Polarity of Chemical Bonds

Skills to Develop

- Distinguish polarity from polarizability
- Define polarizability

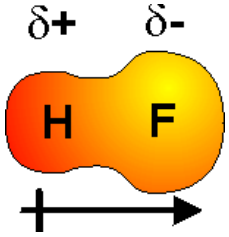
Polarity means separation, in this case of electrical charge. If a bonding pair of electrons are pulled more toward one atom and away from the other, this will cause the first atom to be partially negatively charged, and the second to be partially positively charged. This will create an electric dipole moment, such as the the dipole moment in water that makes water so good as a solvent.

Although covalent and ionic substances might seem really different, with Lewis theory we can think of them as being basically similar. At one extreme, we have a complete transfer of an electron, such as in CsF, making a positive and negative ion that are then attracted to each other. At the other extreme, we have a completely equally shared pair, such as in F_2. In between, we have bonds with unequal sharing. Either way, usually all atoms will have a **noble gas electron configuration**, either by sharing or by losing electrons.

Examples of noble gas electron configuration for various ions.

In addition to average polarity of a bond, we can have temporary polarity. The electrons move around, and sometimes it will happen that both of them move toward one atom. In general, the more electrons an atom has, the looser they are held. For example, iodine has 53 electrons, which is a lot! They can move around pretty easily. Even though I_2 has a non-polar bond on average, because the atoms are the same, it can easily become polar because the electrons are held loosely. In solution, I_2 can split a little bit into I^+ and I^-.

To keep these ideas separate, **polarity** means the permanent average separation of charge, and **polarizability** means the ability to become polarized temporarily. In a non-polar polarizable molecule like I_2, the average polarity is 0, but if we take many precise measurements of the instantaneous (very short time) polarity, many of them will be far from 0. In a polar, non-polarizable molecule like HF, all the instantaneous measurements will be very similar, but the average will not be 0. AgI is both polar and polarizable. Both of these have important effects on properties of materials, such as reactivity, solubility, and boiling point, that we will talk about later.



An illustration of the polarity of HF.

Outside Link

- CrashCourse Chemistry: Atomic Hook-ups (10 min)

Contributors and Attributions

- Emily V Eames (City College of San Francisco)