Metals

1. Theories for bonding in metals

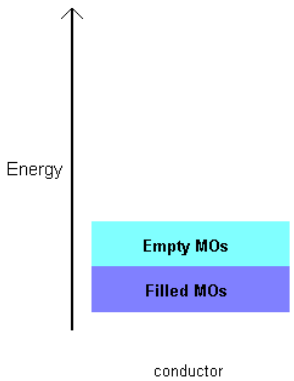
   a. Electron Sea Model – cations regularly arranged e^- move freely around. This theory explains metals ability to conduct because the electrons are described as free moving charged particles – the basic requirement for to conduct.

   b. Band Model – uses molecular orbitals to explain properties.
   In this theory we are looking at the distance separating filled molecular orbitals and the unoccupied molecular orbitals to explain the conducting/insulating properties of various solids.

2. Using Band Theory, explain the difference between conductors, semi-conductors and insulators.

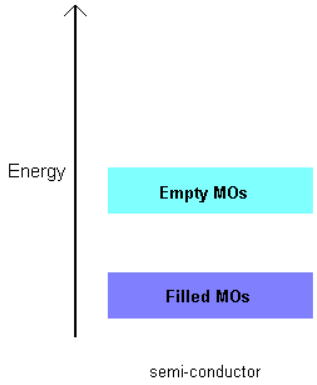
   In this model:

   A substance is described as a conductor when the filled MOs and unfilled MOs are in close proximity to one another. Because there is a very small energy difference, electrons are able to jump into the next unoccupied MO with relative ease. Thus the electrons are "free moving" charged particles.

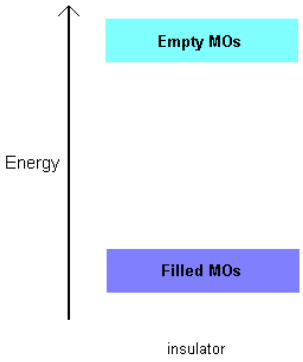


Semiconductors are substances who filled MOs and empty MOs have a greater separation than conductors but are close enough in proximity that electrons are still able to shift to the empty MOs. Because there is

a greater separation it would take more energy (and thus be "harder") to get the shift to occur, but it is still viable.



Insulators are substances whose filled MOs and empty MOs have a significant difference in energy, and whose electrons, therefore, cannot move very freely between the two molecular orbitals



3. What are p-type and n-type semiconductors?

P-type and N-type semiconductors are said to be "doped". Meaning that they have has some impurity added to them to enhance their conducting abilities. Remember that the ability to conduct hinges on the movement of electrons.

Silicon (Si) is a commonly used semi-conductor. If a silicon sample is taken and some of the silicon atoms are replaced with gallium a p-type semi-conductor would be created.

The “p” stands for positive. It has this namesake because while Si has 4 valence electrons, Ga only has 3 – thus there is one less electron leaving the sample “positive” by comparison.

The reason that this enhances the conducting abilities is that with less electrons in the filled MOs there are “open” spaces created for remaining electrons to move into leading to a greater movement of charged particles (electrons) which leads to better conducting abilities.

If, instead, a silicon sample is taken and some of the silicon atoms are replaced with arsenic, an n-type semi-conductor would be created.

The “n” stands for negative. It has this naming because Arsenic has one additional valence electron compared to Si – thus there is one more electron making this sample more “negative” by comparison.

The reason this enhances the conducting abilities is that with more electrons present, there are more charged particles to transition over the band separating the filled MOs and the unfilled MOs. More moving charged particles mean more conductive ability.