Al-Mustaqbal University College

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Types of lattice

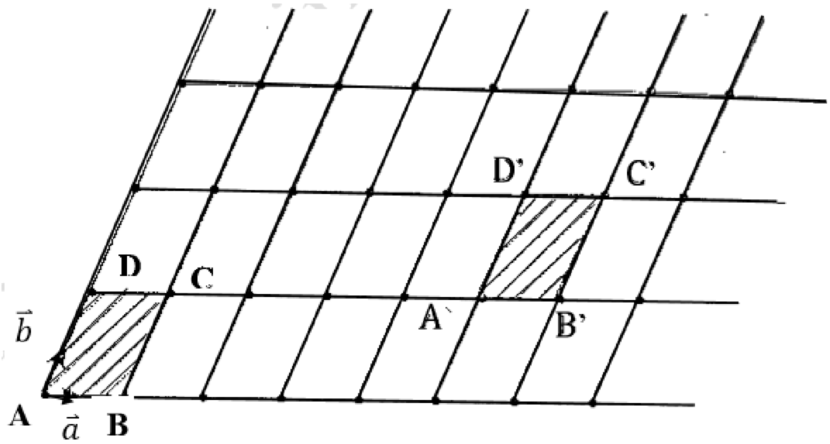
An ideal crystal is composed of basic building units arranged in a three-dimensional order so that when viewed from a lattice point with a position vector r, it appears the same when viewed from another point $\vec{r}'$, according to the equation

$$\vec{r}' = \vec{r} + \vec{T}$$

The transition vector connecting any two points in the lattice is known as the following relationship

$$\vec{T} = n_1 \vec{a} + n_2 \vec{b} + n_3 \vec{c}$$

where $\vec{a}$, $\vec{b}$ $\vec{c}$ and are called "basic transition vectors" and are definite and constant in any crystal lattice, and n1, n2, n3 are optional integers that depend on the position of the lattice point.

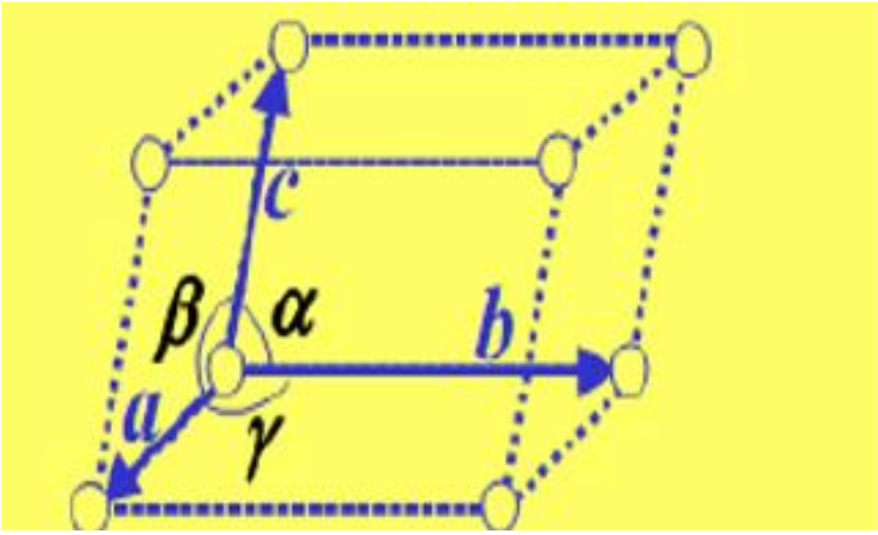


2D crystal lattice

The above figure represents the formation of D, C, B, A part of a crystal lattice in two dimensions in which the points of the lattice

Its repeated transition using the vectors ABCD vertices of the parallelogram a and $\vec{}$ b $\vec{}$ leads to $\vec{}$ the formation of the overall pattern of the crystal lattice and it is called the “unit cell”. It can be seen from the figure that the vector transitional $5a$ $\vec{}$ + b $\vec{}$= $\vec{}$ T and the equivalent point ABCD connects any lattice point in a unit cell $\vec{}\vec{}$ A'B'C'D' to it in another cell.

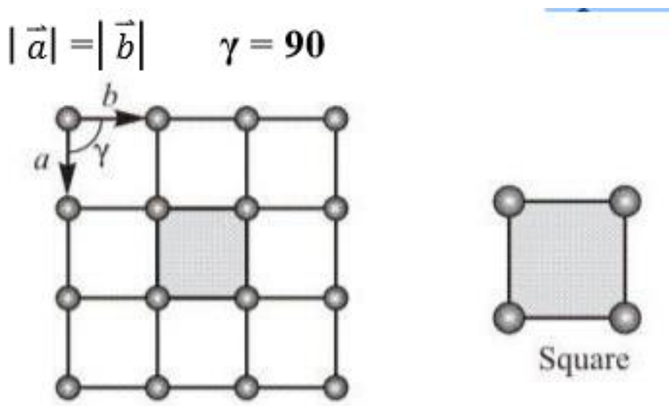
As for the crystal with a stereo lattice (three-dimensional), in which the "unit cell" is defined by parallelepipeds a, the solid with three axes γ and corresponding angles b, c, and as shown in Figure β, α below. It has been possible to classify crystals on the basis of the possible shapes of the unit cell and the elements of their symmetry that meet the conditions of the crystal lattice



3D cell unit

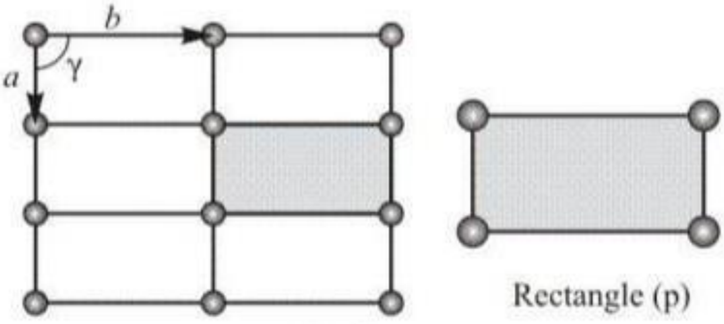
Types of lattice in two dimensions: There are five forms of lattice in two dimensions depending on the lengths of the two primitive vectors in the planar lattice and the angle between them.

Square Lattice



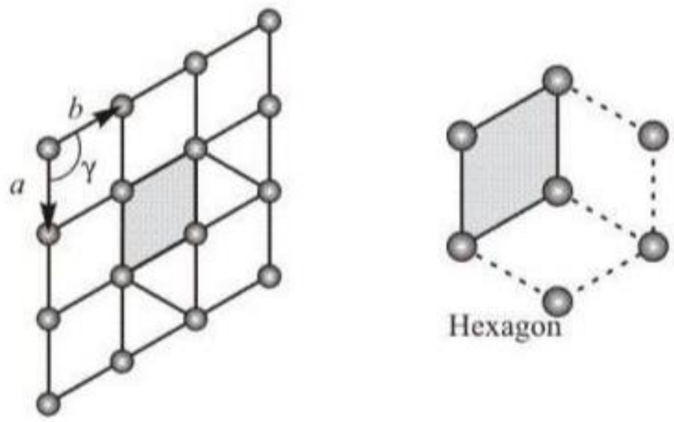
Rectangle lattice (p)

$|\vec{a}| \neq |\vec{b}| \qquad \gamma = 90$



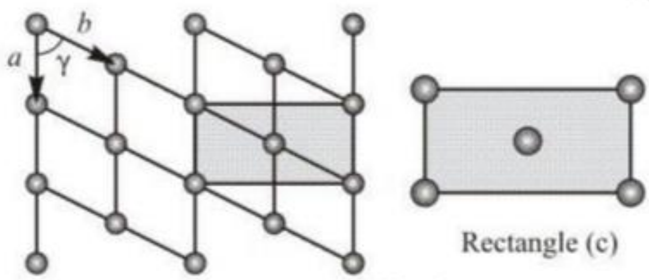
Hexagonal lattice

$|\vec{a}| = |\vec{b}| \qquad \gamma = 120$



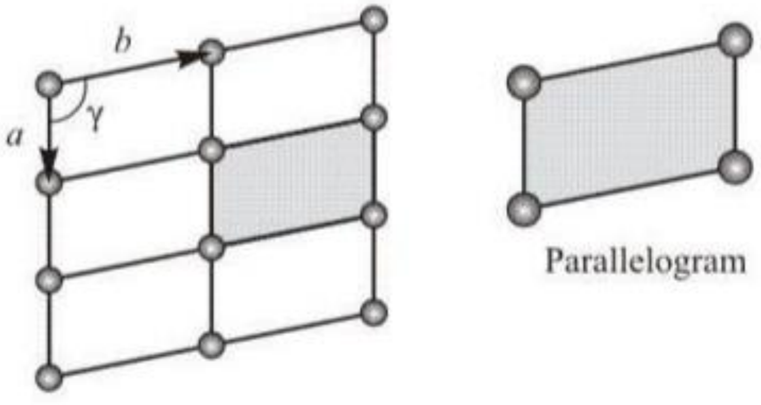
Rectangle lattice (I)

$|\vec{a}| \neq |\vec{b}| \qquad \gamma = 90$



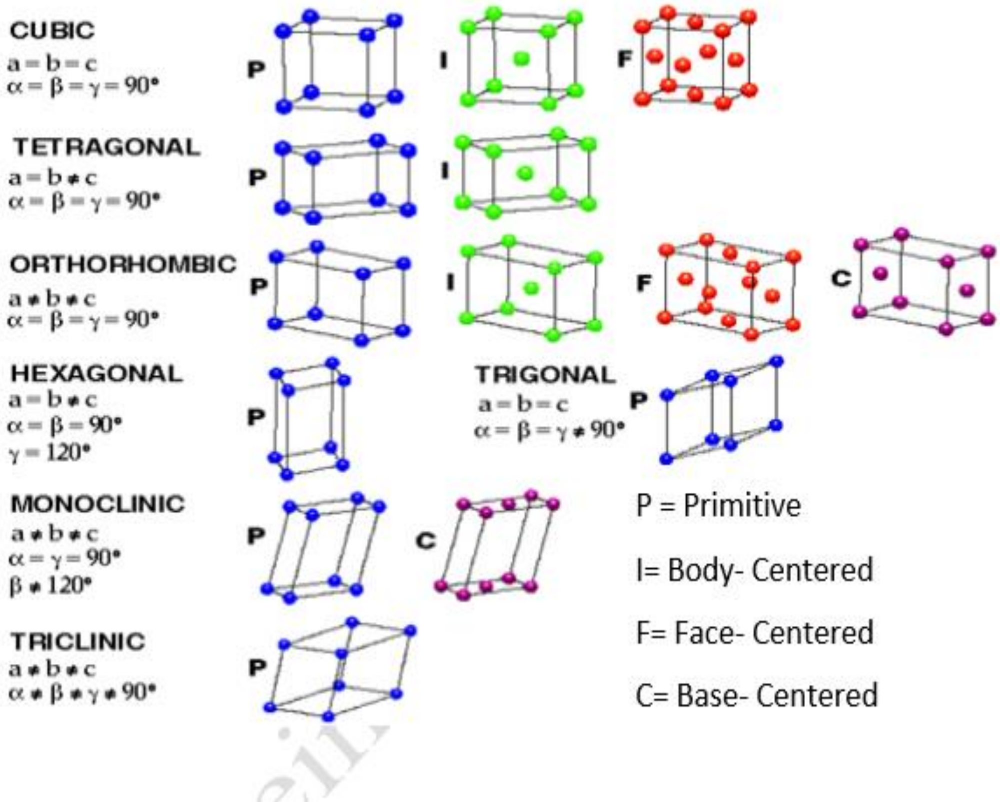
Oblique lattice

$|\vec{a}| \neq |\vec{b}| \qquad \gamma \neq 90$



Lattice types in the three dimensions (Parvas lattices):

Crystal "The classification of crystal lattices Bravais is attributed to the French crystallologist System to fourteen lattices distributed over seven crystal systems. The number of fourteen baravi lattices and seven crystal systems is limited by the number of possible ways to arrange the lattice points so that the environment is The 'Bravian reticle' surrounding any of them is exactly the same and when it includes simple (primitive, primitive) P, if its points are only at the corners and denoted by the letter or body-centered I on additional points in special positions, it . be face centered F or base centered C



Types of the cubic crystal system (P) In the cubic crystal system, there are three types of cubic cells: the simple cube. The characteristics of these cubic cells (F) face-centered cube, (I), body-centered cube are summarized in the following states:

Simple Cubic Unit Cell (P): (Simple Cubic Unit Cell), this type contains (Primitive Cubic Unit Cell) is also called the primitive cubic cell, eight atoms, ions, or molecules located in the corners of the cube (cube oil at the corners only)

Every molecule, atom, or ion in the corner points in a simple cubic unit cell is shared by every point in the corner 1/8 of eight cubic cells, so the share of one cell and therefore only one point

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Body Centered Cubic Cell: In this type of cubic cell, there is a point in the center of the unit cell in addition to the points in the corners of the cube, and thus this type of cubic cell contains two reticulate points. The number of atoms per unit cell

8*1/8+1=2

Face-Centered Cubic: In this type of cubic cell, there is a reticulation point in the center of the Unit Cell in each of the six faces in the cell, in addition to the points in the corners of the cube. Two cells, so the share of one cubic cell of these points in the six faces is three points, and therefore the sum of the points is three plus one (the points of the grid in the corners), that is, four points of the grid

8*1/8=3=4

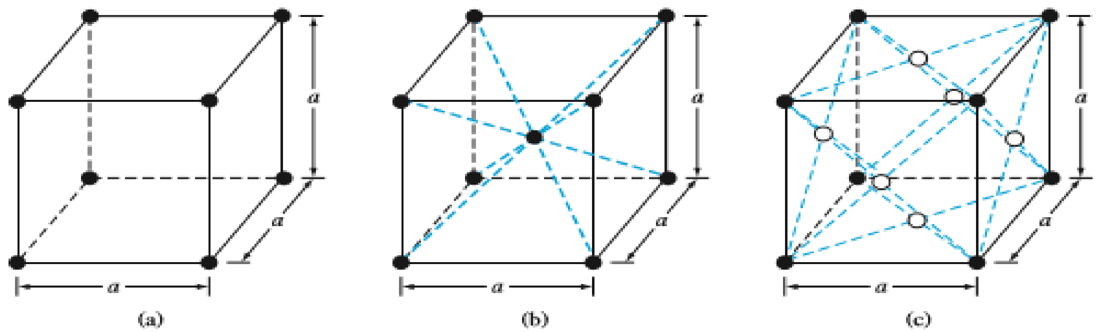

Figure 1.5 | Three lattice types: (a) simple cubic, (b) body-centered cubic, (c) face-centered cubic.