

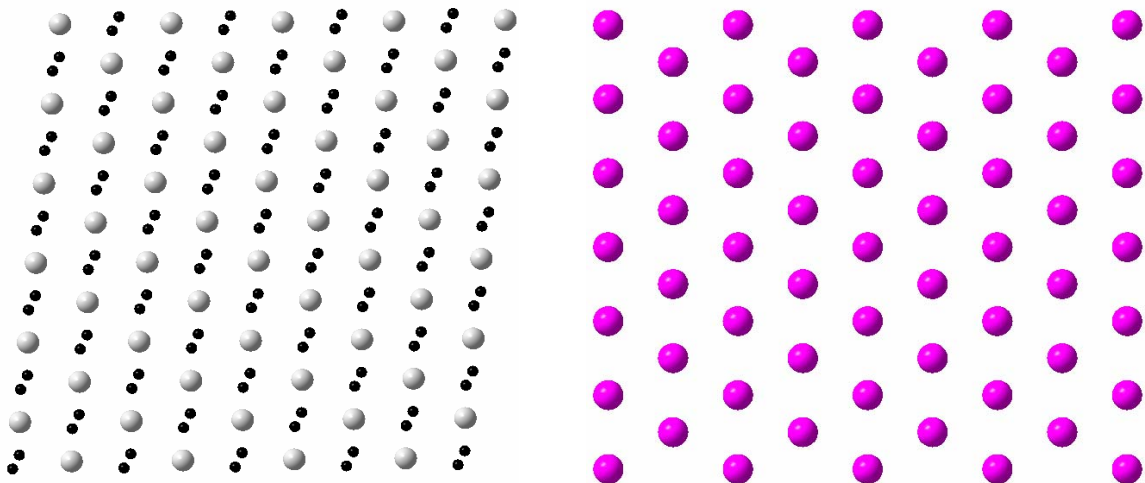
Exercices – part I “Solid State Chemistry”-

1) General aspects of the solid state.

- a) Explain the different degrees of structural order in solids
- b) How is the radius of an ion determined following the procedure of Pauling ?
- c) What is the main feature of structures with occupancy factors smaller than 1.0?
- d) Characterize the terms lattice motif and structure

2) Concept of unit cell and structures

- a) Sketch the primitive unit cell of the following 2D structures



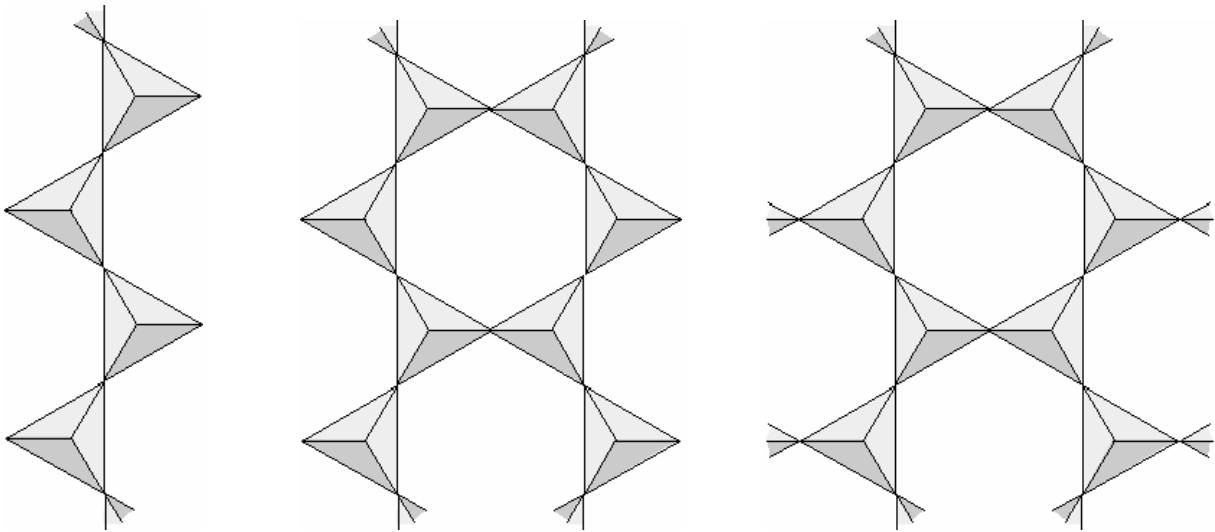
- b) Explain the term crystal system
- c) Numerate restrictions concerning unit cell axes and angles of the crystal systems

3) Atomic coordinates, counting of atoms

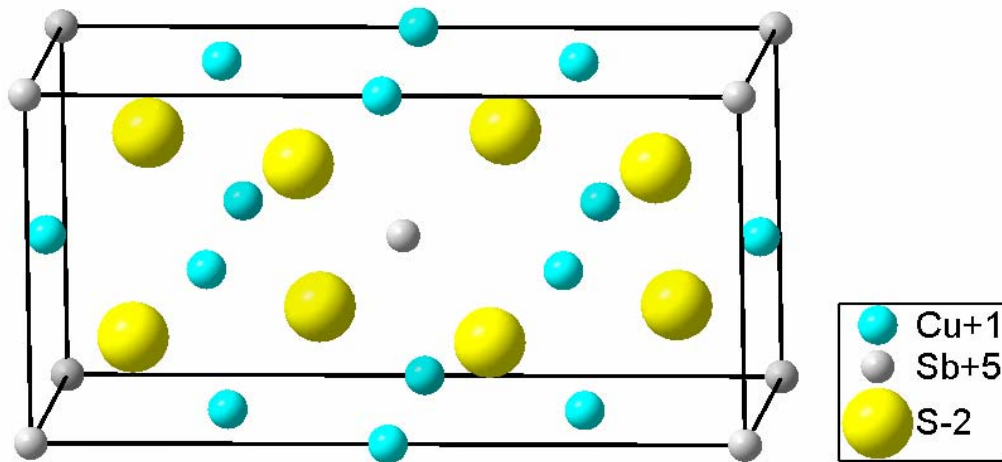
- a) The atoms (A, B and C) of a cubic structure are located on : $0\frac{1}{2}0$ (A), $\frac{1}{2}\frac{1}{2}0$ (B) and 000 (C). Sketch the unit cell
- b) Determine the composition of a crystal with this structure

4) Composition of crystals

- a) Determine the composition of the following fragments (Si-O-partial structure of silicates)

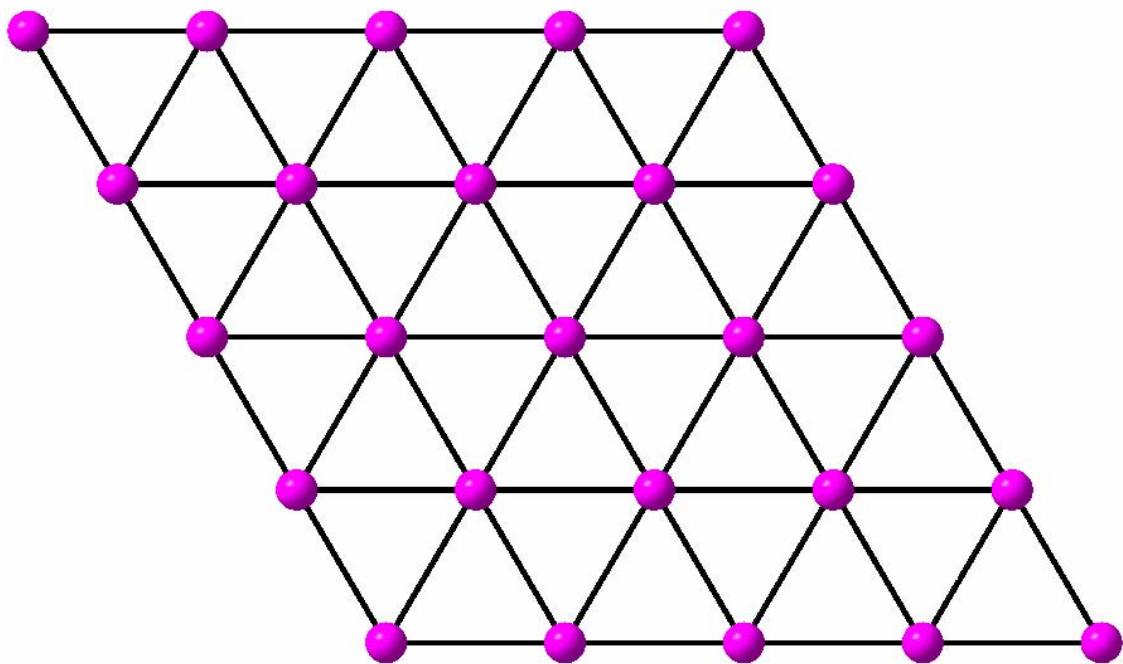


- b) Determine the composition of the following superstructure of the Sphalerite type



5) Structure of metals, close packing in structures

- a) The following image (see next page) represents a top view of a close packed layer of atoms. Mark and specify the positions of the atoms in the neighbored and next nearest neighbored layer for a CCP and HCP arrangement



- b) Give one example for a metal crystallizing in CCP, HCP, BCC and in an own structure type, respectively
- c) How many close packed structures exist? Give reasons

6) Holes in close packed structures, concept of polyhedra

- a) Sketch the positions of OH and TH in a FCC arrangement
- b) Give one example for a cubic structure with OH and TH completely filled
- c) Is there any hexagonal analog to the structure described in b? Give reasons
- d) Characterize the term optimum radius ratio cf. Pauling rule no. 1

7) Basic structure types: Sphalerite

- a) The structure of Sphalerite and cubic diamond are related. Describe and sketch this relationship
- b) What are the most important properties of Sphalerite type structures?
- c) Give two examples for binary Sphalerite type structure (except ZnS)

8) More complex structures: Perovskite, Spinel, Zeolites

- a) Sketch the unit cell of a cubic Perovskite-type structure
- b) Enumerate applications of Perovskite type compounds
- c) Describe the structure of normal and inverse Spinel type structures.

- d) Give one example for naturally occurring normal and inverse Spinel type compounds, respectively
- e) Specify the general formula of Zeolites. Explain the fundamental structural properties of Zeolites

9) Intermetallics

- a) Describe the structure of solid solutions. Numerate the prerequisites for the formation of a solid solution
- b) Sketch the unit cell of CuZn, CuAu

10) Synthesis

- a) Numerate the general goals of solid state synthesis
- b) Explain the essential aspects of the “shacke and backe” procedure
- c) Why could the use of nanoparticles as educts be important for solid state synthesis?
- d) What kind of problems could occur during HT-synthesis