

Fascinating Coordination Complexes and Their Applications

Coordination chemistry investigates the characteristics of coordination compounds formed by the interaction between metal atoms or ions and inorganic, organic ions or molecules, as well as their bonding, structure, reaction, classification, and preparation. These compounds possess a wealth of structural, physicochemical, and catalytic properties. Meanwhile, [coordination compounds](#) have long been concerned and researched for their applications in catalysis, supramolecular chemistry, magnetism, electrochemistry, nanoscience, energy materials, and biological applications. Here, we provide a brief overview of several common classes of complexes and their interesting applications.

Schiff Base Complexes and Their Applications

The Schiff base is a very important ligand. Its synthesis is relatively easy and can flexibly react with a wide range of amines, aldehydes, or ketones with its carbonyl groups. By altering the bonding moieties and the nature or position of donor groups, Schiff base ligands with different properties and variable structures can be developed, ranging from chains to rings and from monodentate to polydentate. In addition, Schiff base ligands can form complexes of varying stabilities with most metal ions., i.e., [oxygen-donor ligands](#), [nitrogen-donor ligands](#), [sulfur-donor ligands](#), etc. Therefore, they are essential for the development of coordination chemistry. Some applications of Schiff base complexes include:

- (1) Molecular design of drugs based on biological activity;
- (2) Synthetic chemistry for catalysts, stabilizers, etc.;
- (3) Chelating agents and polymer modification based on different functional groups and stereo configurations.

Metal-Organic Complexes and Their Applications

Metal-Organic compounds, which contain at least one metal-carbon bond, are of great importance in industrial and fine organic synthesis, catalysts, the development of new functional materials, and life sciences. Among them, [transition metal complexes](#) and [rare earth element complexes](#) have been the main focus of organometallic chemistry research. For instance, metal cyclopentadienyl compounds (metallocenes) are particularly noteworthy due to

their high stability and strong reactivity, and related applications include catalytic asymmetric synthesis, catalytic polymerization, and more.

Development of Functional Complexes

With the development and integration of advanced technology into material science, biological science, and solid physics, research on a series of functional complexes based on certain physical properties, such as optical, electrical, thermal, magnetic, and more, is developing rapidly, such as:

(1) Conductive complexes with potential in information processing and memory.

(2) The wide range of metals, ligands, and geometries available in coordination complexes make them highly useful in the biomedical field. [Biomedical complexes](#) have been developed for drug delivery, disease treatment, magnetic resonance contrast agents, *etc.*

(3) In terms of sensing applications, luminescent coordination complexes, especially transition metal complexes (e.g., [Ru](#), [Os](#), [Re](#), [Rh](#), [Ir complexes](#)), have attracted much attention due to their excellent performances. Typical sensing applications utilizing coordination complexes include pH sensing, ion sensing, photo-oxygen sensing, DNA-based sensing, *etc.*