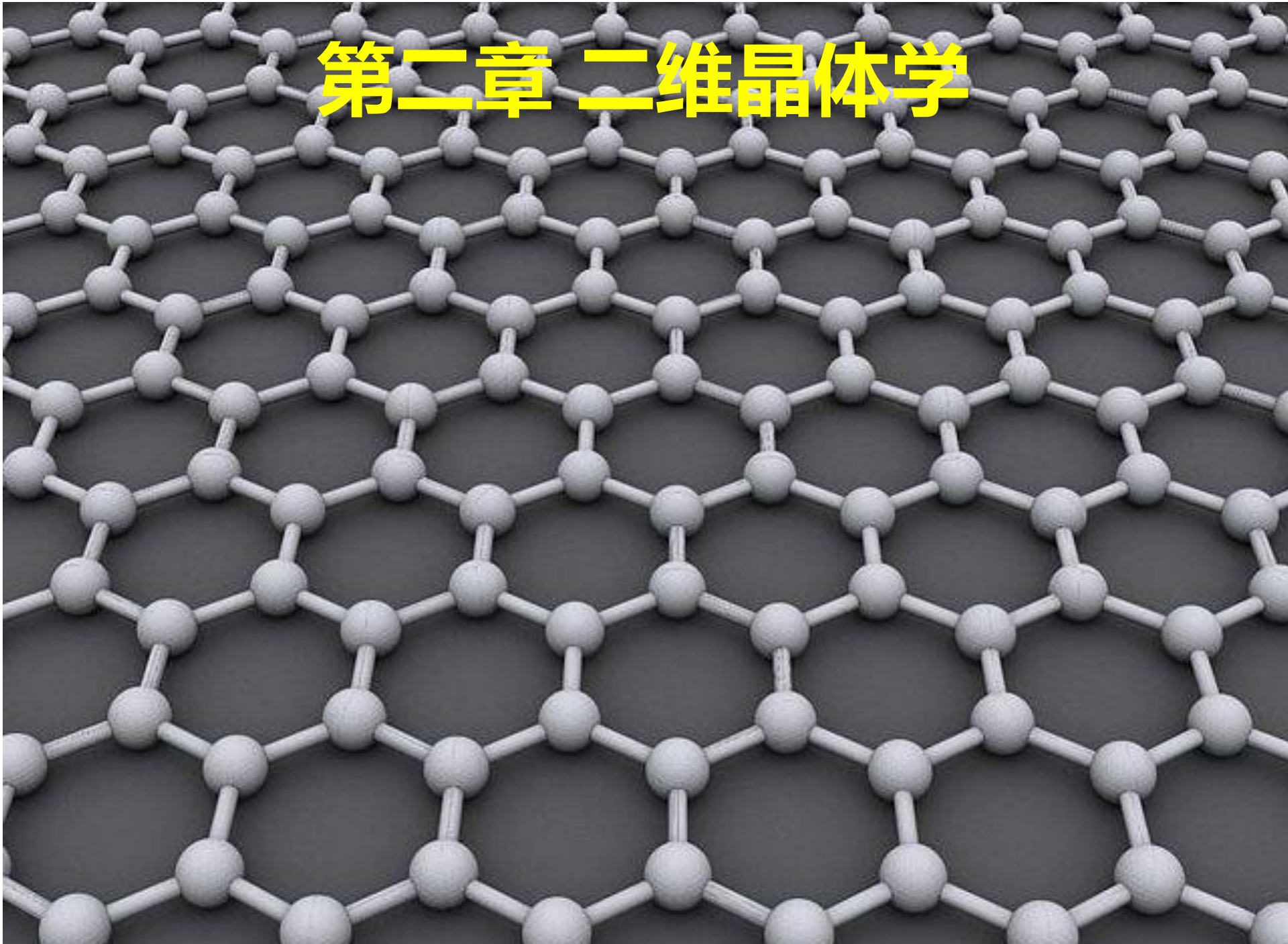
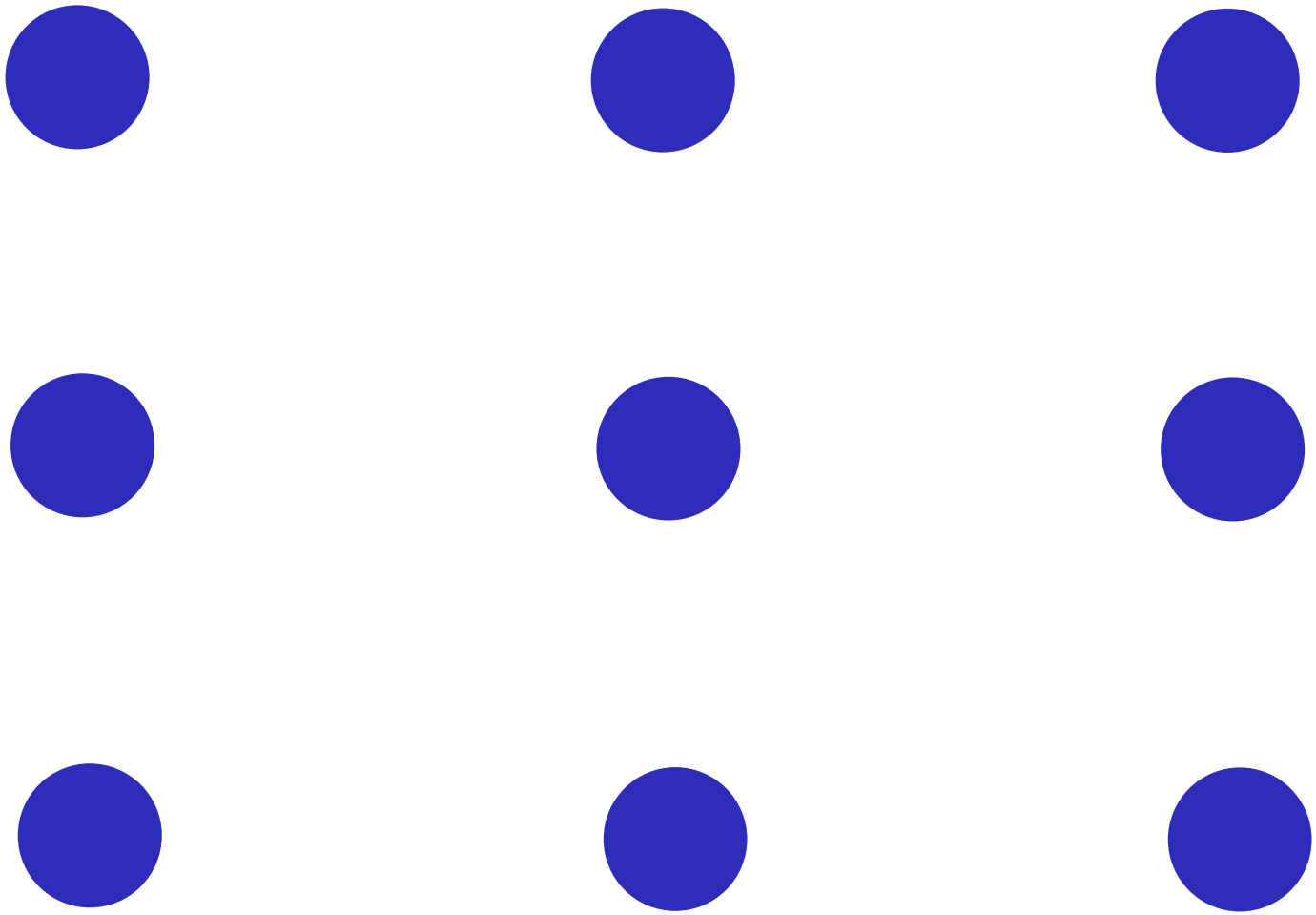
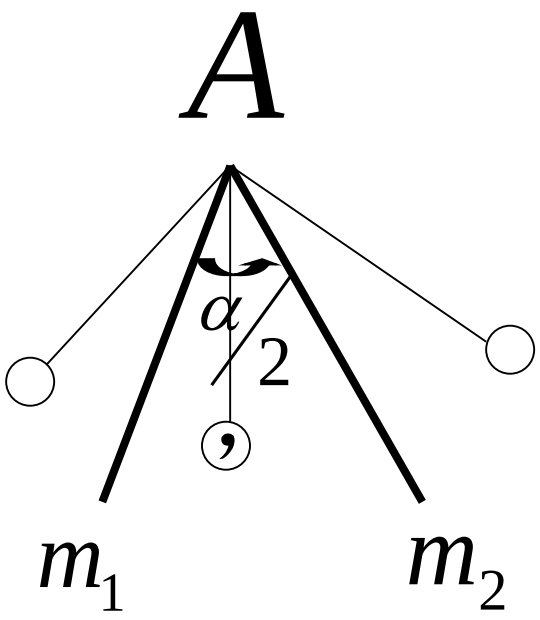

第二章 二维晶体学

点阵/阵点

点阵+基元 ➡ 晶体结构



十个平面点群



$(m_2)(m_1) = A_\alpha$

夹角为$\alpha/2$的两镜面反映组合

= 绕两镜面交线旋转α角

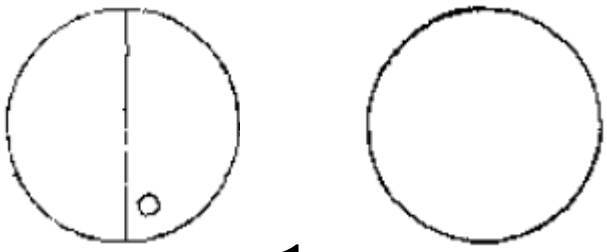
$m_1 = (m_2)(A_\alpha)$

A_α旋转与铅垂面m_2反映组合 =

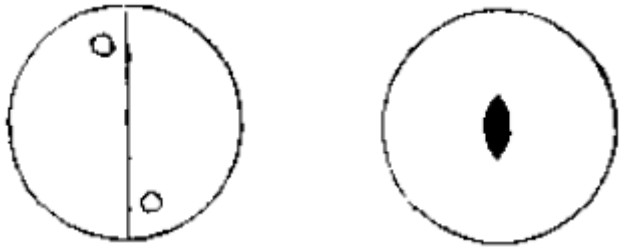
镜面反映m_1（与m_2成$\alpha/2$角）

旋转与反映组合得到10个平面点群！！

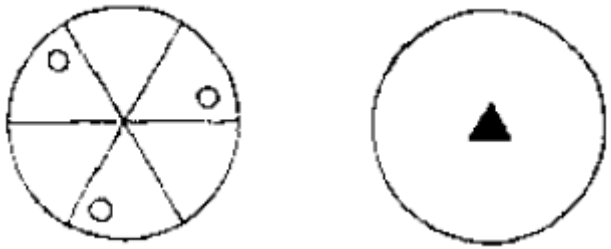
十个平面点群



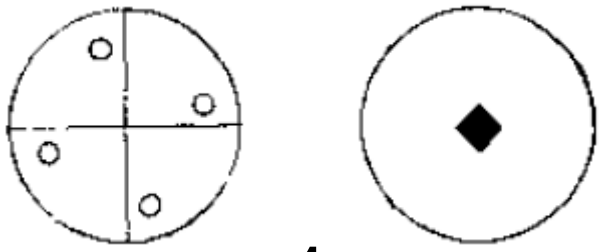
1



2



3



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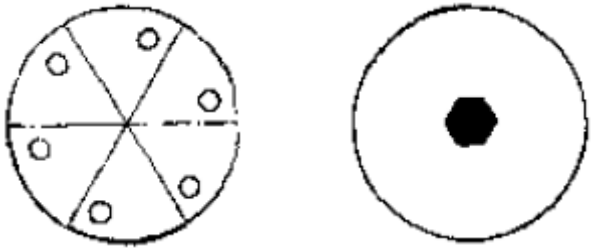
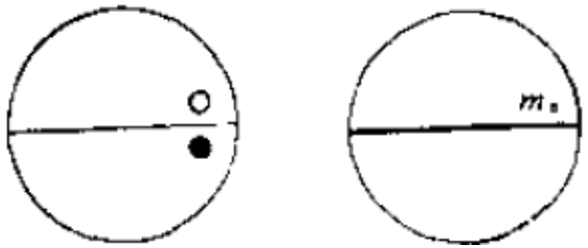
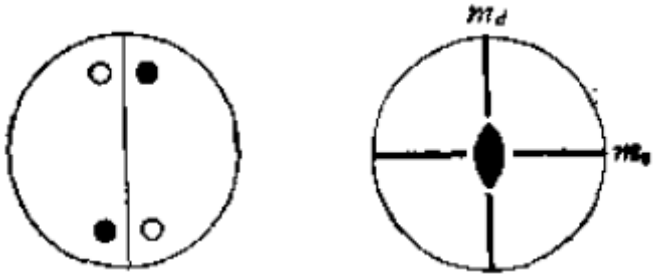


6

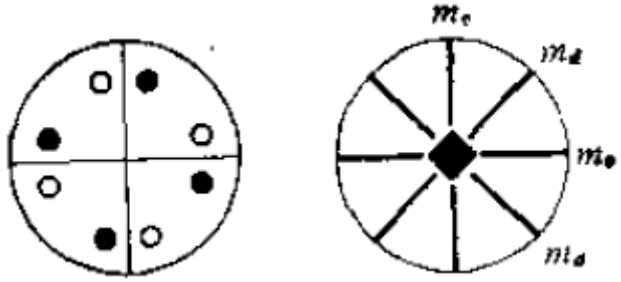


m

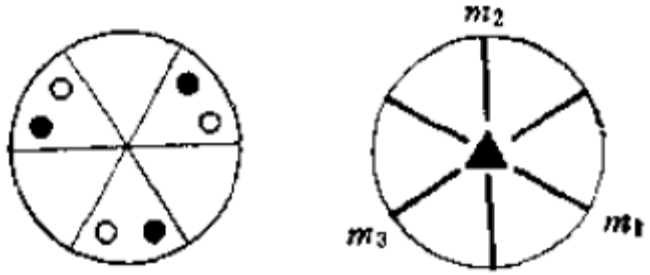
十个平面点群



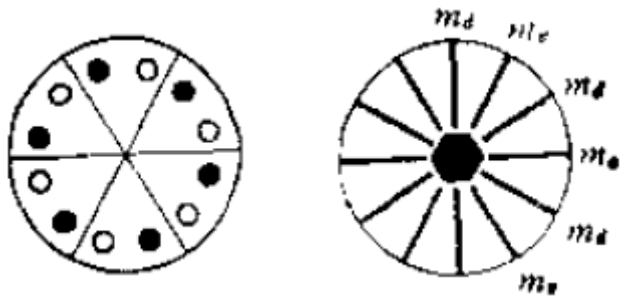
2*mm*



4*mm*

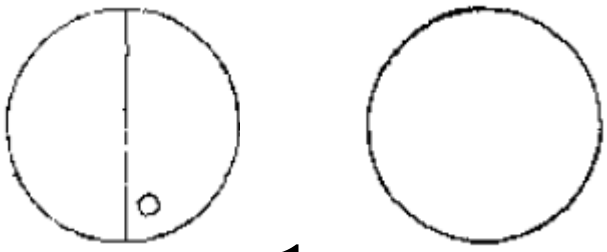


3*m*

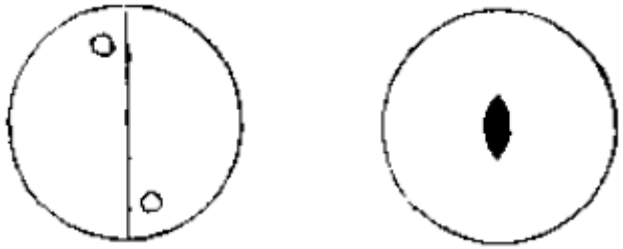


6*mm*

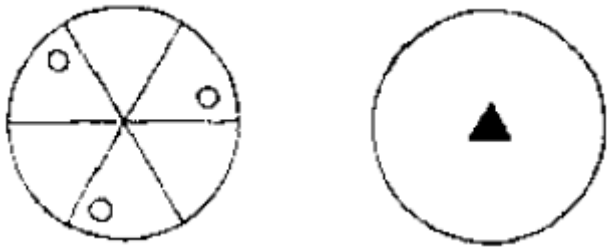
十个平面点群



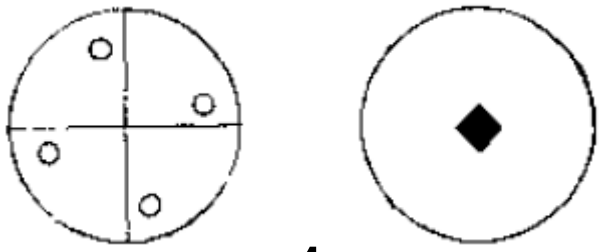
1



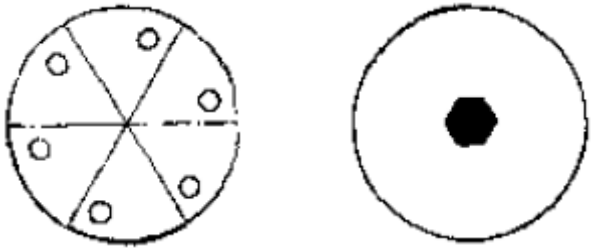
2



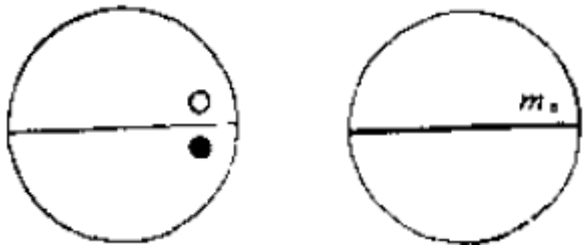
3



4

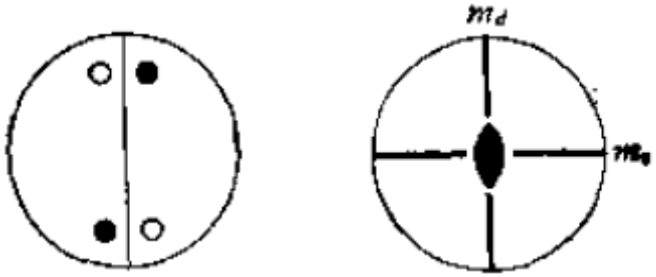


6

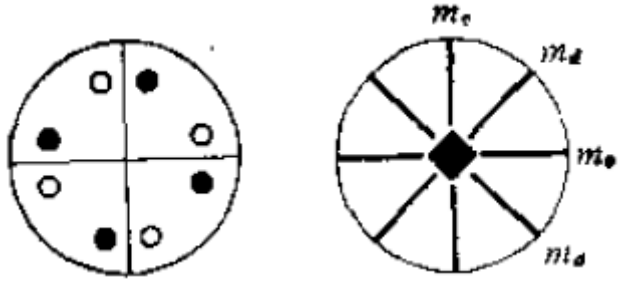


m

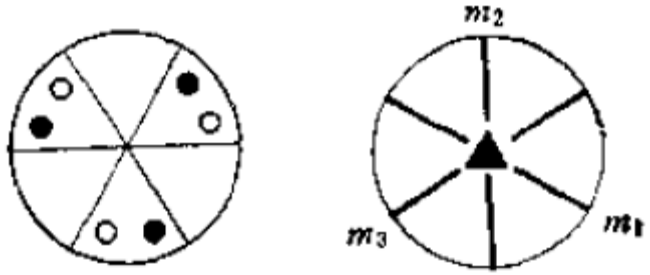
十个平面点群



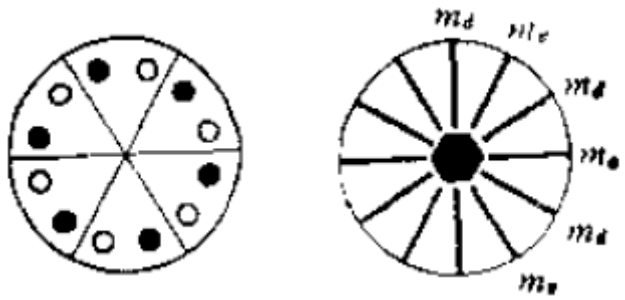
2*mm*



4*mm*



3*m*



6*mm*

P177页， 表7-6

表 7-6 HM 符号的对称性方向

Bravais 系		每一位 HM 符号的对称性方向		
		第一位	第二位	第三位
二维	斜交	平面中的旋转点		
	矩形		[10]	[01]
	正方		{[10], [01]}	{[1$\bar{1}$], [11]}
	六角		{[10], [01], [$\bar{1}\bar{1}$]}	{[1$\bar{1}$], [12], [2$\bar{1}$]}

十个平面点群

- 围绕一点的对称操作的集合构成点群。共十个平面点群
- 点群　　对称操作
- 1　　1
- *m*　　1, m_v
- 2　　1, 2
- 2*mm*　　1, 2, m_v, m_d
- 3　　1, 3^+, 3^-
- 3*m*　　1, 3^+, 3^-, m_v, m_v', m_v''
- 4　　1, 4^+, 4^-, 2
- 4*mm*　　1; 4^+; 4^-; 2; m_v, m_v' m_d, m_d'
- 6　　1, 6^+, 3^+, 2, 3^-, 6^-
- 6*mm*　　1; 6^+, 6^-; 3^+, 3^-; 2; m_v, m_v', m_v''; m_d, m_d', m_d''

五个平面点阵

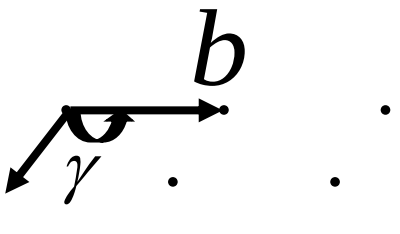
平面制约点操作 $\Rightarrow n=1,2,3,4,6 \Rightarrow$ 10个平面点群

点操作制约平移 $\Rightarrow$ 5个平面点阵 $\Rightarrow$ 4个平面晶系

对照表2－2 *P*.36

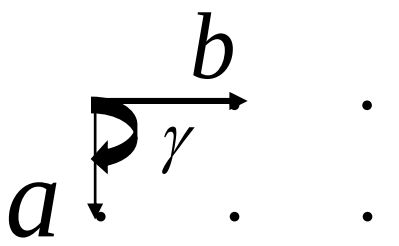
斜交

mp



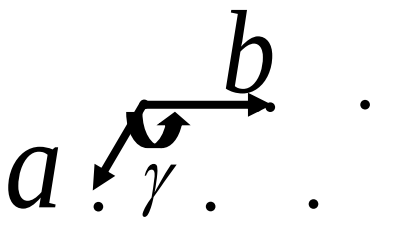
正方

tp

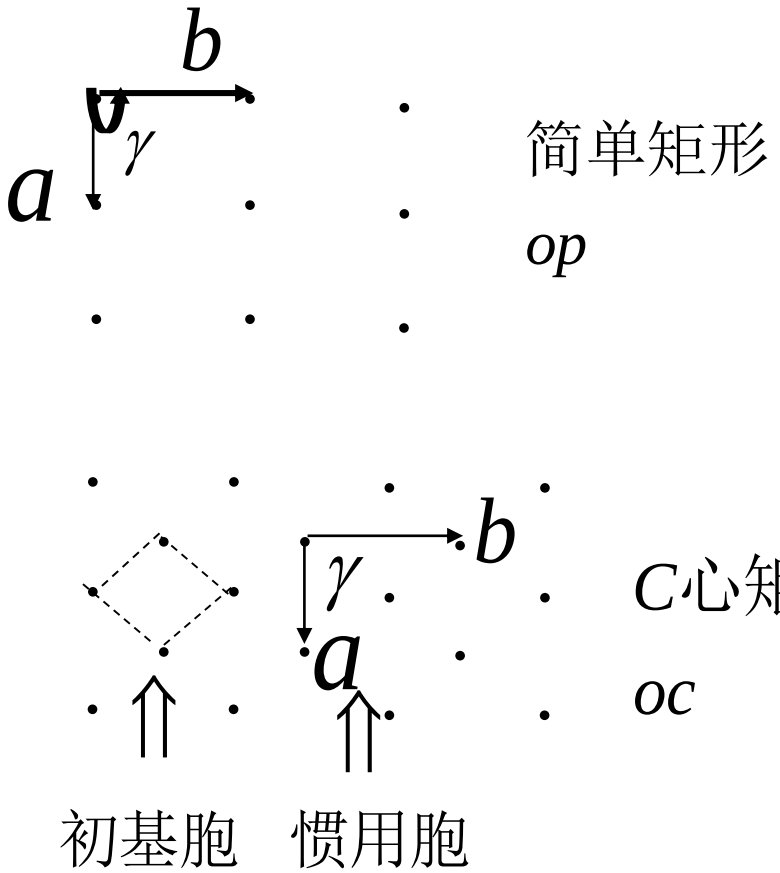


六角

hp

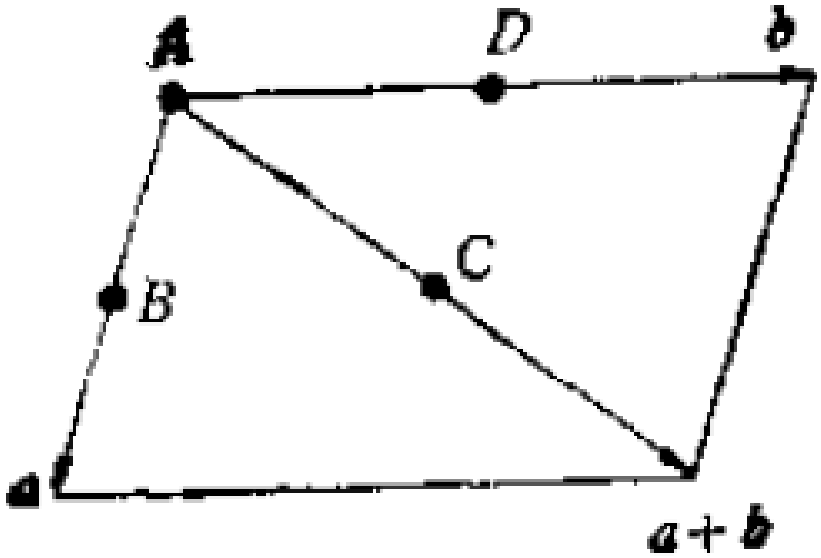


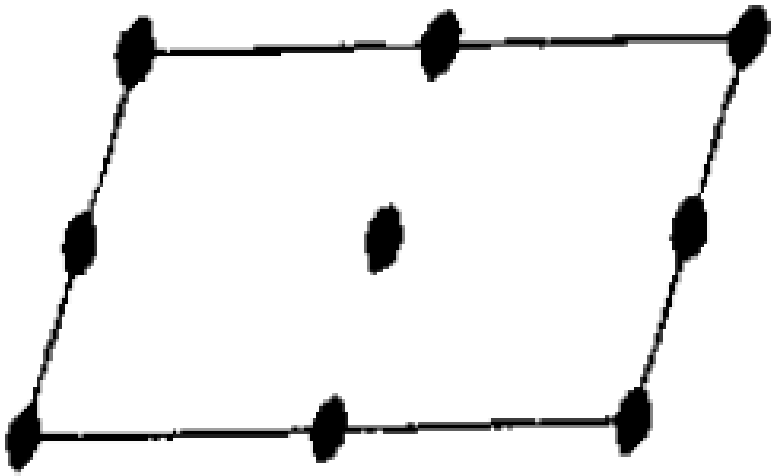
矩形晶系



点操作与平移的组合

二次轴与平移组合





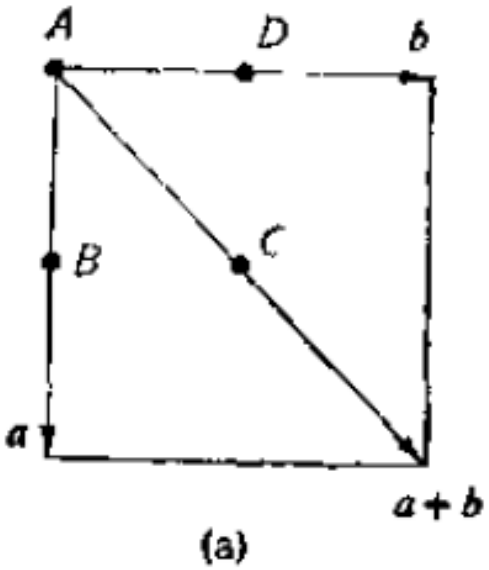
$$(A_\pi, \alpha) = B_\pi$$

$$(A_\pi, \alpha + b) = C_\pi$$

$$(A_\pi, b) = D_\pi$$

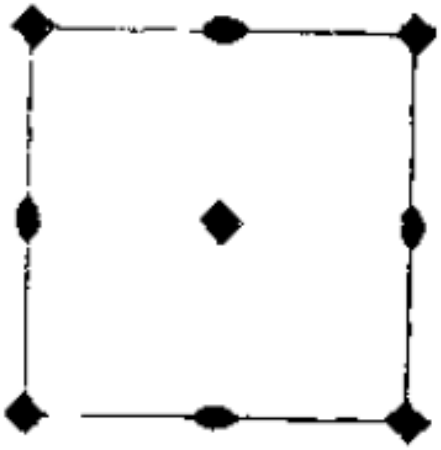
点操作与平移的组合

四次轴与平移组合



(a)

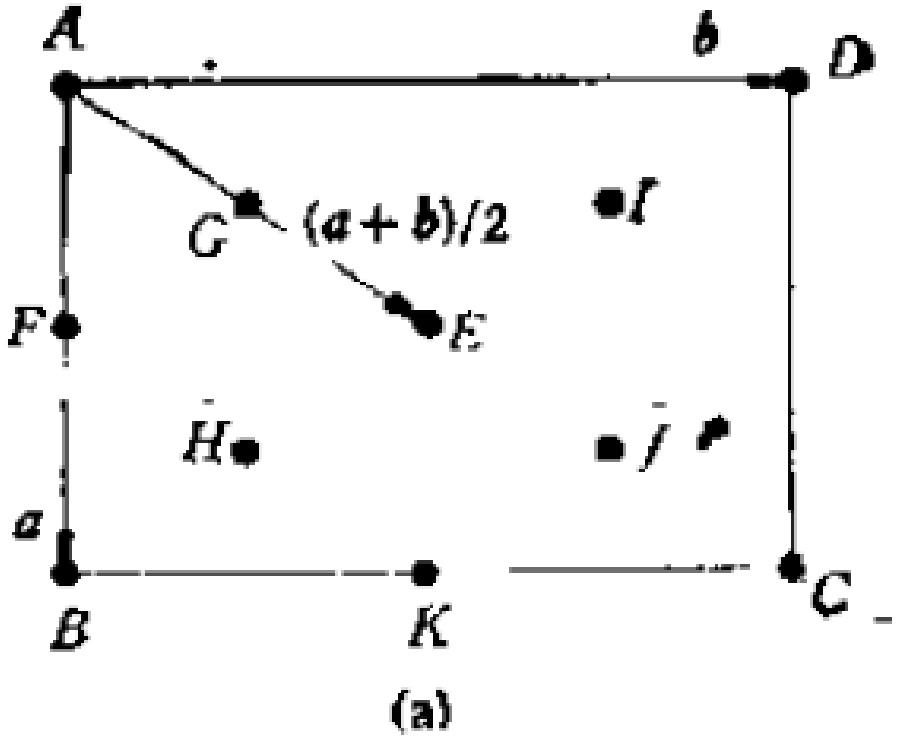
$$(A_{\pi/2},\ a) = C_{\pi/2}$$
$$(A_{\pi},\ a) = B_{\pi}$$
$$(A_{\pi},\ a+b) = C_{\pi}$$
$$(A_{-\pi/2},\ b) = C_{-\pi/2}$$
$$(A_{\pi},\ b) = D_{\pi}$$


(b)

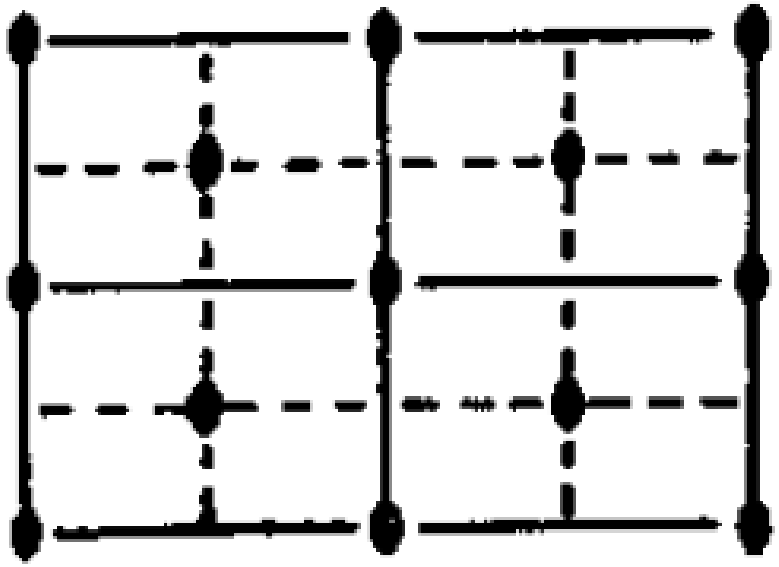
三次轴与六次轴与平移组合 （P37-38）

点操作与平移的组合

点群2*mm*与平移组合



(a)



(b)

P36页， 表2-2

表 2-2　5 个平面点阵和 4 个平面晶系

平面晶系	点阵类型及其符号	点阵的点群	相协调的点群	惯用晶胞形状
斜交	斜交点阵　(mp)	2	1，2	平行四边形，$a \neq b$，γ 任意
矩形	简单矩形点阵　(op)	$2mm$	m，$2mm$	矩形，$a \neq b$，$\gamma = 90°$
	c 心矩形点阵　(oc)	$2mm$		
正方	正方点阵　(tp)	$4mm$	4，$4mm$	正方形，$a = b$，$\gamma = 90°$
六角	六角点阵　(hp)	$6mm$	6，$6mm$，3，$3m$	120° 菱形，$a = b$，$\gamma = 120°$

17个平面群

平面群的推导：把互相协调的点群与点阵组合

（1）即让点阵的阵点所代表的图象具有该点群的对称性

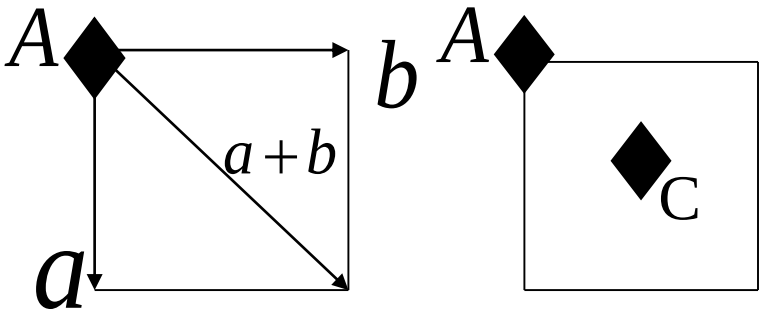
（2）或把点群中的m换成之g后的对称性

由(1)得 $P1, P2, P3, P4, P6;\ P3m1, P31m;\ P4mm;$

$P6mm;\ P1m1, C1m1;\ P2mm, C2mm;$

见图 2－11

(i)点操作与平移组合派生出新的点操作：



$$\left.\begin{aligned}\left(A_{\pi/2}, a\right) &= C_{\pi/2}\\ \left(A_{\pi}, a+b\right) &= C_{\pi}\\ \left(A_{-\pi/2}, b\right) &= C_{-\pi/2}\end{aligned}\right\} \Rightarrow C\text{处有4次轴}$$

(1) $P3m1$ 与 $P31m$的m方位不同

$(m \perp a)$　　$(m \perp a-b)$

由（2）得

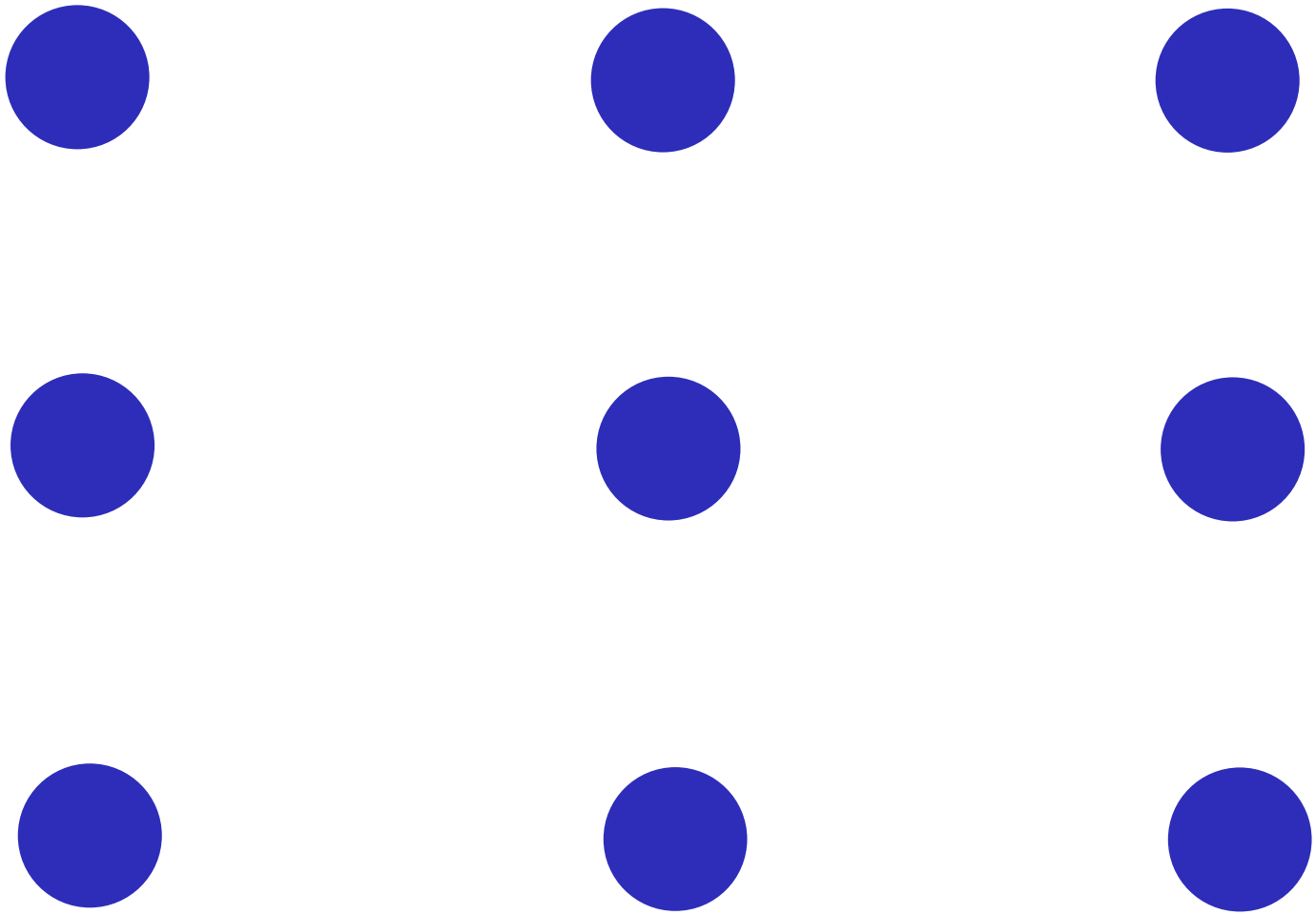
P1g1,　C1g1;　C2mg,　P2gg, $\underbrace{\text{C2}mg, \text{C2}gg}_{\text{c2mm}}$; P4mg
　　‖
　C1m1
　　‖
　P4mm

P4gm,　P4gg;　P3g1,　P31g;　$\underbrace{\text{P6}mg, \text{P6}gm, \text{P6}gg.}_{\text{P6}mm}$
　　‖　　‖　　‖
　P4gm　P3m1　P31m

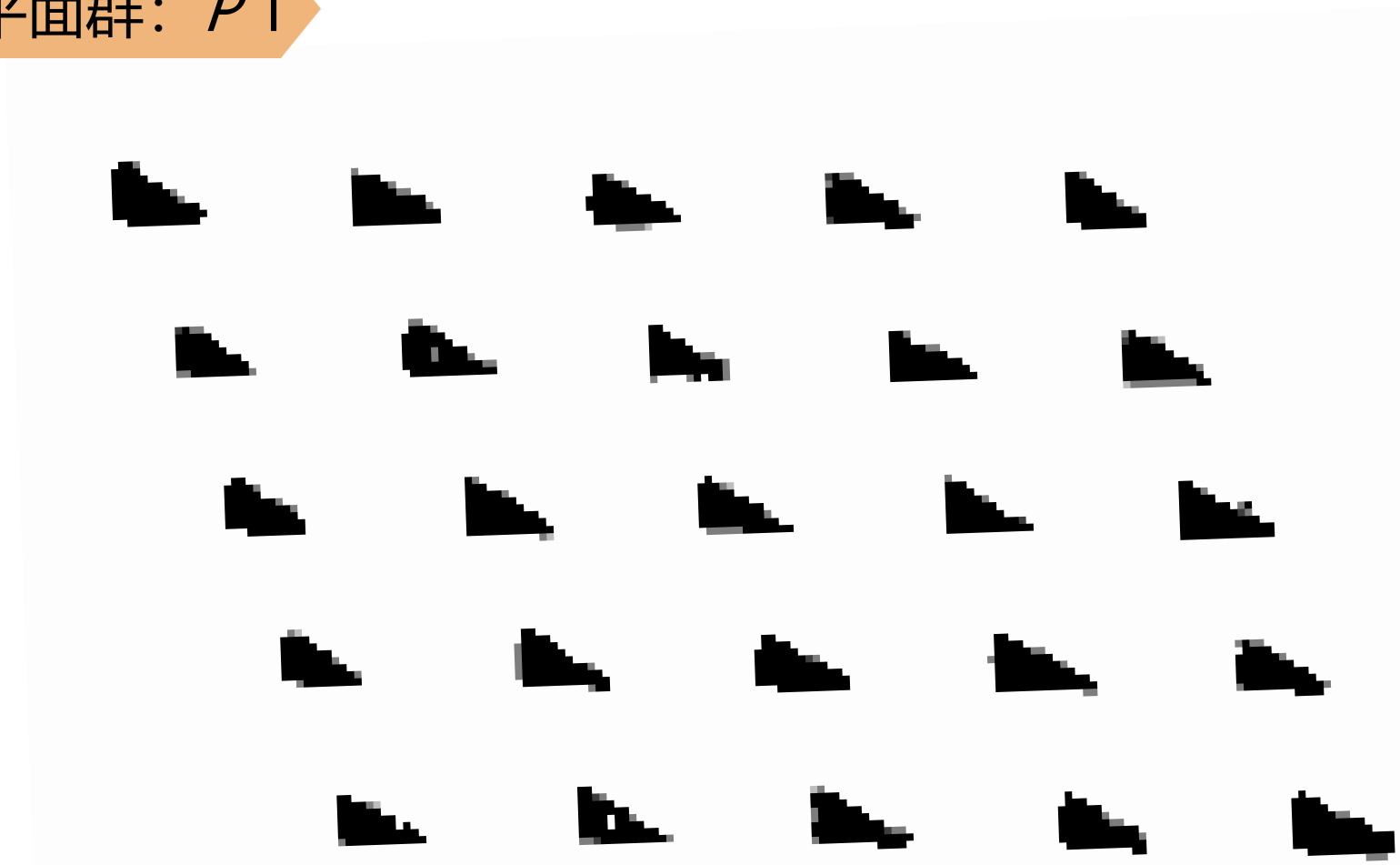
不重复的仅4个

点阵/阵点

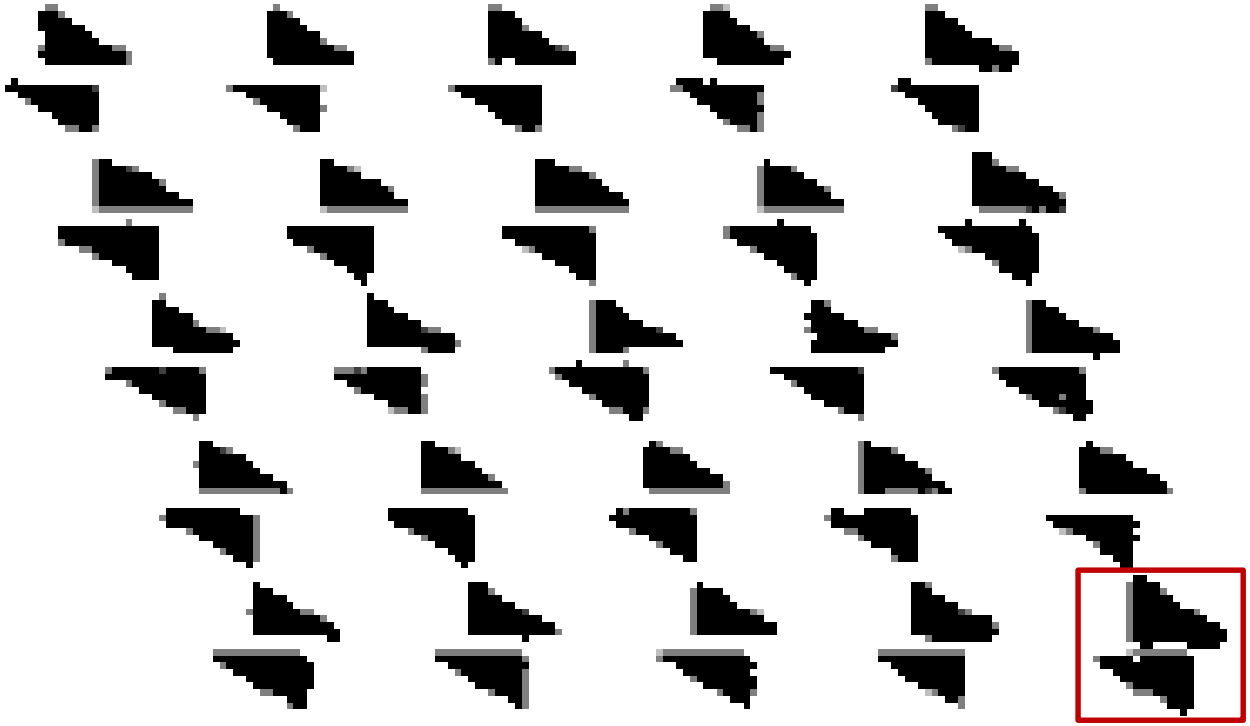
点阵+基元 ➡ 晶体结构



平面群：$P1$

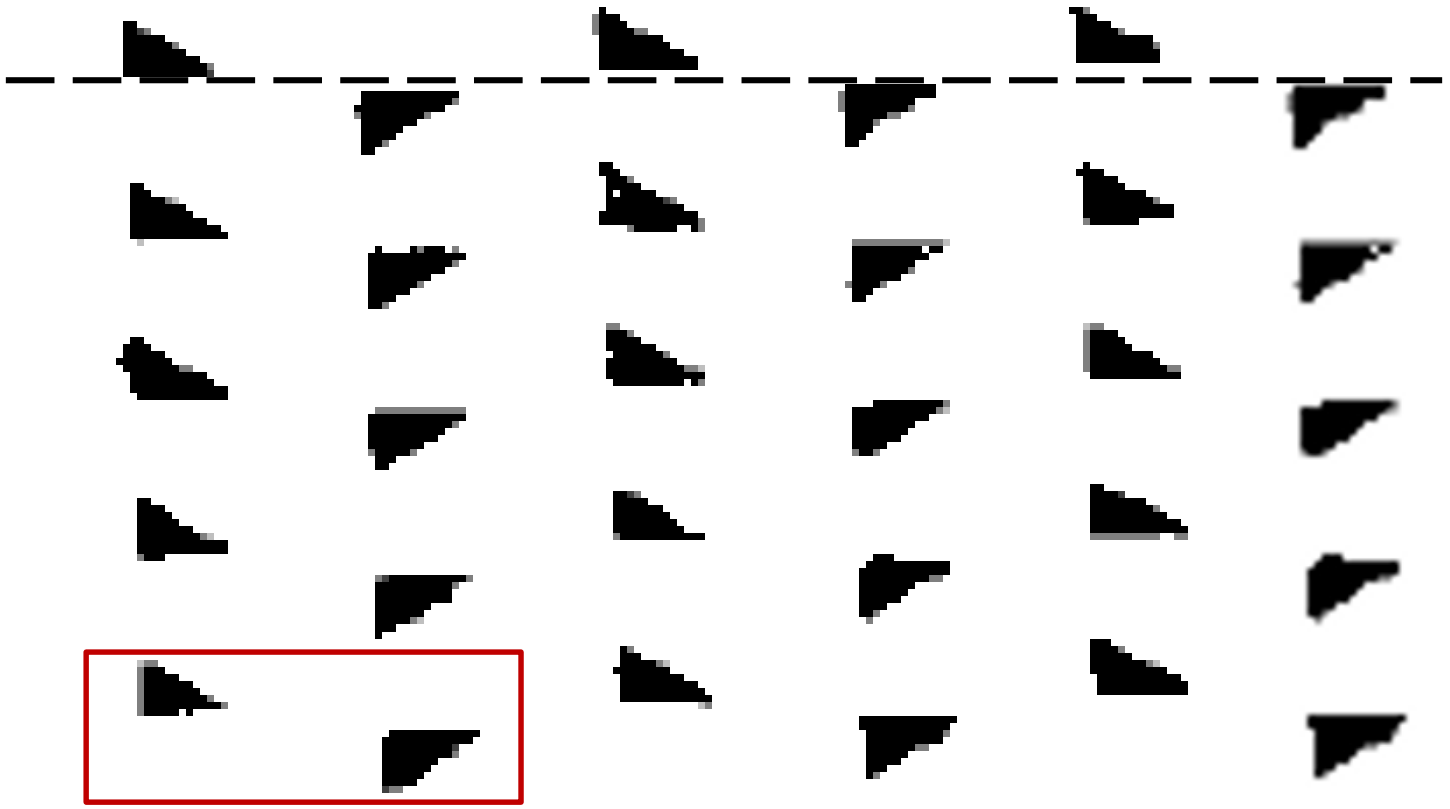


平面群：*P*2

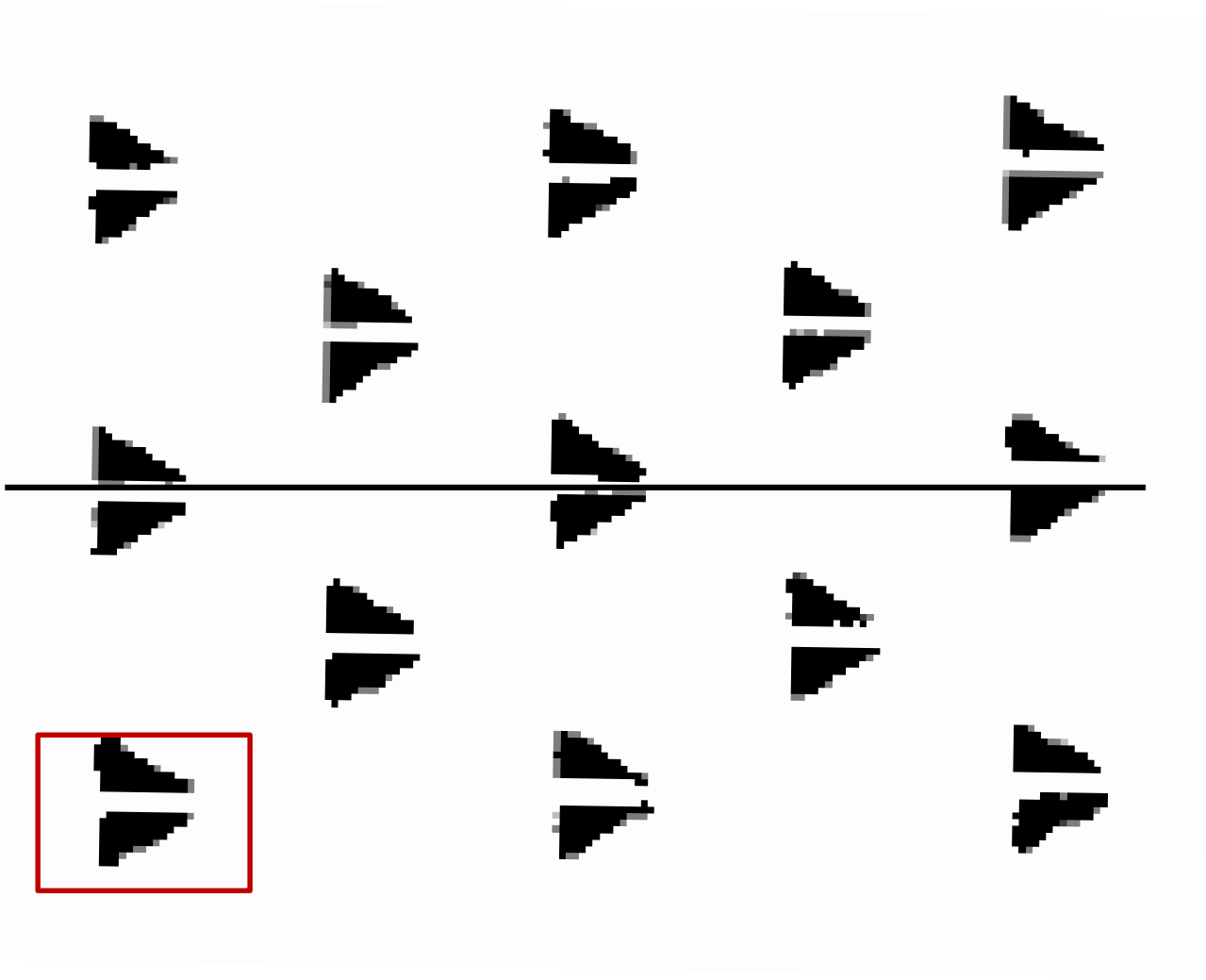


平面群：*P m*

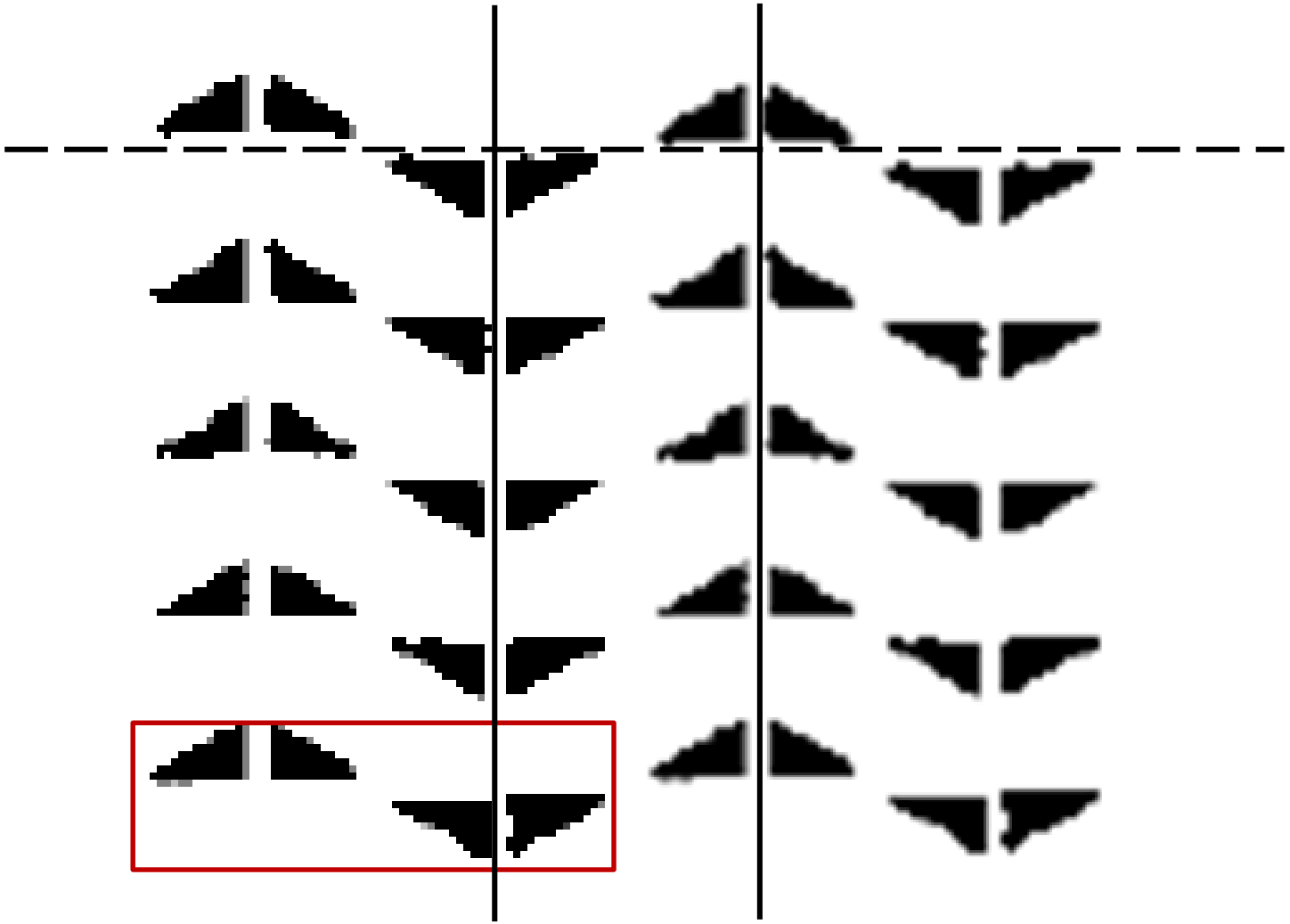
平面群：Pg



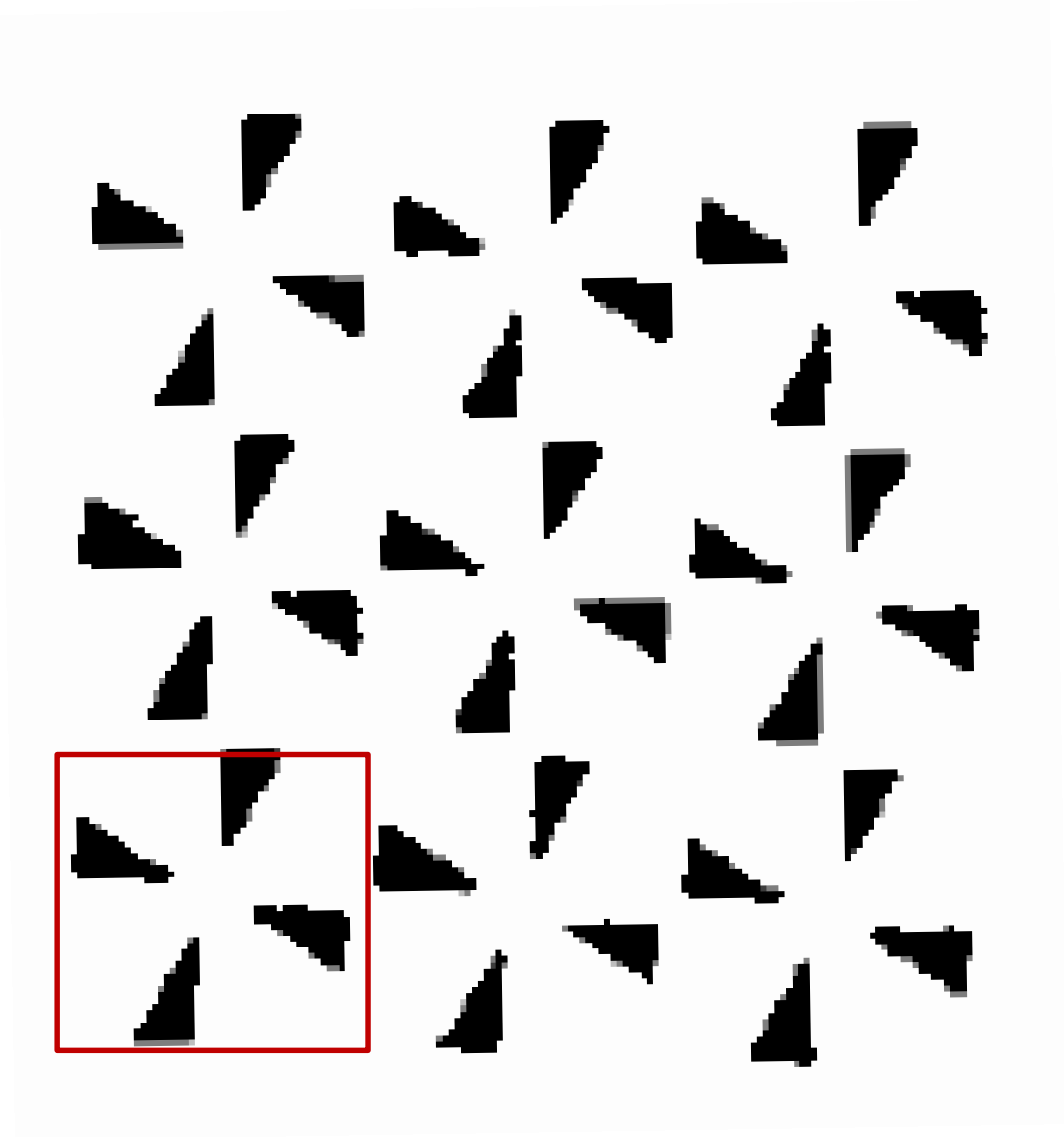
平面群：*Cm*



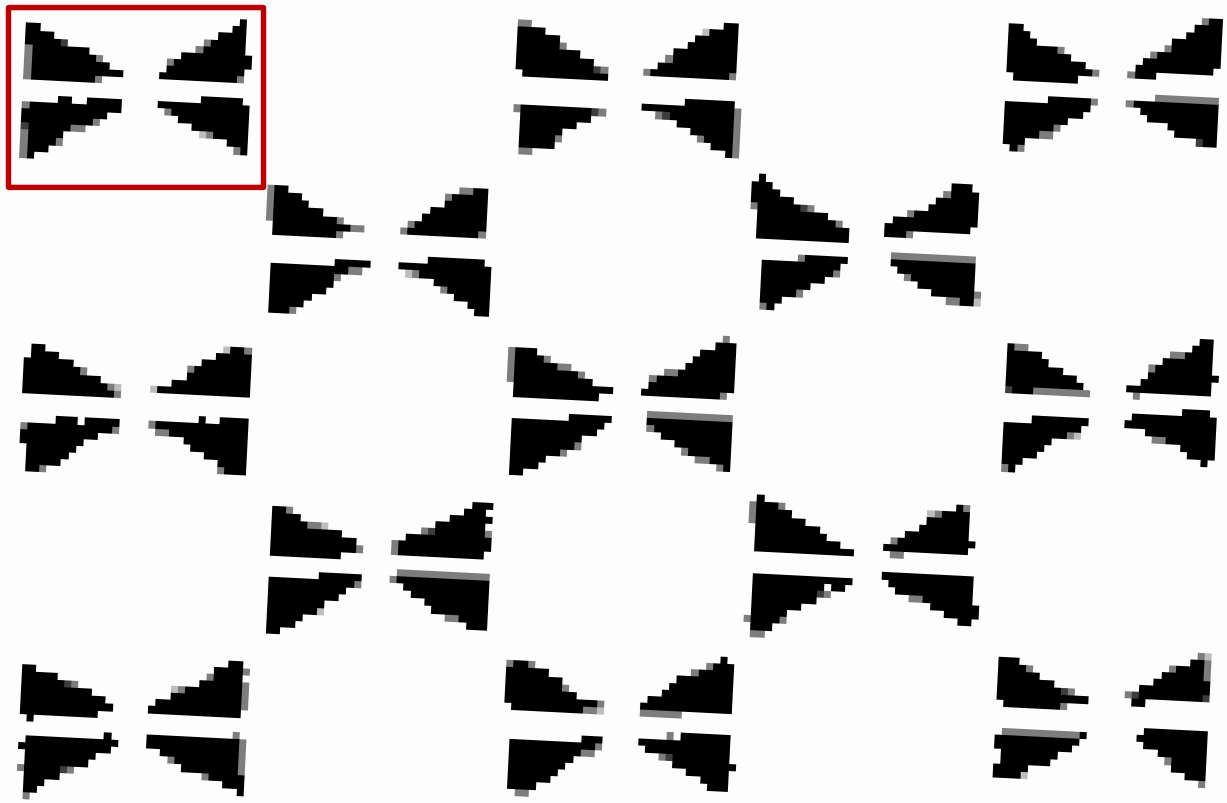
平面群：$P2gm = P2mg$



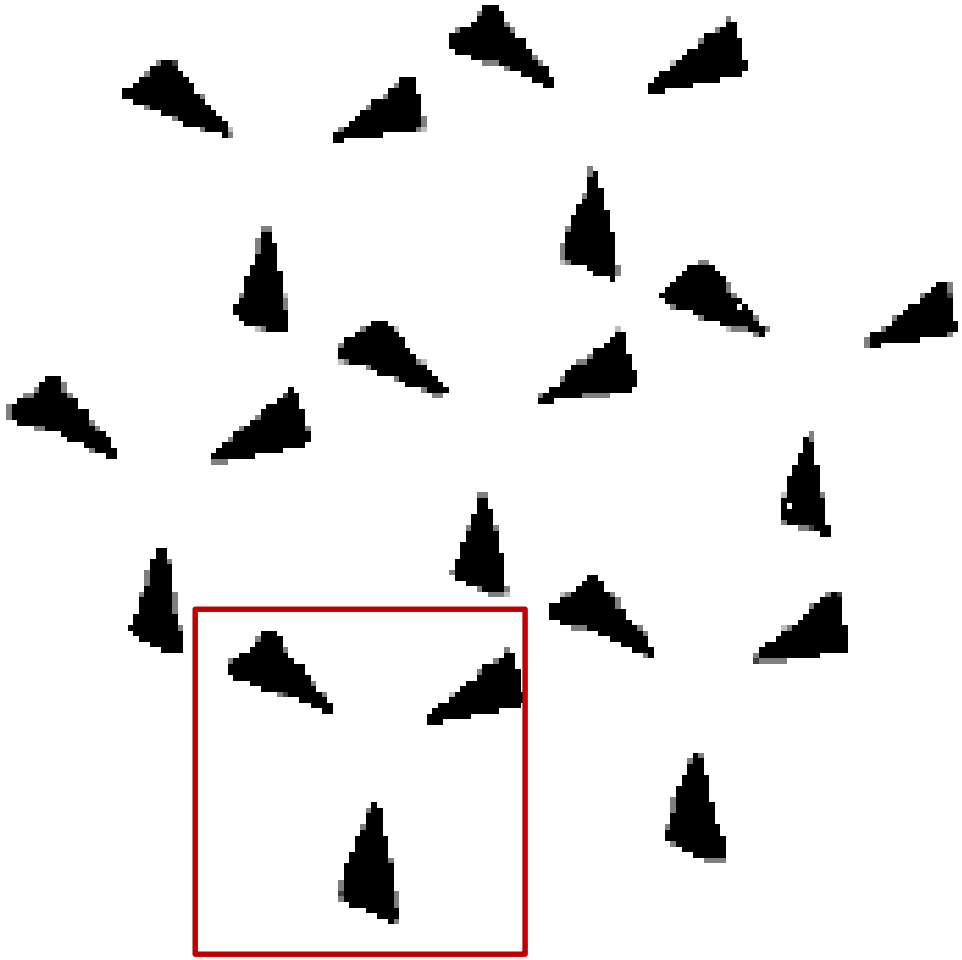
平面群：$P4$



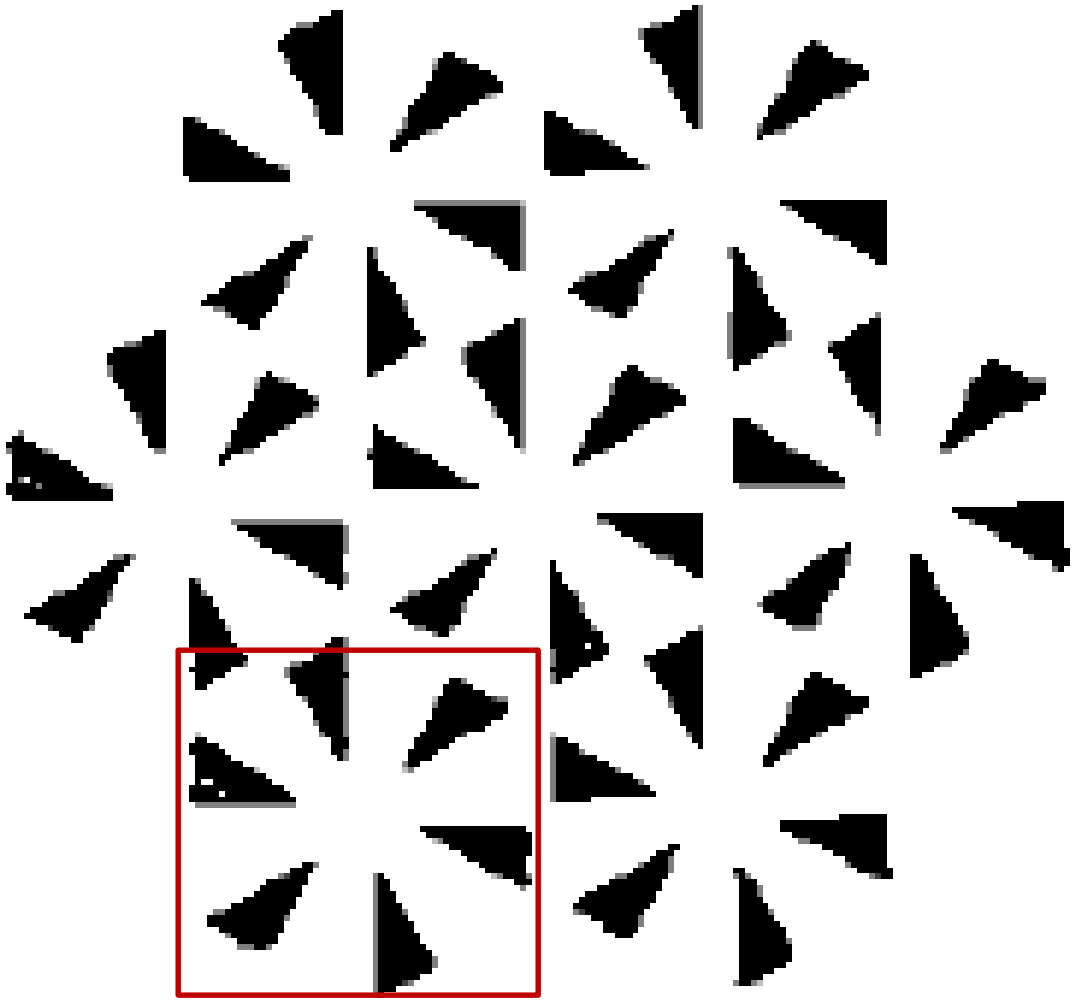
平面群：*C2mm*



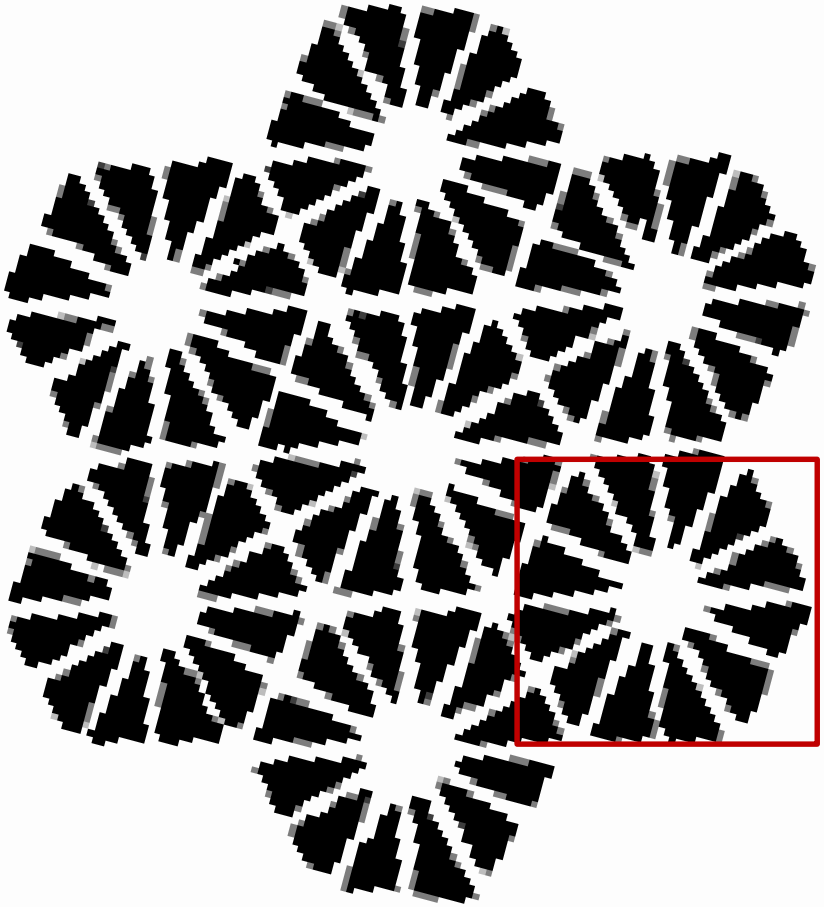
平面群：$P3$



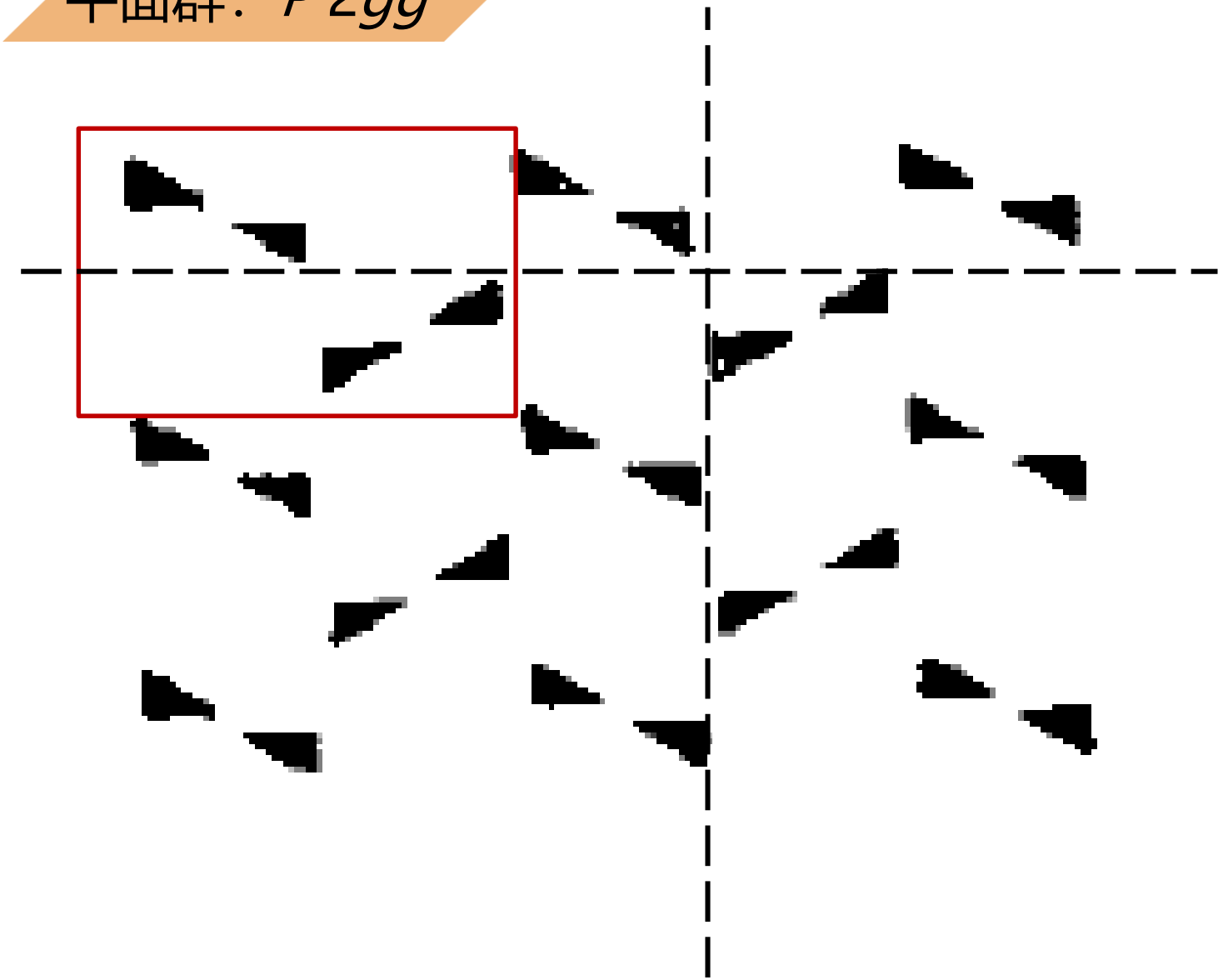
平面群：$P6$



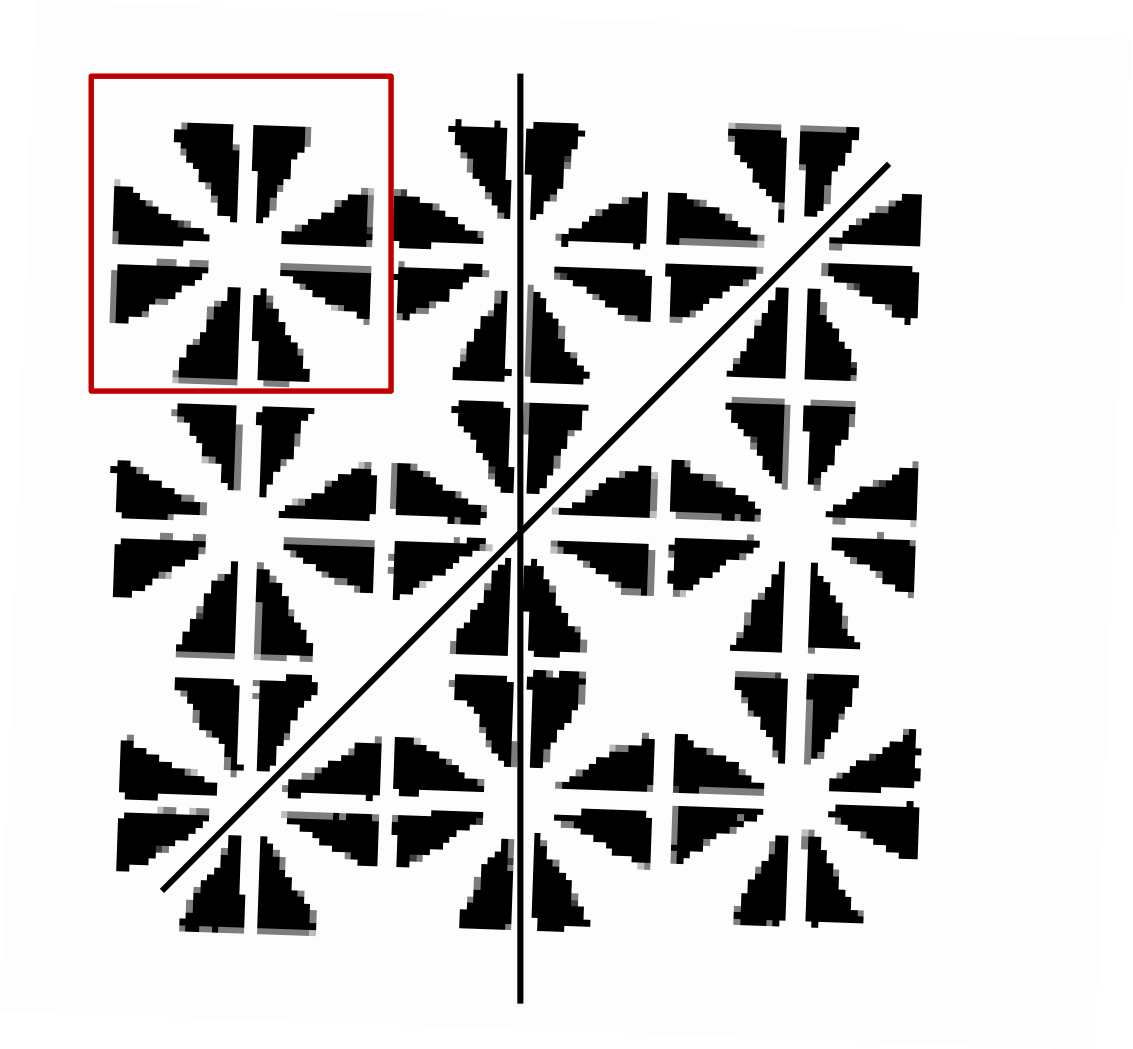
平面群：*P6mm*



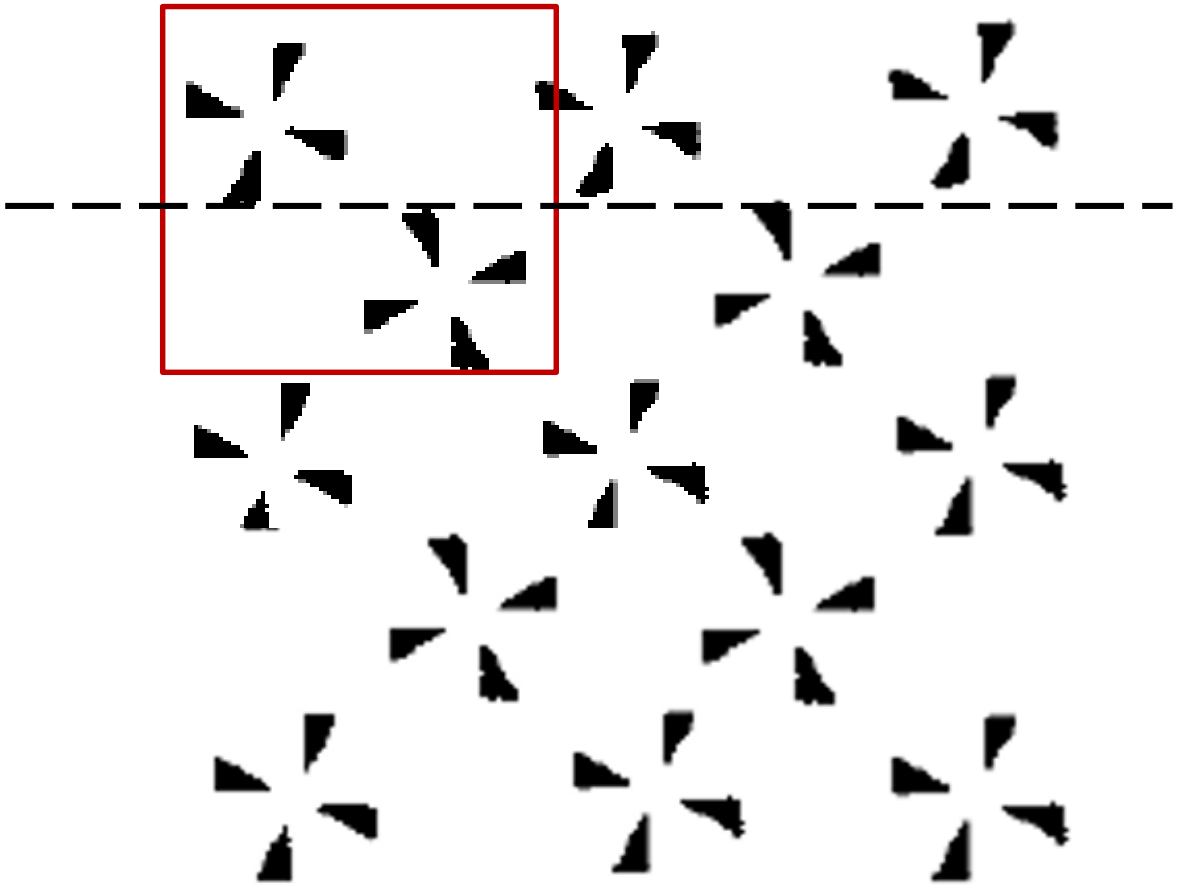
平面群：*P2gg*



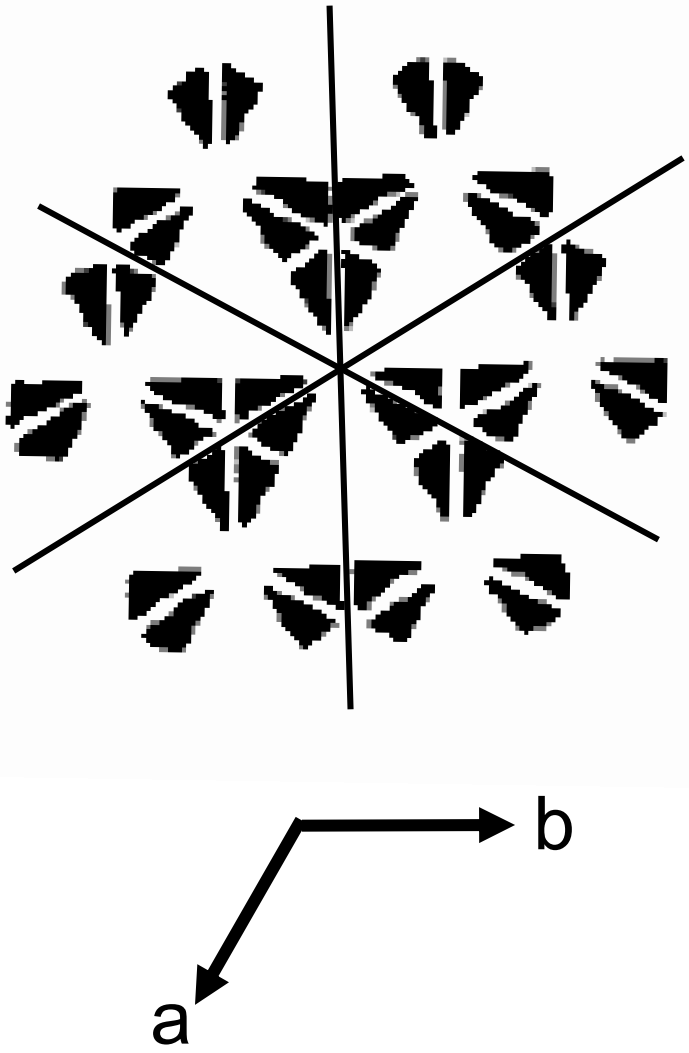
平面群：*P4mm*



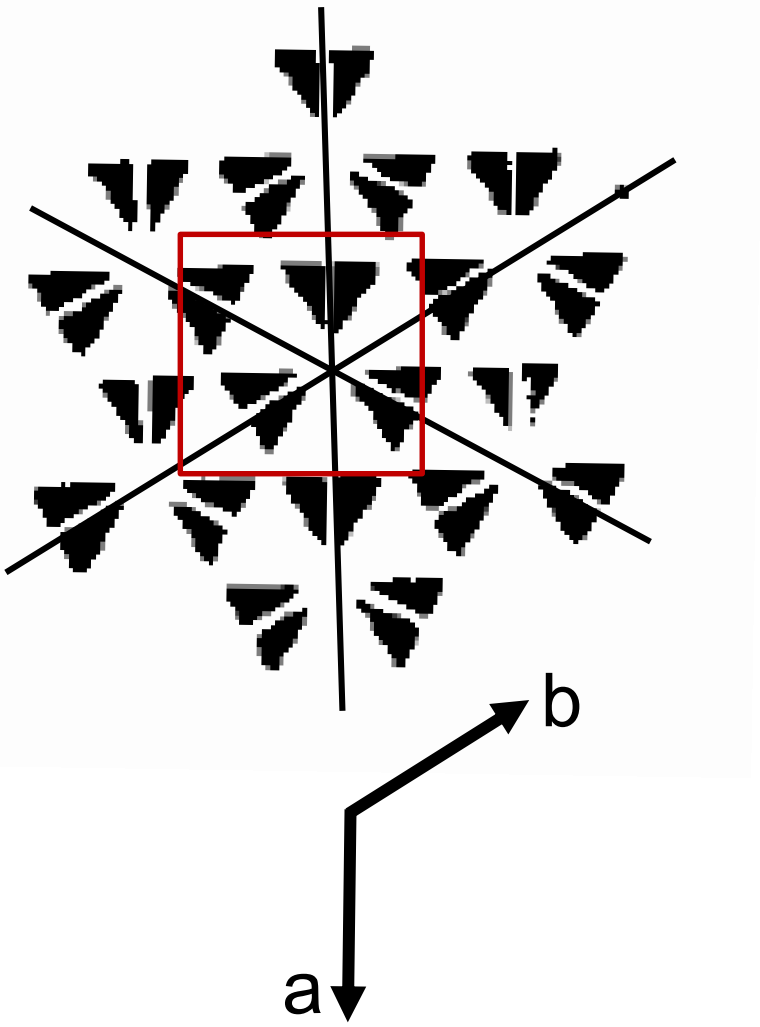
平面群：*P4gm*



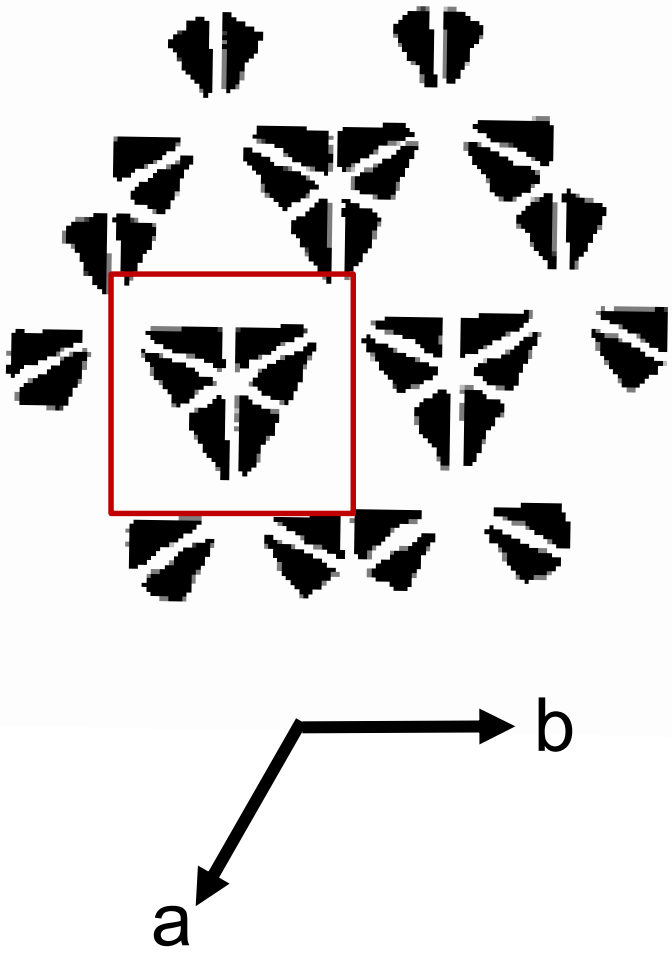
平面群：$P3m1$



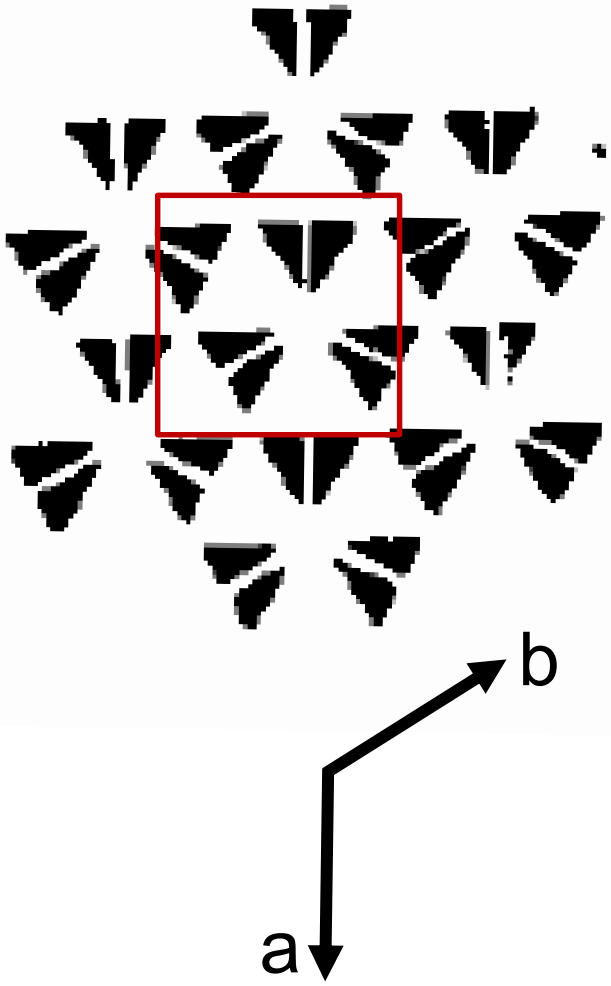
平面群：$P31m$



平面群：$P3m1$

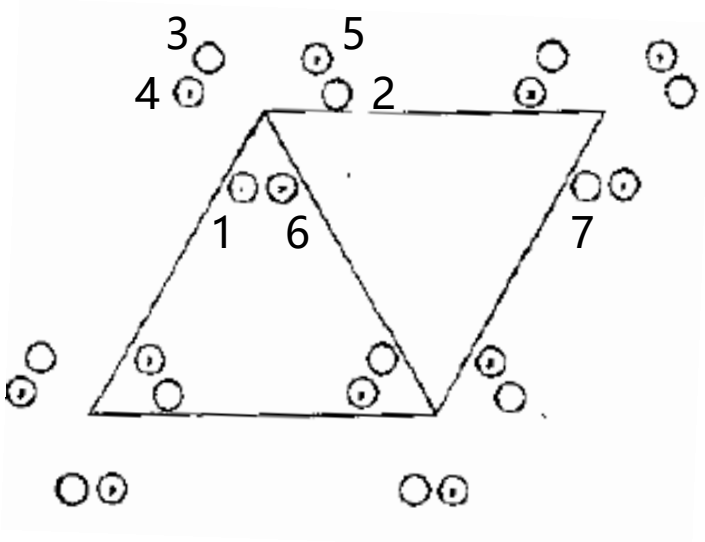


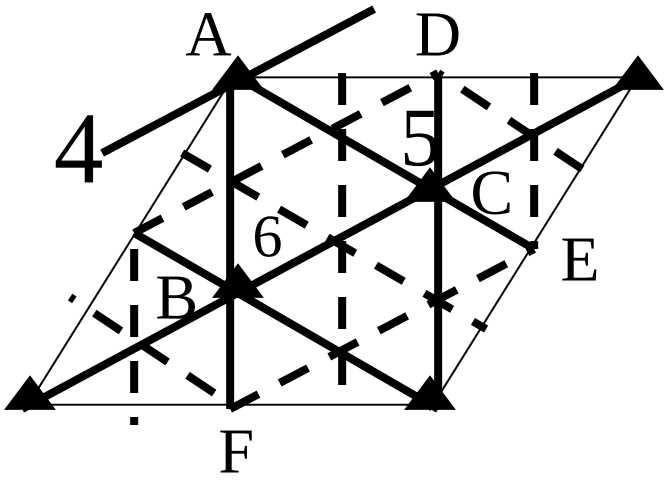
平面群：$P31m$



平面群：$P3m1$　P 42页

等效点配置图





对称元素配置图

对称操作：　(1) 1　(2) 3^+ 0, 0　(3) 3^- 0, 0

(4) m $x,\bar{x}$　(5) m $x,2x$　(6) m $2x,x$

等效位置（一般）：　(1) x,y　(2) $\bar{y},x-y$　(3) $\bar{x}+y,\bar{x}$

(4) $\bar{y},\bar{x}$　(5) $\bar{x}+y,y$　(6) $x,x-y$

特殊位置：

.m.	$x,\bar{x}$	$x,2x$	$2\bar{x},\bar{x}$
	(1)(4)	(2)(6)	(3)(5)

无对称单元：　$0\le x\le\frac{2}{3}$ ； $0\le y\le\frac{2}{3}$ ； $x\le 2y$ ； $y\le\min(1-x,2x)$

顶点	0,0	2/3, 1/3	1/3, 2/3

第二章作业：1 （P45页）