

$D_4^9$

$I422$

No. 97

$I422$

Generators selected (1);  $t(1,0,0)$ ;  $t(0,1,0)$ ;  $t(0,0,1)$ ;  $t(\frac{1}{2},\frac{1}{2},\frac{1}{2})$ ; (2); (3); (5)

General position

Multiplicity,	Coordinates
Wyckoff letter,	$(0,0,0)+ (\frac{1}{2},\frac{1}{2},\frac{1}{2})+$
Site symmetry	

16	$k$	1	(1) $x, y, z$	(2) $\bar{x}, \bar{y}, z$	(3) $\bar{y}, x, z$	(4) $y, \bar{x}, z$
			(5) $\bar{x}, y, \bar{z}$	(6) $x, \bar{y}, \bar{z}$	(7) $y, x, \bar{z}$	(8) $\bar{y}, \bar{x}, \bar{z}$

I Maximal *translationengleiche* subgroups

[2] $I411$ (79, $I4$ )	$(1; 2; 3; 4)+$	
[2] $I221$ (23, $I222$ )	$(1; 2; 5; 6)+$	
[2] $I212$ (22, $F222$ )	$(1; 2; 7; 8)+$	$\mathbf{a-b, a+b, c}$

II Maximal *klassengleiche* subgroups

• Loss of centring translations

[2] $P4_22_12$ (94)	$1; 2; 7; 8; (3; 4; 5; 6) + (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
[2] $P4_222$ (93)	$1; 2; 5; 6; (3; 4; 7; 8) + (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	$0, 1/2, 0$
[2] $P4_212$ (90)	$1; 2; 3; 4; (5; 6; 7; 8) + (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	$0, 1/2, 1/4$
[2] $P422$ (89)	$1; 2; 3; 4; 5; 6; 7; 8$	

• Enlarged unit cell

[3] $\mathbf{c}' = 3\mathbf{c}$			
$\left\{ \begin{array}{l} I422 (97) \\ I422 (97) \\ I422 (97) \end{array} \right.$	$\langle 2; 3; 5 \rangle$	$\mathbf{a, b, 3c}$	
	$\langle 2; 3; 5 + (0,0,2) \rangle$	$\mathbf{a, b, 3c}$	$0, 0, 1$
	$\langle 2; 3; 5 + (0,0,4) \rangle$	$\mathbf{a, b, 3c}$	$0, 0, 2$

• Series of maximal isomorphic subgroups

[ $p$ ] $\mathbf{c}' = p\mathbf{c}$			
$I422 (97)$	$\langle 2; 3; 5 + (0,0,2u) \rangle$	$\mathbf{a, b, pc}$	$0, 0, u$
	$p > 2; 0 \leq u < p$ $p$ conjugate subgroups for the prime $p$		
[ $p^2$ ] $\mathbf{a}' = p\mathbf{a}, \mathbf{b}' = p\mathbf{b}$			
$I422 (97)$	$\langle 2 + (2u, 2v, 0); 3 + (u+v, -u+v, 0); 5 + (2u, 0, 0) \rangle$	$p\mathbf{a}, p\mathbf{b}, \mathbf{c}$	$u, v, 0$
	$p > 2; 0 \leq u < p; 0 \leq v < p$ $p^2$ conjugate subgroups for the prime $p$		

I Minimal *translationengleiche* supergroups

[2]  $I4/mmm$  (139); [2]  $I4/mcm$  (140); [3]  $F432$  (209); [3]  $I432$  (211)

II Minimal non-isomorphic *klassengleiche* supergroups

• Additional centring translations

none

• Decreased unit cell

[2]  $\mathbf{c}' = \frac{1}{2}\mathbf{c}$   $C422$  (89,  $P422$ )