Crystals are composed of three-dimensional patterns. These patterns consist of atoms or groups of atoms in ordered and symmetrical arrangements which are repeated at regular intervals keeping the same orientation to one another. By replacing each group of atoms by a representative point a crystal lattice is obtained. Keep in mind; lattice sites are not necessarily associated with the position of atoms. Thus, a crystal lattice is a set of infinite, arranged points related to each other by transitional symmetry. The outlines for such patterns are called lattices. Lattices are comprised of the intersections of three parallel planes. The planes intersect producing three-dimensional figures which have six faces (like a cube) these are set in three sets of parallel planes, thus making a figure known as a parallelepiped.

**Introduction**

In a crystal lattice there is the parallelepiped constructed from vectors which correspond to translational periods called unit cells. These can be chosen in different ways. Commonly, unit cells are chosen so that its vertex coincides with one of the atoms of the crystal. Then lattice sites are occupied by atoms, and of the atoms of the crystal. Thus, the lattice sites are occupied by atoms, and vectors that connect the nearest equivalent atoms. The unit cell contains at least one atom of each of the types that make up the crystal. Providing that the unit cell is made up of only one type of atom, it is called monatomic, anymore than that and it is polyatomic. Correspondingly a monatomic lattice is often identified as a simple lattice and a polyatomic one, a composite lattice. One such example is table salt, NaCl (pictured in Figure 1.1).

**BRAVAIS LATTICE**

There are fourteen types of lattices that are called the Bravais lattices. A Bravais lattice is a set of all equivalent atoms in a crystal that are able to be brought back into themselves when they are displaced by the length of a unit vector in a direction parallel to a unit vector. Bravais lattices are not always primitive, having one point in the unit cell; other points can be found within the cell. These lattices are classified according to symmetry and space rotations into the seven crystal systems.

**SEVEN CRYSTAL SYSTEMS**

A crystal system is a group of crystal structures that are organized according to their axial system used to describe their lattice. The following types are pictured and described below.

**CUBIC**

This is the cubic crystal system. The cubic crystal system is also known as the isometric system. It is characterized by its complete symmetry. This system contains three crystallographic axes, which are perpendicular to each other, as well as all equal in length. These axes are all at angles 90° to one another. The cubic system contains one lattice point at each of its four corners, and has six faces. (Figure 1.2)

**HEXAGONAL**

The hexagonal crystal system contains four crystallographic axes. These consist of three equal horizontal axes at 120° of
each other. It has one vertical axis which is perpendicular to the other three, which maybe shorter or longer than the other three, horizontal axes. It is composed of eight faces. (Notice in Fig. 1.3)

TETRAGONAL

A tetragonal crystal is a simple cubic shape that is extended along its vertical axis to create a rectangular prism. It consists of a square base and top, as well as three axes. These axes have one perpendicular and two horizontal with angels of 90°. Like the cubic system it is composed of six faces. (See Fig. 1.4)

RHOMBOHEDRAL

The rhombohedral is a trigonal system, that has a three-dimensional shape similar to a cube, but it has been inclined to one side making it oblique. It consists of three axes, one vertical and two horizontal all laid perpendicular to one another. These axes are at angles of 90° to one another. The rhombohedral is composed of six faces, although since the faces are not square they are more commonly known as rhombi. (Viewed in Fig.1.5)

ORTHORHOMBIC

Orthorhombic crystal systems consist of three axes. These axes are mutually perpendicular having all different lengths. Yet, the axes angles are all equidistant laying at 90° to each other. The orthorhombic has six faces. (Seen in Fig. 1.6)

MONOCLINIC

A monoclinic system has three unequal axes. The vertical and forward facing axes are inclined toward each other at an oblique angle, and the horizontal axis is perpendicular to the other two axes, this is known as the ortho axis. These angles are all arranged 90° to each other. A monoclinic system is made up of six faces. (Pictured in Fig. 1.7)

TRICLINIC

A triclinic system is made up of three unequal crystallographic axes. The axes intersect at oblique angles. These angles are 90° to one another. The triclinic system has six faces. (Depicted in Fig. 1.8)

References

Contributors

• Cassandra Patterson (UCD)