

1. Lithium can exist in either body-centered cubic (*bcc*) or face-centered cubic (*fcc*) packing. Do you expect the density of *fcc* lithium to be greater, the same, or less than *bcc* lithium?

Explain your answer.

Greater, because an *fcc* lattice contains 4 atoms per unit cells, whereas a *bcc* lattice contains only 2 atoms per unit cell. Therefore, *fcc* packs more atoms of Li per unit cell than *bcc* Li.

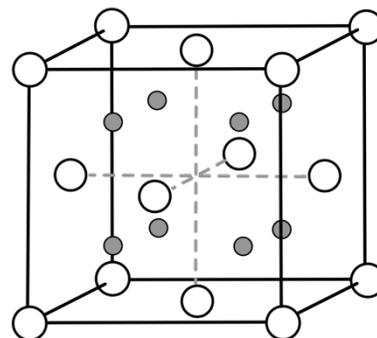
2. Drawn below is the lattice structure for a lithium oxide compound, where the open circles are oxide anions and the gray-filled circles are the lithium cations.

- (a) Based on the lattice drawn, determine the chemical formula of the lithium oxide compound by counting the number of Li and O ions in the unit cell.

of Li ions = 8

of O ions = 4

Formula = Li₂O



- (b) What is the occupancy of the holes in the oxide lattice?
Circle one answer.

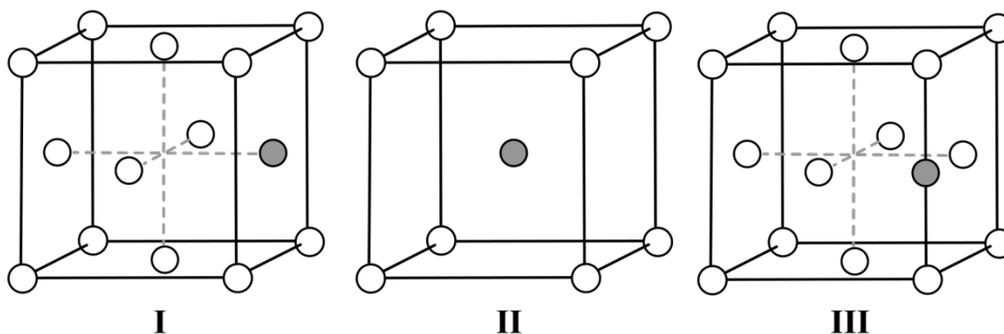
Half of the tetrahedral holes

Half of the octahedral holes

All of the tetrahedral holes

All of the octahedral holes

3. Consider the following unit cells of iron-carbon alloys. The white circles represent iron atoms and the gray circles represent carbon atoms.



- (a) Which of the unit cell(s) is an interstitial alloy of *fcc* iron?

III carbon atom occupies an octahedral hole

- (b) Which unit cell(s) could be substitutional alloys?

I carbon substitutes face-centered Fe atom

II carbon substitutes a body-centered Fe atom if assuming Fe is *bcc*

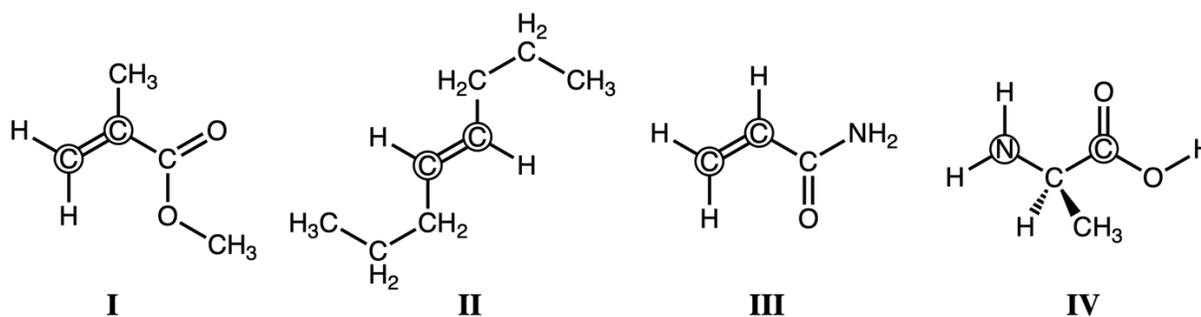
- (c) Determine the Fe:C ratio in each unit cell?

I Fe:C = 7/2:1/2 or 7:1

II Fe:C = 1:1

III Fe:C = 4:1/4 or 16:1

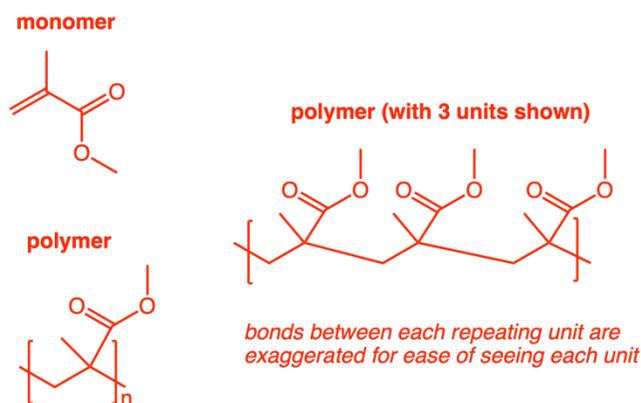
4. Consider the following monomers. The **circled atoms** represent where the monomers would link together to form their respective polymers.



- (a) Draw the line structure for monomer **I**.

Draw the addition polymer **I** (arising from monomer **I**) showing 3 repeating units.

Draw the addition polymer **I**, but with just the repeating unit and square brackets [].



- (b) Which monomer(s) would form a polymer with an sp^2 -hybridized carbon?

I III IV

- (c) Which polymer(s) could engage in hydrogen bonding with itself?

III IV

- (d) Assuming the monomers form straight-chain polymers, which monomer would you expect to produce the least dense polymer?

II

- (e) Which monomer(s) would produce a polymer that is least soluble in water?

II

- (f) Which monomer(s) would produce a polymer via condensation?

IV