Atomic joins[1]

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http://homepage.mac.com/whitby/

http://web.me.com/whitby/Octahedron/Welcome.html

1. Excerpted from Octahedron1stEd.pdf—bookmark: JOIN—pages 147-150

JOIN

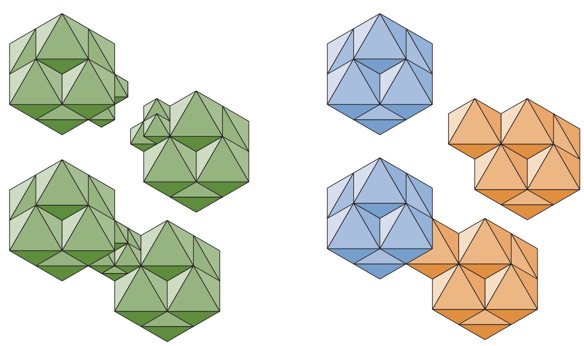
Atomic joins

The crystalline atom is a structural association of identical octahedra identically oriented in precise positions. If the positions are changed or the parts removed it is no longer the same element. The parts and their relative positions determine how an element may join with another element to produce a group. The identity of the element is maintained in any molecular association. It gives up nothing; it gains nothing. It is in no way transformed. The concept of the ion is not applicable as a transformation of the crystalline atom. The concept of electron pairing is analogous to triplet pairing. Shell completion is analogous to layer completion.

Atoms join so that each of the epn edges which is paired by their contact is congruent with another to which it is polarly attracted.

Triplet pairing by atoms with odd atomic numbers

Odd numbered elements can join so that the single unpaired triplet of one is paired with that of the other so as to form a He-octahedron. For modeling purposes, a pair of Al-atoms can be shown using a Mg-atom and a Si-atom. The Si-octa of the Si-atom being shared by the two Mg portions of the paired Al-atoms. This type of join has been termed an “ionic bond”.

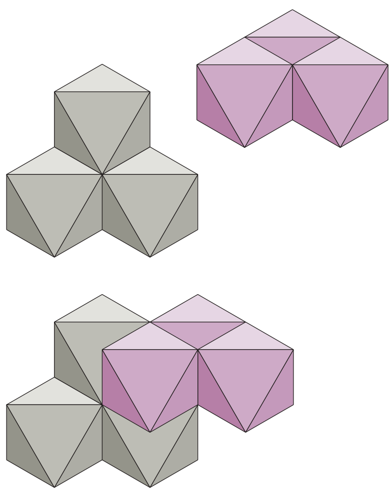


Triplet pairing join of Al-atoms.

On the upper left is shown two Al-atoms oriented for triplet pairing with the completed join below. On the upper right a Mg-atom is depicted with a Si-atom and the join between them is shown below. This SiMg group has the same conformation as the Al_2 group. The Al_2 group could be described as one Al-atom giving up an electron to the other leaving one as a Mg-atom and the other as a Si-atom. No such transfer occurs.

Cleft pairing by atoms

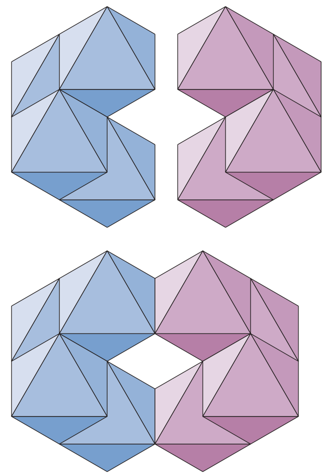
Some of the elements have clefts. Clefts provide attachment locations. The atoms join so that a pair of He-octas of each forms a tetrahedral array. Each of the four He-octas provides a face enclosing a regular tetrahedral void. A pair of C-atoms joined in this way will each have a He-octa location occupied by a He-octa of the other. The join is specified as a C-Ne-join which means that the C-octa of one occupies the Ne-location of the other.



Cleft join of two C-atoms.
A pair of C-atoms is shown at the top. The atoms are shown cleftly joined at the bottom. A He-octa of each of the atoms occupies a position of the other atom that a He-octa would occupy in the formation of a higher numbered atomic element. The three positions for a C-atom are the O-void, the Ne-void, and the Mg-void.

Simple edge to edge

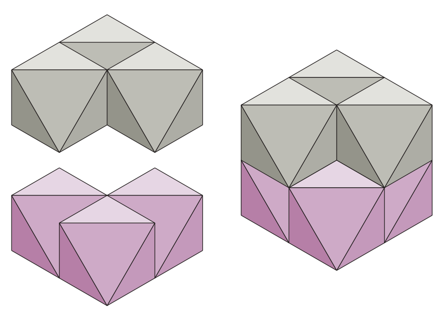
Atoms can join by simple edge pairing. Two O-atoms can form an O_2 group where the epn edges of the He-octa or O-octa of one atom are paired with the He-octa or O-octa of the other atom.



Edge pairing of two O-atoms.
Two O-atoms are shown at the top. The O-atoms join so that each has two He-octas joined edge-to-edge with two He-octas of the other. The result is an O_2 group.

Face to face

Two C-atoms can produce a Mg-atom form when joined like the epn triplet pairs in a He-atom.



Face-to-face join of two C-atoms.
Two C-atoms at the left join face-to-face to form a C_2 group which is the same shape as a Mg-atom.

Molecular arrangements

The crystalline atom imposes restrictions

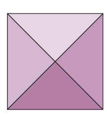
Crystals

Crystals formed from crystalline atoms require that there be only one orientation for the each epn of each of the atoms of each of the groups of each of the units which form the crystal.

Helixes

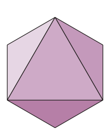
The helix requires a rotation between units. Thus, the rotation must be such that the rotation of the unit leaves the epns of the two units in the same orientation. This can happen only if the rotation matches the symmetry of the epn about an axis parallel to the helical axis.

A vertexial diameter of the epn is an axis of fourfold symmetry. It provides for 1/4 revolution and 1/2 revolution helical joins.



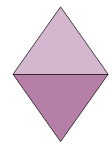
View parallel to vertexial diameter

A facial diameter of the epn is an axis of double threefold symmetry. It provides for 1/3 revolution helical joins.



View parallel to facial diameter.

An edgial diameter is an axis of twofold symmetry and provides for 1/2 revolution helical joins.



View parallel to edgial diameter.

Modeling tests the atomic forms

The atoms produced by the regular association of identical regular octahedral particles provide a periodicity of form which matches the periodicity of the elements. The forms of the atoms can be tested by fitting them together structurally in crystalline order to produce geometrically defined groups.

- Chains and angular relationships between portions of the same chain, as in the lipids, are useful in this regard.
- Associations between chains, as in the pleated sheets of proteins further test the validity.
- Rings of atoms or groups are especially useful, because the closure is an additional restraint. Rings are essentially a single chain. The carbon ring and the cyclic peptides are examples.
- Helixes, like rings, require a type of closure through rotation with a translation.
- The production of handedness in the peptides and in the helixes of the mineral crystals also try the atomic shapes.

Facially joined octahedra

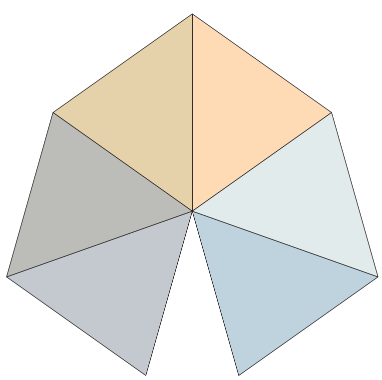
Three octahedra sharing a single edge

Three regular octahedra can be joined facially so as to share a common edge. The angular sinus is $2 \times \operatorname{asin}\sqrt{2/27}$, which is approximately equal to $31°35'11'$.This is calculated from the octahedral geometry as follows.

Let θ be one half of the sinus angle, s be the length of the octahedral edge, and x be half the distance between the octahedral vertexes at the mouth of the sinus. Then,

$$\theta = \frac{1}{2} \times (360 - 3 \times (180 - \operatorname{atan}\sqrt{8})) = \operatorname{asin}\sqrt{\frac{2}{27}}$$

$$x = s \times \frac{\sqrt{3}}{2} \times \sin\theta = s \times \sqrt{\frac{1}{18}}$$



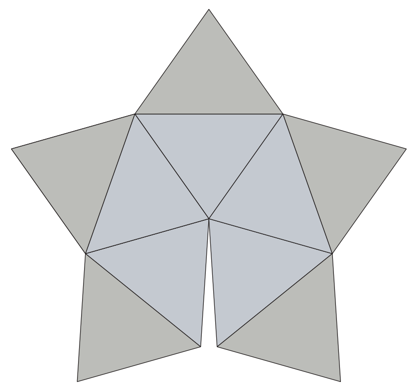
Three facially joined octahedra sharing a common edge.

Five octahedra sharing a single vertex

Five regular octahedra can be joined facially so as to share a common vertex. The angular sinus is $2 \times \operatorname{asin}\sqrt{1/243}$, which is approximately equal to $7°21'22''$. This is calculated from the octahedral geometry as follows.

Let θ be one half of the sinus angle, s be the length of the octahedral edge, and x be half the distance between the octahedral edges at the mouth of the sinus.

$$\theta = \frac{1}{2} \times (360 - 5 \times \operatorname{atan}\sqrt{8}) = \operatorname{asin}\sqrt{\frac{1}{243}}$$



Five facially joined octahedra sharing a common vertex.[1]

1. N. Pangarov,, Twinned Crystals in electrical crystallization of silver, Figs. 28a and 28b, **Growth of Crystals**, vol. 10, N. N. Sheftal, editor, tranlated by J. H. S. Bradley, U. of London, Consultants Bureau, London.