

Exercise 5: Crystal models

Objective: To visualize different packings of atoms in solids by building crystal models (the ICE kits) and to characterize some quantitative aspects of them.

1. Consider a substance made of identical size spheres of radius r . Calculate the percent efficiency of packing these spheres into unit cells that are:

a. Simple cubic

b. Body-centered cubic (bcc)

c. Face-centered cubic (fcc)

d. Identify which type of packing above is related to hcp and which to ccp.

2. Build the following models (the page numbers refer to the ICE Model Handbook) and fill in the table:

Model	Which color ball represents which element?	Number of atoms per unit cell (list each element)	Which crystal system?	What coordination number?
CsCl (p. 11)				
Diamond (p. 23)				
Cu₃Au (p. 30)				
BF₃ (p. 19)				

3. Did the **empirical formula** given for each substance correspond to the number of atoms of each element in a unit cell? List any discrepancies.

4. a. Examine the ICE model of the superconductor. Recall how to count atoms in a unit cell (for instance, an atom on the corner of the unit cell counts as 1/8 of an atom). What is the chemical formula of the superconductor? Green = Y, yellow = Ba, blue = Cu, O = colorless.

b. On a separate sheet, draw the z-diagrams for the model. Also include a key so you can tell the atoms apart. There should be a total of 7 diagrams, including $z = 0$ and $z = 1$.