HOW TIGHTLY DO LIGANDS BIND

All Lewis acid-base complexes form reversibly. That means that, just as the Lewis base can donate its electrons to the acid, it can take them back again.

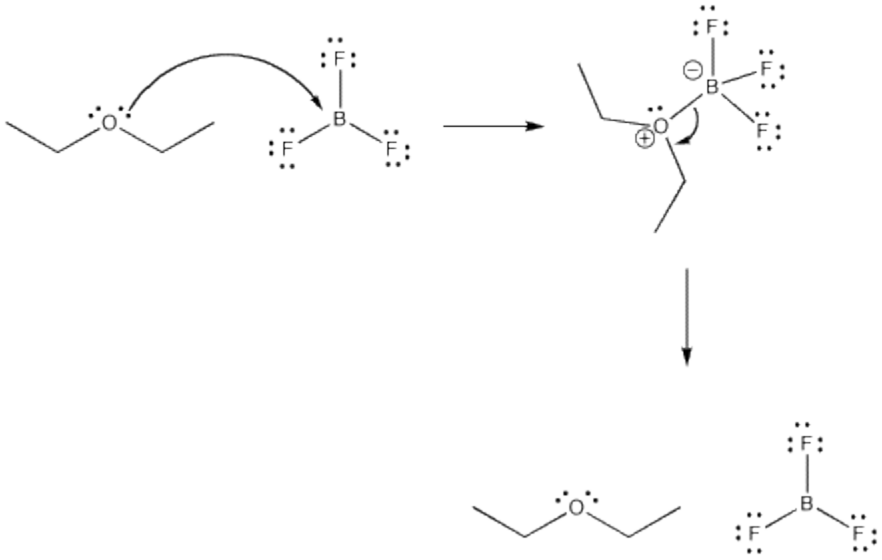
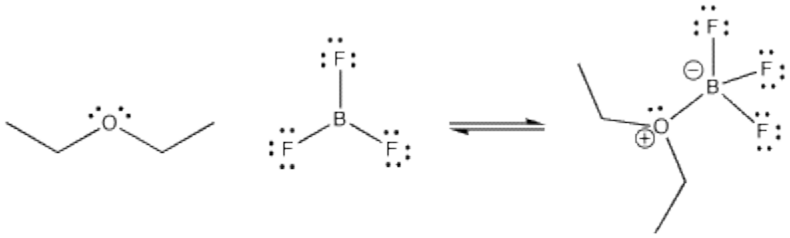


Figure CC2.1. Reversible binding in a Lewis acid-base complex.

Exactly how reversible are these bonds? How tightly is a ligand bound in a coordination complex? There are many factors that affect the answer to this question, including the nature of the metal, the ligand, the environment or solvent, the temperature, and so on. However, in general, the answer could be found in any specific case by looking at an equilibrium constant.



$$K_f = \frac{[BF_3OEt_2]}{[BF_3][Et_2O]}$$

Figure CC2.2. The equilibrium constant in a Lewis acid-base complex.

This equilibrium constant, which compares the ratio of complex to free Lewis acid and Lewis base, is sometimes called the formation constant or the binding

constant. It is a measure of how tightly the ligand is bound. The same thing expressed in reverse, K = $[BF_3][Et_2O] / [BF_3OEt_2]$, is called the dissociation constant. Of course, it really measures the same thing from the opposite point of view: how easily is the ligand given up? Numerically, it is just the inverse, 1 / K_f.

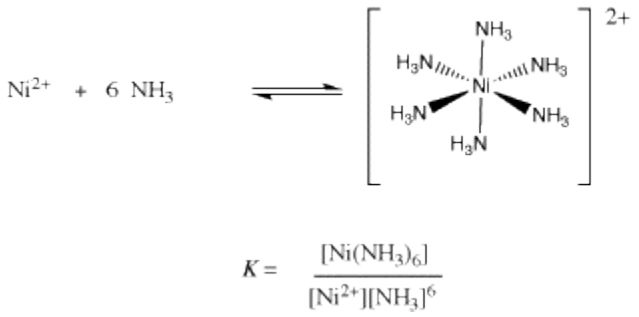


Figure CC2.3. Formation of a hexaammine nickel ion.

If there are many ligands bound to the ion, as in the formation of hexaammine nickel ion, then the formation constant becomes more complicated. It is really a combination of six different binding constant: the constant for the first ammonia with nickel ion, the constant for the second ammonia with the ammine nickel ion, and so on. When all of these individual constants are combined, we arrive at an ammonia concentration raised to the sixth power in the expression for the formation constant.

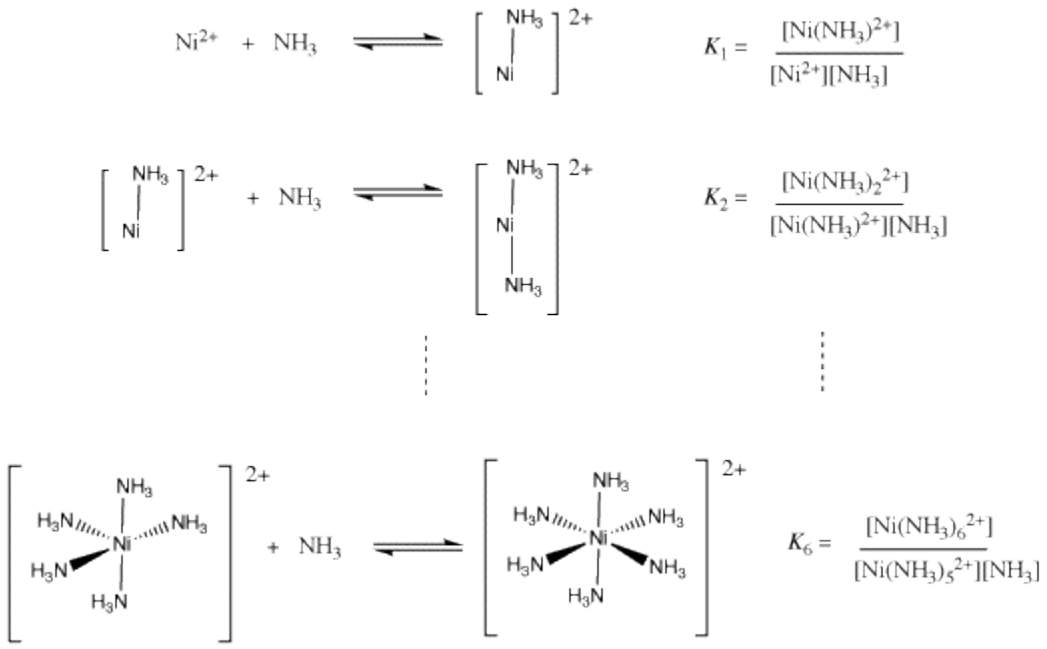


Figure CC2.4. Stepwise formation of a hexaammine nickel ion.

Source : http://employees.csbsju.edu/cschaller/Reactivity/coordchem/coordchem%20binding.htm