9 - Metallic bonding

Conductive Bonds: Unveiling Metallic Mysteries

Video 9 - Transcript

Hello everyone, welcome to video number 9. Today we are going to be looking at metallic bonding. Metallic bonding occurs between metals. If you recall, metals - groups 1, 2 & 3 of the periodic table. What happens is that we have the valence electrons of the metals. Remember these are the electrons in the outermost shells. And groups 1, 2 & 3 we have 1, 2 & 3 valence electrons respectively. What happens is the metallic atoms, they eject these valence electrons. What is left are my cations. The positively charged cations are being held together by what we call a "sea" of delocalized electrons. We have here my mutual attraction between the lattice of the cations and the conduction electrons, which keeps the entire structure together. Metallic bonding accounts for many physical properties of metals such as - listed here. Strength, malleability, that's the ability to bend, ductility, that's the ability to stretch without breaking easily. Thermal and electrical conductivity - again, due to my delocalized sea of electrons - opacity and luster, the ability to shine. There are two main things that influence the strength of the metallic bond. The first one is what we call the charge density. The charge density is basically the charge to size ratio that is going to be existing in the cations. Then we have the density of the mobile cloud. The density of the mobile electron cloud. Metals are giant structures of atoms that are held together by metallic bonds. The outer valence electrons, as we said, are loosely held by my electrons, they separate from the nuclei and they move at random through the crystal lattice. The solid structure of metals may be called crystalline. They may be called crystalline because it consists of a regular lattice of particles. Most metals are close packed, meaning they fit as many atoms as possible in whatever volume is available. Now, just as we mentioned when we spoke about ionic bonding. Metallic bonding will not be observed within the biomolecules that make up living systems. Living systems are not made up of metals. They are made up of carbon based organic compounds. However, it is very important to note that many metal ions are vital for life. Fe^{2+} for example, iron, is very important in the formation of hemoglobin, which is the pigment in our red blood cells that is responsible for transporting oxygen around our body. We have other ions like Mg^{2+}, Ca^{2+} and Zn^{2+} and a host of other ions that are very important for the maintenance of the electrolyte balance in our bodies. As well as the functioning of enzymes, for example. Even though we're saying that metallic bonding on its own is not seen within living systems, we're still mentioning it because many metals, as well as combinations of different metals, which we know as alloys, are very important in the field of biomaterials. These special metal alloys are able to be used to create implants for use in the body. They're called biomaterials because they do not elicit an immune response. This allows, for example, healing and regaining of function of joints and

other tissues. If we think about stainless steel for example, stainless steel is an alloy which comprises of chromium, nickel, molybdenum, titanium, manganese, etc. Stainless steel plays a very important role in orthopedic and dental devices. That's all that we're going to talk about. With regards to metallic bonding, we should be able to understand how metals bond. We should recognize that certain metal ions are responsible for very important functions within living systems. We should remember that metallic bonding plays an important role in the field of biomaterials.