

INVESTIGATION 2

Notes for the Instructor

PURPOSE

To introduce students to the zinc blende structure by comparing it to the structure of diamond. To provide students with the background information necessary to make the discussion of solid solutions with AZ stoichiometry and tunable band gaps meaningful.

METHOD

The students are provided with models or are asked to construct models of diamond and zinc blende (face-centered cubic orientation) using the ICE Solid State Model Kit.

ANSWERS TO THE FOLLOW-UP QUESTIONS

1. Each carbon atom has four nearest neighbors. Each Zn atom has four nearest neighbors. Each S atom has four nearest Zn neighbors.
2. The shape defined by the nearest neighbors to each C atom is tetrahedral. The shape defined by the nearest S neighbors to each Zn atom is tetrahedral. The shape defined by the nearest Zn neighbors to each S atom is tetrahedral.
3. For the diamond unit cell:
 $8 \text{ corner atoms} \times 1/8 = 1$
 $6 \text{ face atoms} \times 1/2 = 3$
 $4 \text{ interior atoms} \times 1 = 4$
 $= 8 \text{ atoms total}$
For the ZnS unit cell:
 $8 \text{ Zn corner atoms} \times 1/8 = 1$
 $6 \text{ Zn face atoms} \times 1/2 = 3$
 $= 4 \text{ Zn atoms}$
 $4 \text{ S interior atoms} \times 1 = 4$
 $= 4 \text{ S atoms}$
4. The atoms in both structures occupy tetrahedral sites. In the diamond crystal structure all the atoms are C. In the zinc blende structure each Zn atom is tetrahedrally surrounded by 4 S atoms, and each S atom is similarly surrounded by 4 Zn atoms.
5. The zinc blende structure has AZ stoichiometry because the ratio of Zn to S atoms is 1:1.
6. See diagrams on pages 23 and 51 of the manual that accompanies the ICE Solid State Model Kit.