Mn-atom doping of 100-planes of ZnSe crystal

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27 July 2005
http://homepage.mac.com/whitby/

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

References

1. Octahedron, the Universe defined by Robert William Whitby

A description of the atomic shapes and how they join which follows from the discovery that the periodicity of the atomic elements matches the periodicity of recurring form in which identical regular octahedra combine to form ever larger regular octahedra. Octahedron1stEd.pdf shows that the atomic elements are crystalline assemblies of identical regular octahedra and explores the implications of this discovery. 500 pages
See the chapter CRYSTAL.
http://homepage.mac.com/whitby/FileSharing103.html

2. Doped Nanocrystals–Study details basis for preparing tough-to-synthesize semiconductors by Mitch Jacoby, C & E News v. 83 no. 8, 11 July 2005, p. 9

See the figure captioned <STICKY SURFACE Zinc selenide nanocrystals can be doped with metals such as manganese (dots) by adsorbing the metal selectively on certain crystal faces. COURTESY OF STEVEN ERWIN> which shows manganese adsorbed on the [100] faces of ZnSe-crystals.
http://pubs.acs.org/cen/news/83/i28/8328notw1.html

3. Doping semiconductor nanocrystals by Steven C. Erwin, Lijun Zu, Michael I. Haftel, Alexander L. Efros, Thomas A. Kennedy, and David J. Norris, Nature 436, 91-94 (7 July 2005) | doi: 10.1038/nature03832

http://www.nature.com/nature/journal/v436/n7047/full/nature03832.html

4. Tetrapod.pdf by Robert William Whitby

Shows how a Zn-atom and an O-atom can join to form a Sr-atom homomorph.
http://homepage.mac.com/whitby/Crystals/FileSharing215.html

Introduction

The shapes of the Zn-atom and the Se-atom suggest a way that they can join to make a unit that can join with identical units in a crystalline assembly which has faces parallel to three mutually perpendicular planes. This document shows the atoms, the formation of the ZnSe-group, a crystalline assembly of identical ZnSe-groups, and the ways in which a Mn-atom can join to each of the crystal surfaces that are parallel to one of the three mutually perpendicular planes. It shows how a Mn-atom can join with the ZnSe-groups which define each of the two types of 100-plane. It also shows that two Ge-atoms can join as a unit which is a homomorph of the ZnSe-group.

ZnSe-group

Figure 1 shows the Zn- and Se-atoms viewed in the anti-growth direction. The Zn-atom has one He-octa in its fourth layer; the Se-atom has three He-octas in its fourth layer. These fourth layer He-octas are colored yellow. When the Zn-atom is rotated one half-turn about the bottom of the figure it can join with the Se-atom so that its yellow He-octa fills the void of the fourth layer of the Se-atom while the three yellow He-octas of the Se-atom fill the three voids of the Zn-atom. The figure also compares the ZnSe-group with the Ra-atom. Figure 2 shows the ZnSe-group in a facial view.

ZnSe-crystal

The two faces of the ZnSe-crystal which are perpendicular to the16-axes of the ZnSe-groups. have the same appearance as the six faces of the Sr-crystal which are perpendicular to the vertexial diameters of the octahedron. [See Figure 3.] Figure 4 shows the 100-faces of a Ra-crystal.

Mn-atom joining to 100-faces perpendicular to the 16-axis

Figure 5 shows how a Mn-atom joins to the ZnSe-groups that define the100-faces that are perpendicular to the 16-axes of the groups. Figure 6 shows the same relationship in a facial view.

Mn-atom joining to 100-faces parallel to the 16-axis

Figure 7 shows the formation of the ZnSe-group in a vertexial view which is perpendicular to the 16-axis. Figure 8 shows the formation of a 100-face which is perpendicular to the 16-axis, and Figure 9 shows how a Mn-atom joins to the face. Figure 10 shows a Mn-atom joined to the face in a facial view.

GeGe-group

Two Ge-atoms can form a group which is an homomorph of the ZnSe-group shown herein. [See Figure 11.] The two He-octas in the fourth layer of each Ge-atom fill the two voids in the fourth layer of the other Ge-atom. The midlayer of the GeGe-group is the same as the midlayer of the ZnSe-group.

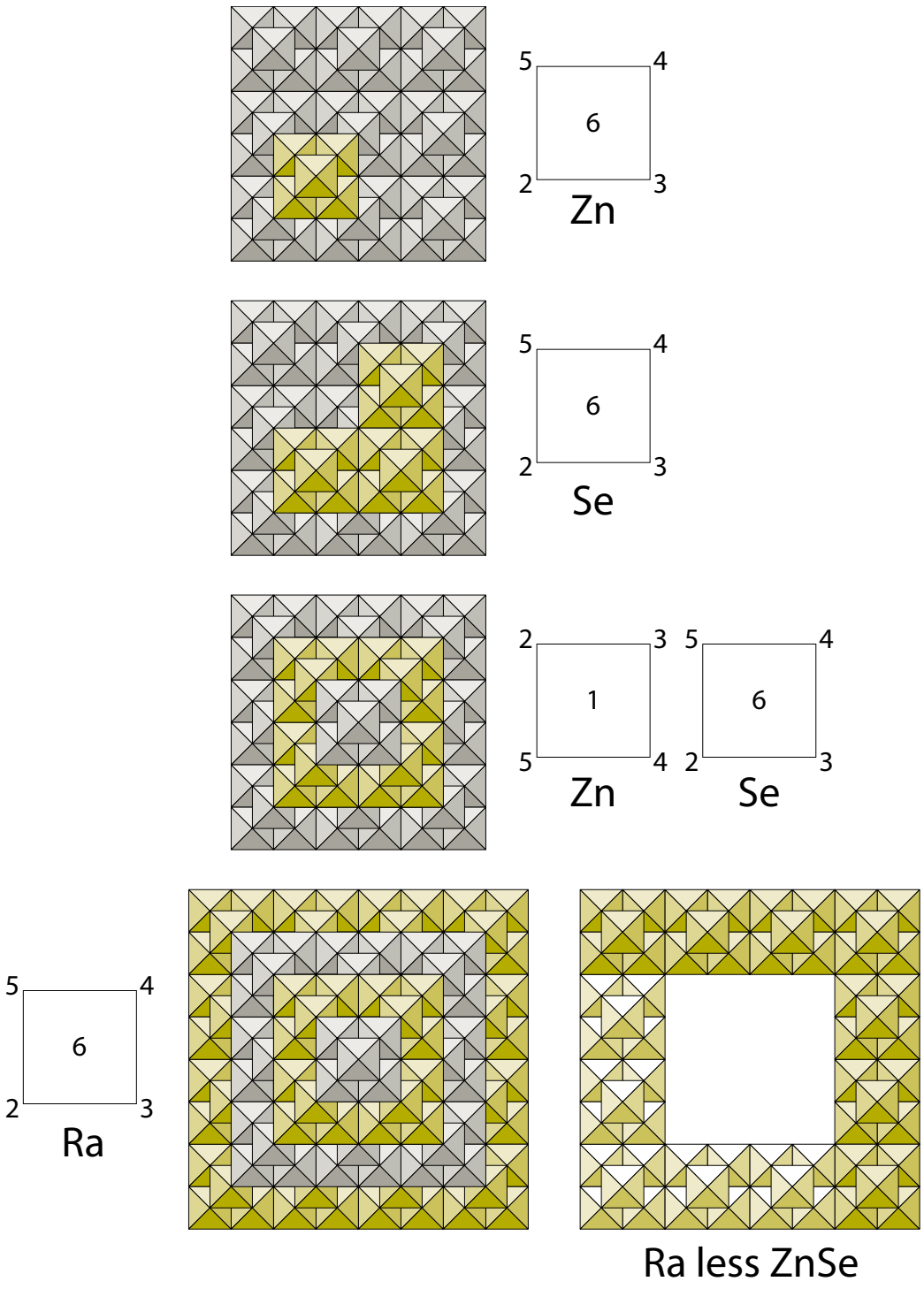

Fig. 1 ZnSe-group

The figure shows that a Zn-atom can join with a Se-atom so that each of their 4-layer He-octas occupies a position in the jointly held 4-layer. The ZnSe-group differs from the Ra-atom shown at the bottom left by the square ring of twelve He-octas shown at the bottom right.

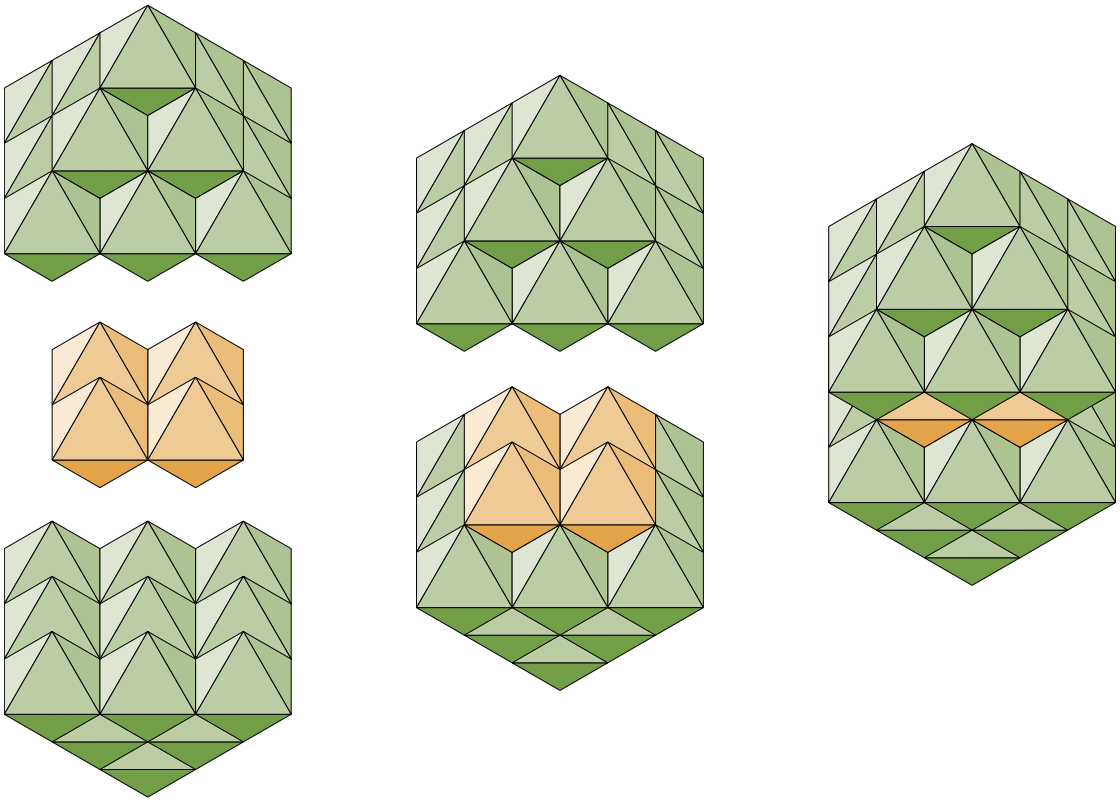

Fig. 2 ZnSe-group–facial view

The figure shows the ZnSe-group viewed facially in He-octa detail.

On left, the group is shown in an expanded view to consisting of two identical square pyramidal groups of fourteen green He-octas each and a square midlayer of four orange He-octas. The midlayer consists of the Ca-octa of the Zn-atom and the Ca-, Ge-, and Se-octas of the Se-atom.

In middle, the square midlayer is joined with the lower pyramidal group.

On right, the upper pyramidal group is joined to the midlayer to complete the ZnSe-group.

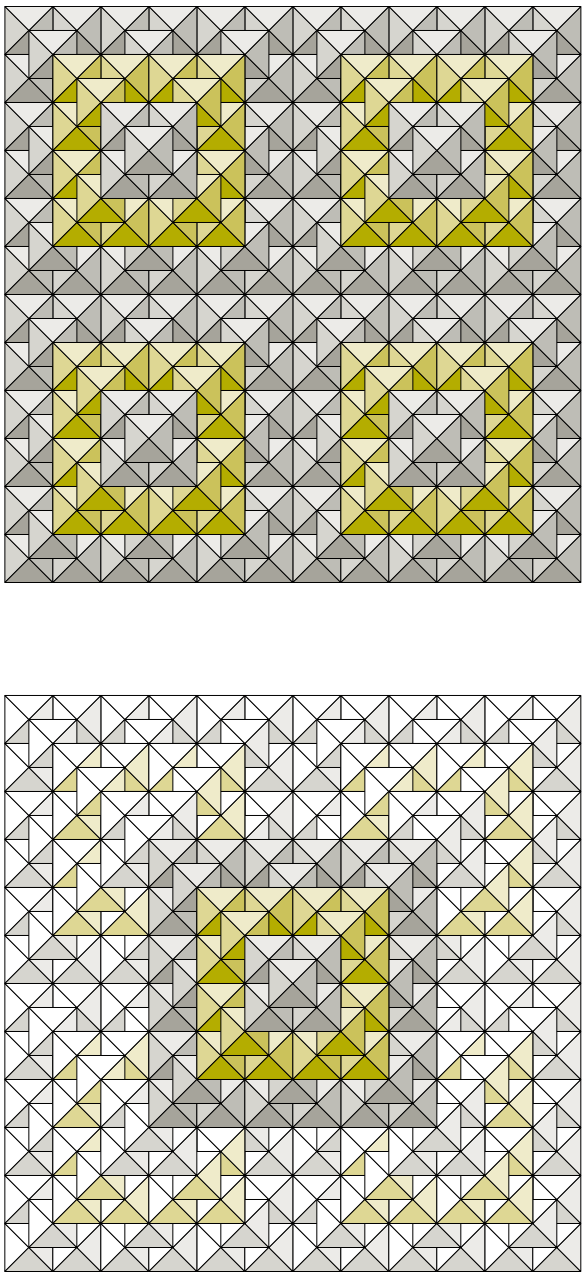

Fig. 3 Joining a ZnSe-group to the 100-face of a ZnSe-crystal

At top, four ZnSe-groups are joined in a layer representing one of the two 100-faces of a ZnSe-crystal that are perpendicular to the 16-axis of each ZnSe-group.

At bottom, a fifth ZnSe-group has been crystallinely joined to the four ZnSe-groups of the100-face of the ZnSe-crystal.

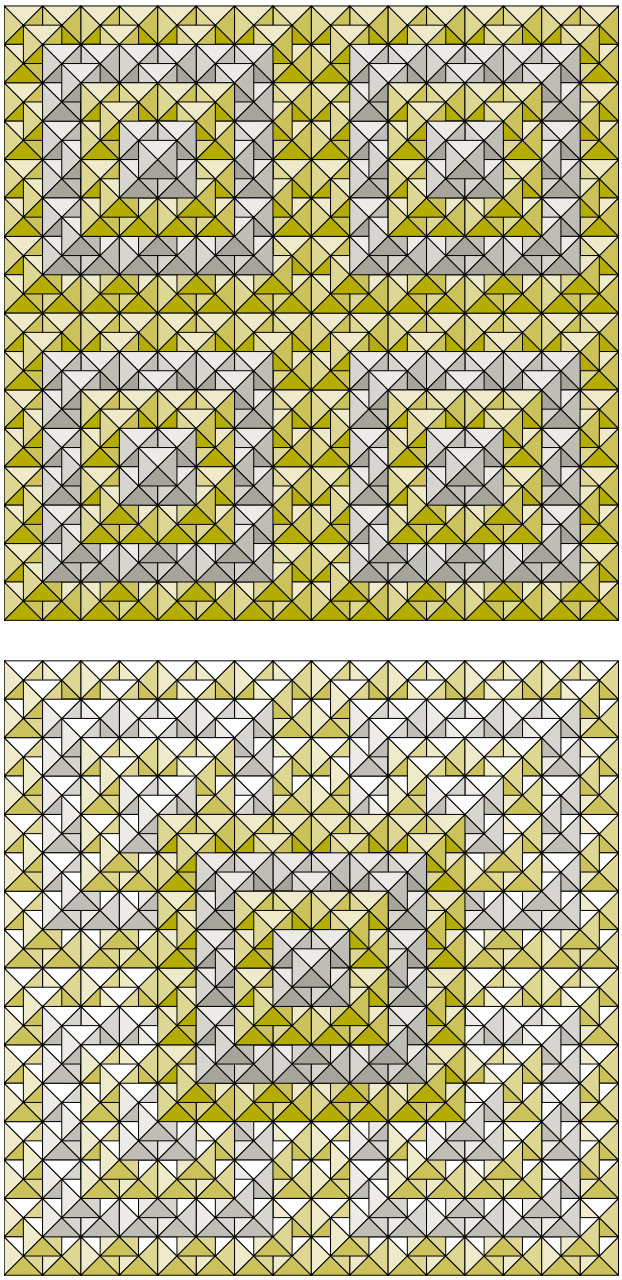

Fig. 4 Ra-crystal–100 face

The figure shows one of the six 100-faces of a Ra-crystal.

At top, four Ra-atoms joined edge to edge form a square array. Each holds a position in a portion of a vertexial plane which is definitive of the 100-plane of a Ra-crystal. Each of the mutually perpendicular vertexial planes that constitute the six 100-planes of the Ra-crystal have the same structure.

At bottom, a Ra-atom has been joined with the four Ra-atoms of the 100-plane.

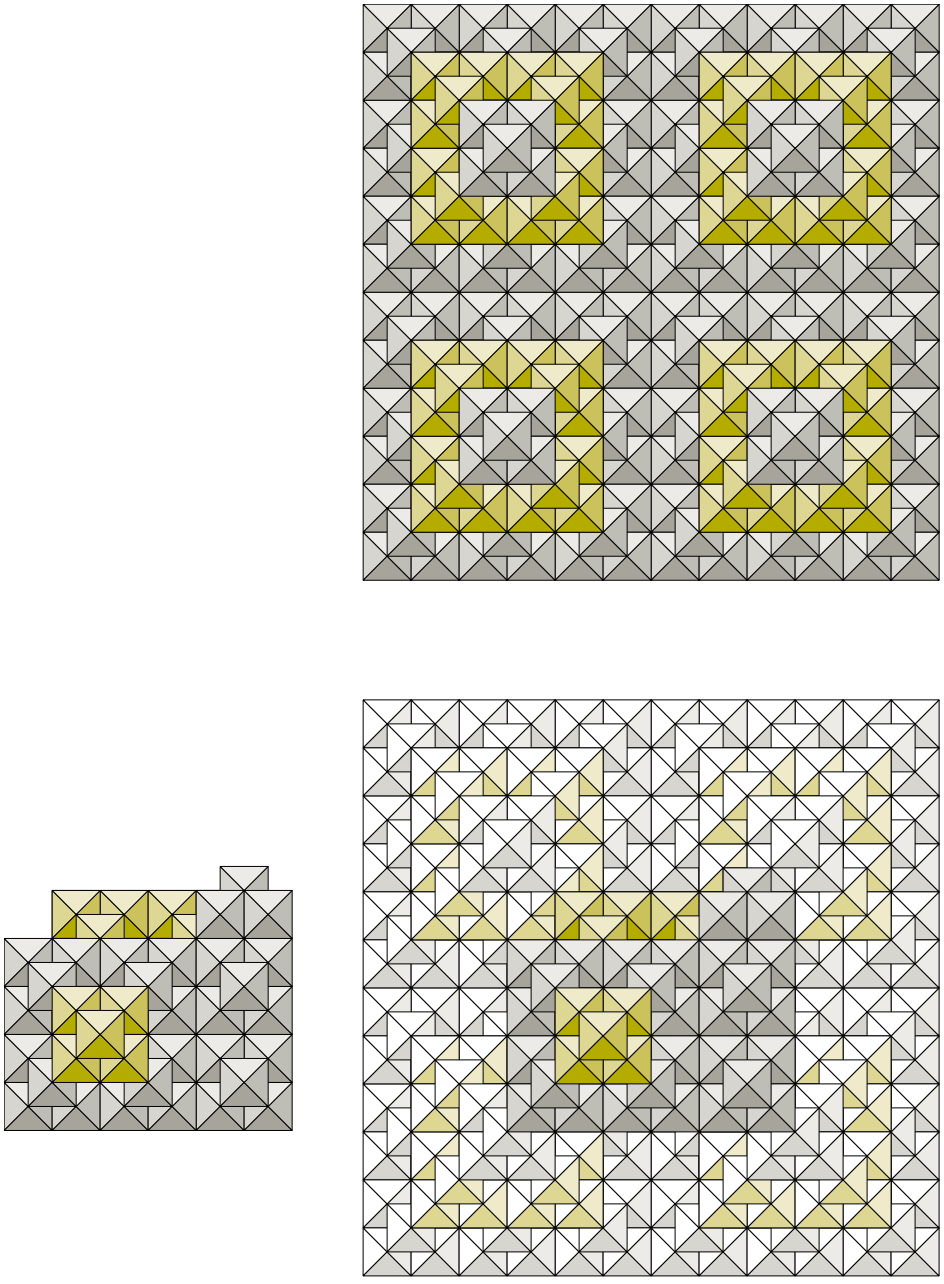

Fig. 5 Joining a Mn-atom to a 100-face of a ZnSe-crystal

The figure shows a way in which a Mn-atom can join with a 100-face of a ZnSe-crystal. The four ZnSe-groups at the top represent one of the two 100-faces of a ZnSe-crystal that is perpendicular to the 16-axis of the ZnSe-group. A Mn-atom is shown separately at bottom left. The Mn-atom is joined with the 100-face of the ZnSe-crystal at bottom right.

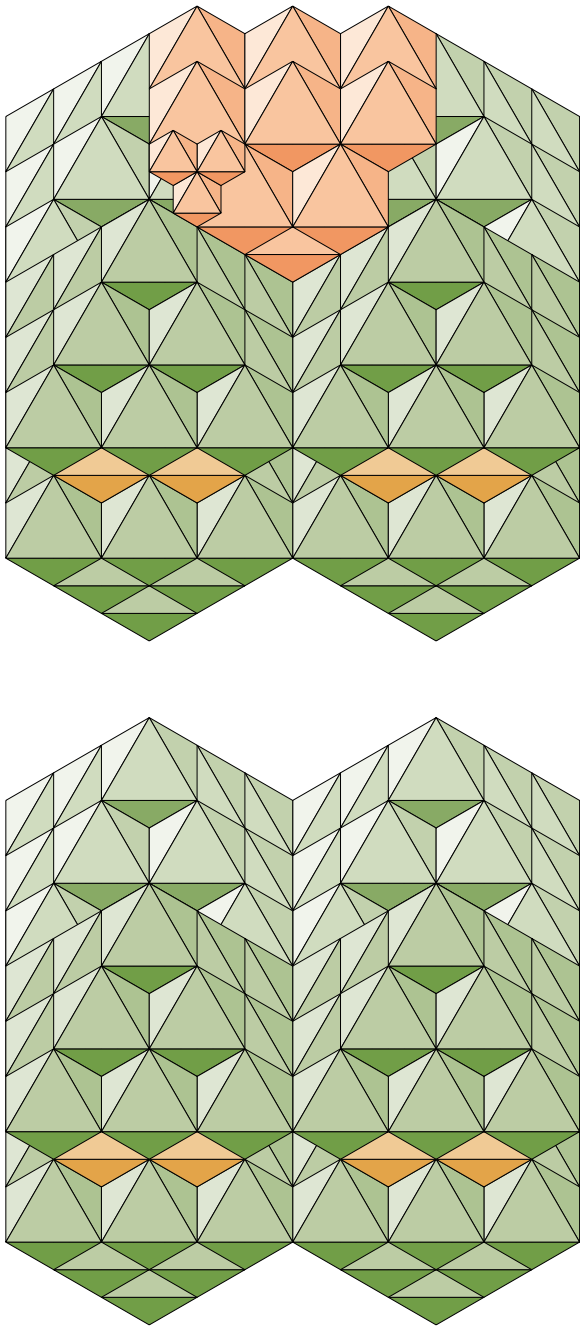

Fig. 6 Mn-atom joined to a 100-face of a ZnSe-crystal–facial view

The figure shows a Mn-atom joined to one of the two100-faces of the ZnSe-crystal that is perpendicular to the 16-axis of the ZnSe-group.

At bottom, four ZnSe-groups define the two 100-faces of the ZnSe-crystal that are perpendicular to the 16-axis of the ZnSe-group.

At top, a Mn-atom is joined to each of the four ZnSe-groups of the 100-face of the ZnSe-crystal.

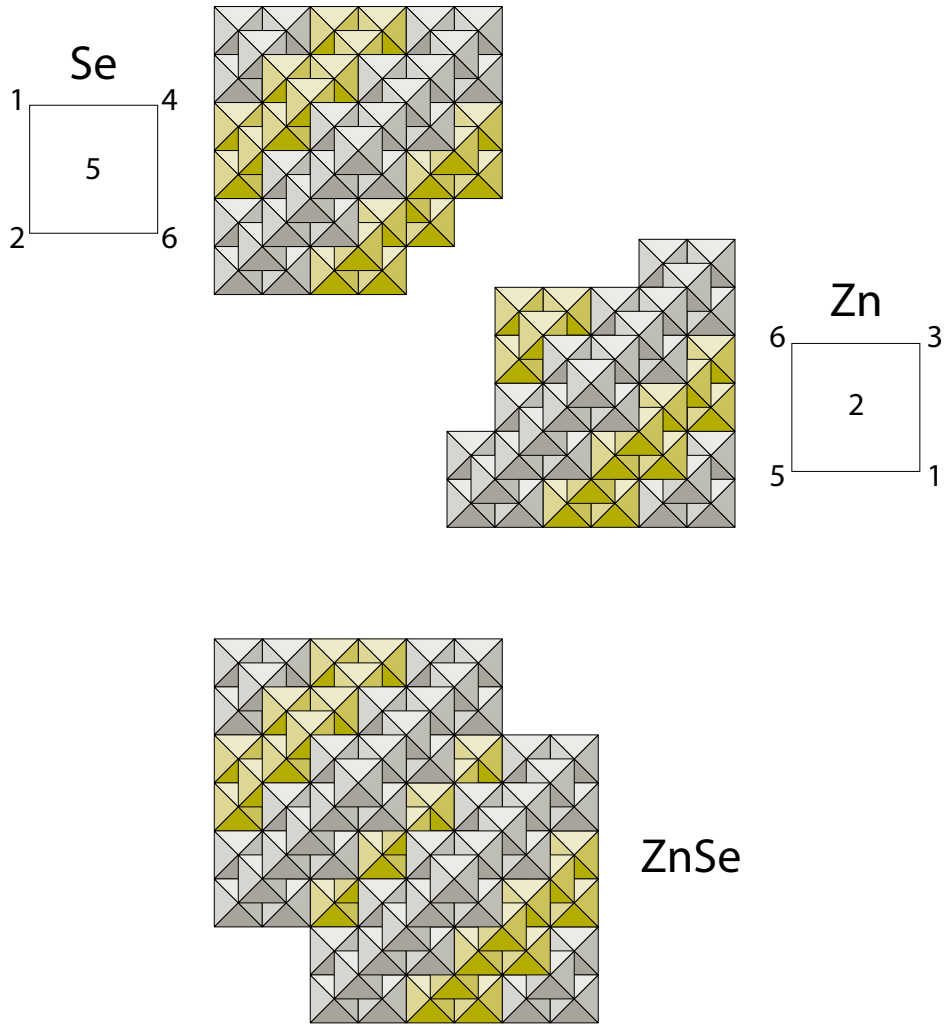

Fig. 7 Joining of Zn-atom with Se-atom to produce ZnSe-group–viewed normal to 16-axis

The figure shows the formation of a ZnSe-group in a vertexial view that is normal to the 16-axes of both the Zn-atom and the Se atom. The ZnSe-group is symmetrical about the collinear 16-axes of its atoms.

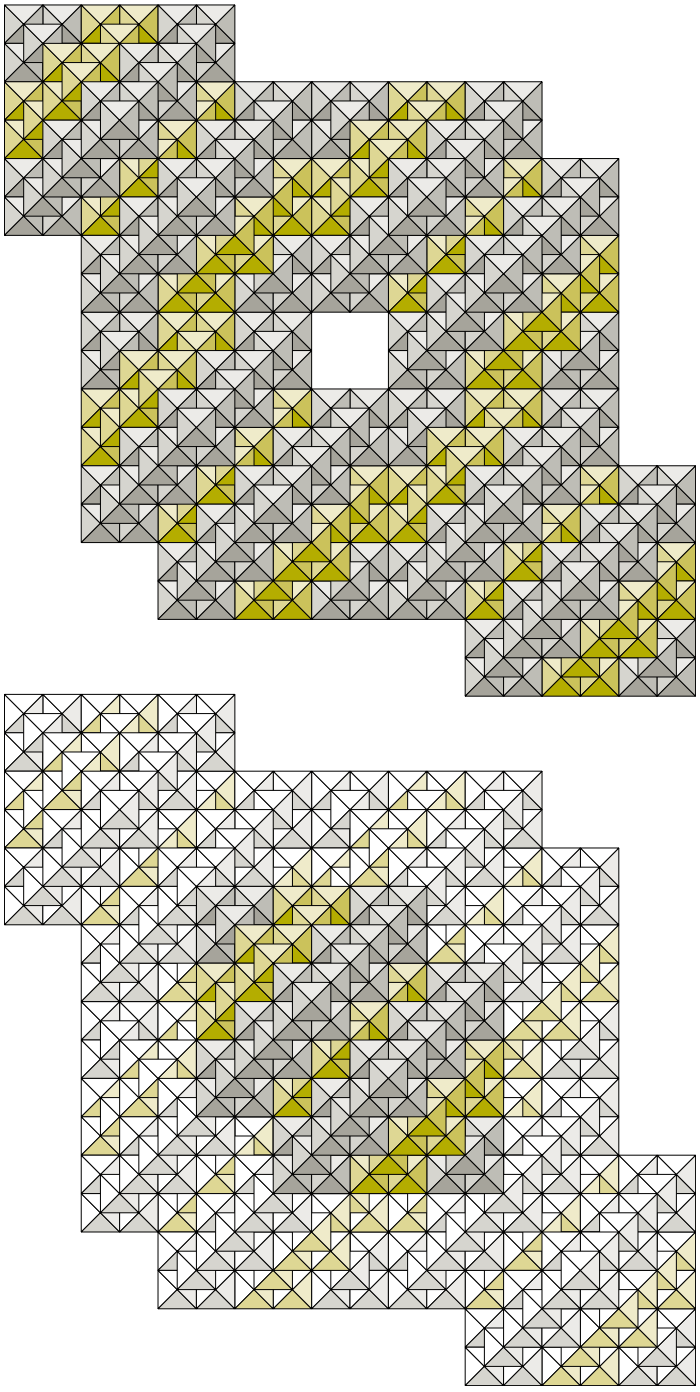

Fig. 8 ZnSe-crystal–100-planes parallel to the 16-axes of its ZnSe-groups

The figure shows one of the four 100-planes of the ZnSe-crystal that are parallel to the 16-axes of the ZnSe-groups which compose it. At top, four ZnSe-groups viewed normally to their 16-axes represent a 100-plane. At bottom, a fifth ZnSe-group joins to each of the groups which define the 100-face.

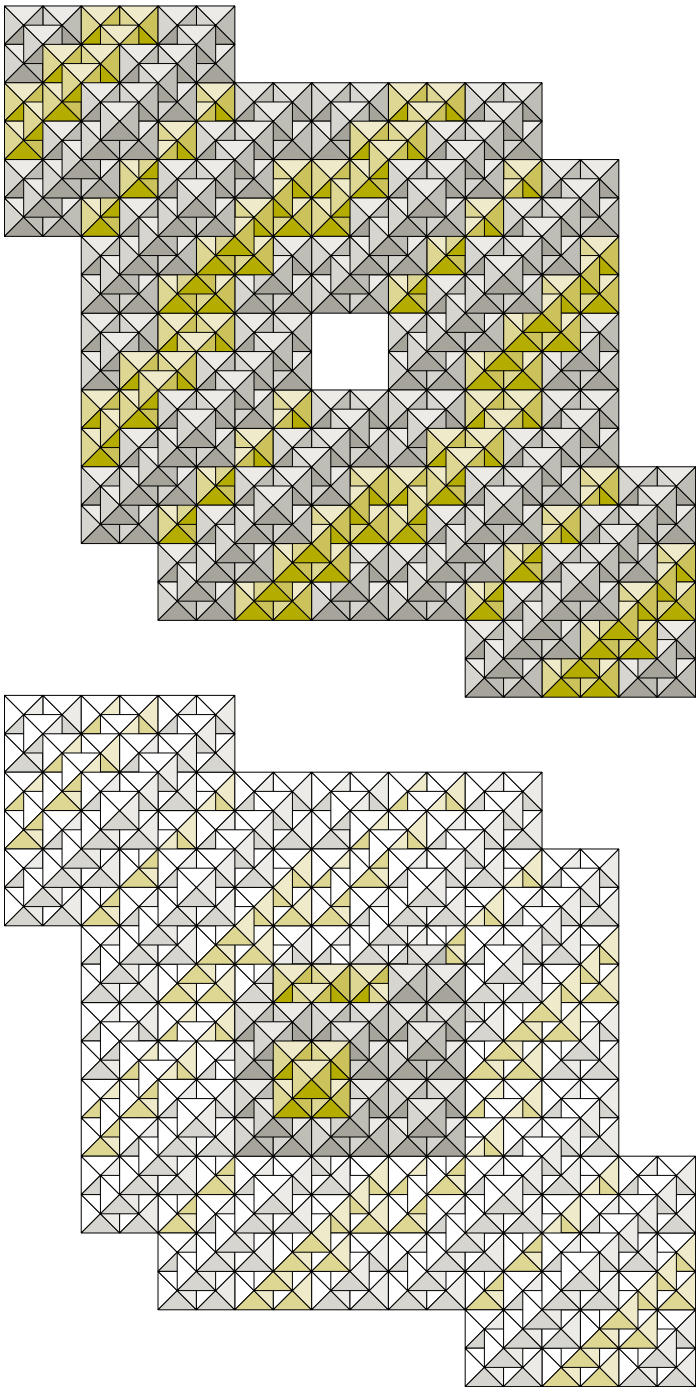

Fig. 9 Mn-atom joined to 100-face of ZnSe-crystal that is parallel to the 16-axes of the ZnSe-groups

The figure shows how a Mn-atom can join with the ZnSe-groups of a100-face of a ZnSe-crystal that is parallel to the 16-axes of the ZnSe-groups. At top, four ZnSe-groups of a 100-face are shown. At bottom, a Mn-atom is joined to the ZnSe-groups of the 100-face.

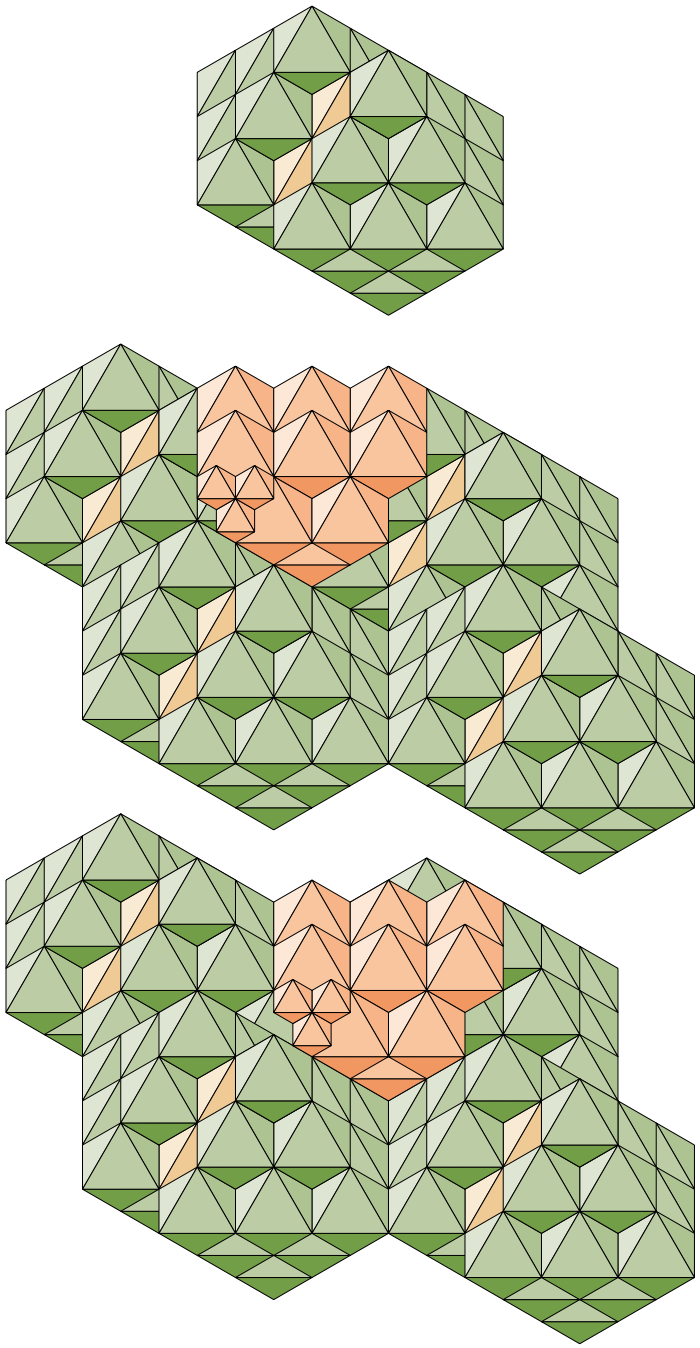

Fig. 10 Facial view of a Mn-atom joined to a 100-face of a ZnSe-crystal that is parallel to the 16-axes of the ZnSe-groups–two positions

The figure shows two ways in which a Mn-atom can join to a 100-face of a ZnSe-crystal that is parallel to the 16-axes of the ZnSe-groups.

At top, a ZnSe-group is shown separately.

In the middle, a Mn-atom is joined to four ZnSe-groups which define a 100-face that is parallel to their 16-axes.

At bottom, the Mn-atom occupies another position in the same 100-face of a ZnSe-crystal.

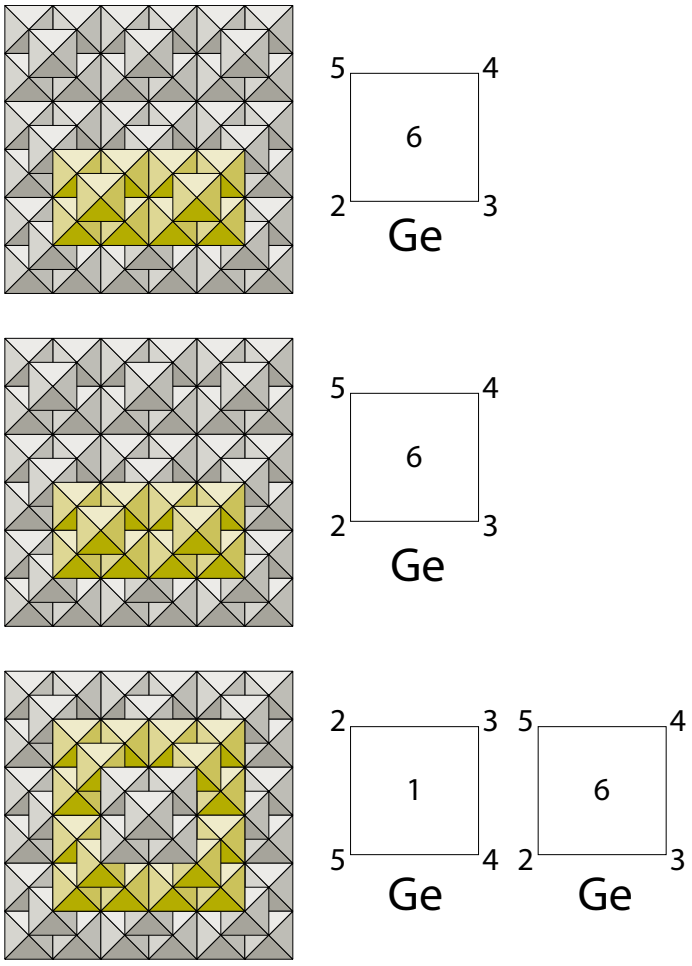

Fig. 11 GeGe-group is a ZnSe-group homomorph

The figure shows how two Ge-atoms can form a group which is a homomorph of the ZnSe-group. GeGe-groups could join to form crystals like those formed by ZnSe-groups. Mn-atoms could join to the GeGe-crystals in the same ways that have been described herein for the ZnSe-crystals.

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