},\mathbf{a}+\mathbf{b},\mathbf{c}$ | |
| $C4md$ (100, $P4bm$) | $\langle 2;\ 5;\ 3+(1,0,0)\rangle$ | $\mathbf{a}-\mathbf{b},\mathbf{a}+\mathbf{b},\mathbf{c}$ | $1/2,1/2,0$ |
| $C4mm$ (99, $P4mm$) | $\langle 2;\ 3;\ 5\rangle$ | $\mathbf{a}-\mathbf{b},\mathbf{a}+\mathbf{b},\mathbf{c}$ | |
| $C4mm$ (99, $P4mm$) | $\langle 2+(1,1,0);\ 3+(1,0,0);\ 5+(0,1,0)\rangle$ | $\mathbf{a}-\mathbf{b},\mathbf{a}+\mathbf{b},\mathbf{c}$ | $1/2,1/2,0$ |
| [2] $\mathbf{a}'=2\mathbf{a},\ \mathbf{b}'=2\mathbf{b},\ \mathbf{c}'=2\mathbf{c}$ | | | |
| $F4mc$ (108, $I4cm$) | $\langle 2;\ 3;\ 5+(0,0,1)\rangle$ | $\mathbf{a}-\mathbf{b},\mathbf{a}+\mathbf{b},2\mathbf{c}$ | |
| $F4mc$ (108, $I4cm$) | $\langle 2;\ 3+(1,0,0);\ 5+(0,1,1)\rangle$ | $\mathbf{a}-\mathbf{b},\mathbf{a}+\mathbf{b},2\mathbf{c}$ | $1/2,1/2,0$ |
| $F4mm$ (107, $I4mm$) | $\langle 2;\ 3;\ 5\rangle$ | $\mathbf{a}-\mathbf{b},\mathbf{a}+\mathbf{b},2\mathbf{c}$ | |
| $F4mm$ (107, $I4mm$) | $\langle 2;\ 3+(1,0,0);\ 5+(0,1,0)\rangle$ | $\mathbf{a}-\mathbf{b},\mathbf{a}+\mathbf{b},2\mathbf{c}$ | $1/2,1/2,0$ |
| [3] $\mathbf{c}'=3\mathbf{c}$ | | | |
| $P4mm$ (99) | $\langle 2;\ 3;\ 5\rangle$ | $\mathbf{a},\mathbf{b},3\mathbf{c}$ | |

- **Series of maximal isomorphic subgroups**

| | | | |
|---|---|---|---|
| [$p$] $\mathbf{c}'=p\mathbf{c}$ | | | |
| $P4mm$ (99) | $\langle 2;\ 3;\ 5\rangle$<br>$p>1$<br>no conjugate subgroups | $\mathbf{a},\mathbf{b},p\mathbf{c}$ | |
| [$p^2$] $\mathbf{a}'=p\mathbf{a},\ \mathbf{b}'=p\mathbf{b}$ | | | |
| $P4mm$ (99) | $\langle 2+(2u,2v,0);\ 3+(u+v,-u+v,0);\ 5+(0,2v,0)\rangle$<br>$p>2;\ 0\le u<p;\ 0\le v<p$<br>$p^2$ conjugate subgroups for the prime $p$ | $p\mathbf{a},p\mathbf{b},\mathbf{c}$ | $u,v,0$ |

## I Minimal *translationengleiche* supergroups

[2] $P4/mmm$ (123); [2] $P4/nmm$ (129)

## II Minimal non-isomorphic *klassengleiche* supergroups

- **Additional centring translations**

[2] $I4mm$ (107)

- **Decreased unit cell** none