Coordinate covalent bond

A coordinate covalent bond, or **dative** bond, **donor-acceptor** is a covalent bond between an electron donor (ligand) and an acceptor. The donor must have at least one free electron pair and the acceptor at least one free orbital. The compound formed in this way is called **complex**.

Ligands

In general, these are compounds of elements with free eletron pairs, i.e. from the 15th, 16th and 17th group, or anions.

- Halogens — (F_2) fluoro, (Cl_2) chloro, (Br_2) bromo, (I_2) iodo.
- Anions — (SO_4^{2-}) sulfate, (ONO^-) nitrate, (NO_2^-) nitro, (NO_3^-) nitrie, (CN^-) cyano, (OCN^-) cyanato, (SCN^-) thiocyanato.
- Neutral ligands — (H_2O) aqua, (NH_3) amine.

Acceptors

In general, these are metals with free **d** and **f** orbitals, especially if the orbital release is achieved by the formation of a cation, which can stabilize the bond to a negatively charged ligand, e.g. Cr^{3+}, Cu^{2+}, Fe^{2+}, Fe^{3+}, Co^{3+}, Ni^{2+}, but also from p-elements, e.g. B^{3+} a Al^{3+} used in organic syntheses as reducing agents ($[AlH_4]^-$, $[BH_4]^-$).

Isomerism of complex compounds

Isomerism of complex compounds can be divided into several groups: geometric, ionic, optical.

Stability of complex compounds

Most of the central atoms forming complex compounds in aqueous solution form aqua complexes, e.g. blue rock, where $CuSO_4$. 5 H_2O is only inconsistently written $[Cu(H_2O)_4]SO_4$. H_2O and upon the addition of a ligand that is more stable in the complex compound (most negatively charged or spatially stabilized ligands), the complex bound water is gradually replaced, and therefore the so-called **consecutive stability constant** is defined:

$$K_k = \frac{[A(H_2O)_{n-k}L_k]}{[A(H_2O)_{n-k+1}L_{k-1}]\cdot[L]},$$

kde A is the central atom, L is the ligand, n the coordination number of the central atom and k the number determining the consecutive constant (the number of bound ligands other than H_2O) and the **total stability constant of the complex**:

$$\beta_n = K_1 \cdot K_2 \cdot K_3 \cdots K_n = \prod_{k=1}^{n} K_k .$$

In general, the stability of the complex is influenced by the properties of the central atom (increases with increasing of the charge and decreasing of the size), the properties of the ligand (number of binding sites, internal stress, ...) and their combination (some central atoms prefer specific ligands).

Color of complex compounds

The color of complex compounds is explained by the ligand field theory, which considers the energetic splitting of **d** orbitals in the electric field of ligands. The resulting energy differences between the originally degenerate **d** orbitals thus enable electron jumps and the absorption of light with a wavelength similar to visible light.

Links

Related Articles

- Types of bonds between atoms

References

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