

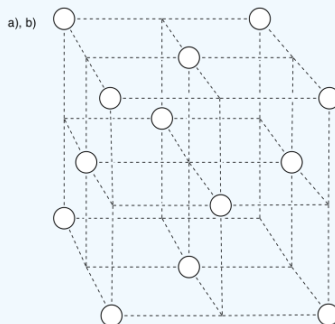
2.4: Application Problems with Metals

? Exercise 2.4.1

Maraging steel is an alloy, Fe_3Ni , that forms a face-centered cubic unit cell. It is used for high-strength applications such as in the forging of fencing swords (épées).

- Draw a cube.
- Add circles to denote atoms in a face-centered cubic array.
- Calculate the number of atoms in the unit cell (always show work).
- Shade in selected atoms in the unit cell to give a 3:1 ratio of iron:nickel in the unit cell.
- Add a legend with shaded and non-shaded circles so that it is clear which circle represents which atom.
- Face centered cubic can also be thought of as forming hexagonal layers. The layers alternate to give which pattern? ABABAB or ABCABCABC
- In the cubic diagram you made, put a letter beside each atom to indicate which of those layers (A or B or C) it is found in.
- Why does the addition of nickel to the steel make the material more difficult to bend or break?

Answer a), b)

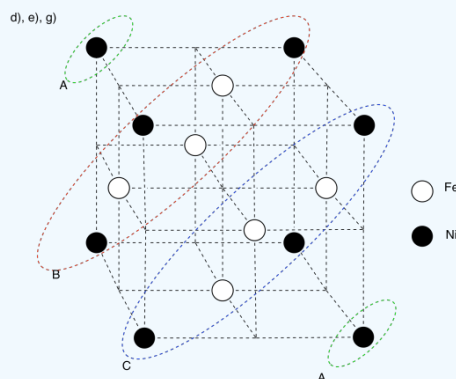


Answer c)

There are eight atoms in the corner; each is shared by eight neighbouring cubes. There are six atoms on the faces; each is shared by two neighbouring cubes.

$$\# \text{ atoms} = 8\left(\frac{1}{8}\right) + 6\left(\frac{1}{2}\right) = 1 + 3 = 4 \text{ atoms}$$

Answer d), e), g)



Answer h)

Nickel is a little smaller than iron. A row of atoms rolling along in the layer above would fall into the "pothole" caused by the smaller nickel atom and get stuck.

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