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RECENT ADVANCES, TECHNIQUES AND APPLICATIONS OF COORDINATION COMPOUNDS

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Abstract

*The term **coordination chemistry** is interpreted broadly, and includes aspects of organometallic, supramolecular, theoretical, and bioinorganic **chemistry**. Coordination chemistry is a branch of chemistry, and its research results are widely used in industry and people's life.*

***Coordination compounds** are molecules that pose one or multiple metal centers that are bound to ligands (atoms, ions, or molecules that donate electrons to the metal). These complexes can be neutral or charged. When the complex is charged, it is stabilized by neighboring counter-ions.*

Various edge disciplines emerge during its development, which propels the methods of disciplines and technology. This article briefly discusses new progress of coordination chemistry and its application in chemistry and industry in recent years.

***Keywords:** Coordination chemistry, Advances, Techniques, Applications, Industry*

Introduction

The coordination chemistry refers to an interdisciplinary field, which develops based on the inorganic chemistry, the combination of coordination chemistry, organic chemistry and structural chemistry which is viewed as the opening of inorganic chemical revival. The establishment of coordination chemistry breaks boundaries in organic chemistry, inorganic chemistry and physical chemistry, and it becomes a joint point of different chemical branches. Coordination chemistry, because of different property, makes a certain achievement in scientific research and practical applications. It is one discipline which is the most active and boasts of more growth points.

Coordination Chemistry and Its Theories and Characteristics

The coordination chemistry refers to a discipline whose research objects are metal atoms, ions, inorganic and organic ions or coordination compounds characteristics obtained by the reaction in molecules and their bonding, structure, reaction, classification and preparation. In

coordination compounds, the central atom combines with ligand through coordination bonds. Theories explaining coordination bounds are valence-bond theory, crystal-field theory and molecular orbital theory.

The characteristics of coordination chemistry are going into the micro level from the macro level. However what research focuses on **isn't** only the macroscopic property of coordination compounds but also its microscopic property. It emphasizes the study on microstructure, **like the interior** structures of molecule and atom, the law of electronic operation, and their behaviors. The chemical structure theory system is established **supported** modern **attractive force** theory on this basis.

Coordination chemistry **is supplied** with experimental data and theoretical basis and it turns from qualitative description to quantitative direction. Modern coordination chemistry commonly adopts mathematical methods and theories including **pure mathematics**, vector analysis, **algebra**, topology and mathematical physics. It also adopts many computers in calculation. It conducts **calculation** to amount of physical and chemical properties of reaction structure information. It combines **processing** with highly accurate and sensitive quantitative tests **so as** reach **a brand new** level of **compound** research [1]. The results shall be more accurate and differentiation occurs when it tends to integration at **the identical** time. On the one hand, modern coordination chemistry accelerates differentiation and on the hand, it mutually penetrates and integrates with different disciplines, bringing **a few** lot of emerging edge disciplines.

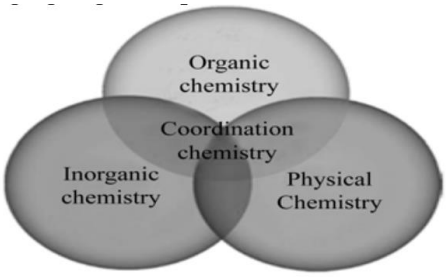

Figure : Status of Coordination Chemistry

Analysis of Research Fields and Application of recent Coordination Chemistry

Modern coordination chemistry includes seven research fields, **like** supramolecular chemistry, transition metal organic complex, complex catalysis, nanometer materials, and bio-coordination chemistry. The supramolecular chemistry, as a systems science, refers to supramolecule with **a selected** functional structure formed by chemical substances through function of component force. The function of force refers to the force between molecules, or it **is** described as a functional system of science formed by molecules through **bond**. Serving as an interdisciplinary, it covers the chemistry, physics and other fields and closely **associated with** development of macrocyclic chemistry. **It's** even **is** said **in an exceedingly** sense that supramolecular chemistry combines the four basic chemistries together. The goal for supramolecular chemical is **to check** the assembly and its process and **to create** supramolecular functional system through assembly **so as** to imitate nature and achieve innovation and development, and its function **will be** compared with natural systems. The assembly **is sometimes** achieved by organization and assembly by virtue of the template effect. The research significance to metal cluster complexes is shown in excellent catalytic performance, **and a few** of them boast of special magnetic or electrical properties. Some organic ligands boast of specific biological activity and are models for studying other substances. **Due to** particularity, **it's** significant to research the **bond** of metal atom compound.

The application of coordination chemistry; the coordination chemistry is applied earlier **and therefore the** application involves in many aspects in life, especially **the sphere** of heavy industry and natural sciences, **like** biochemistry, semiconductors, electroplating and analytical chemistry. **The appliance** in traditional aspects includes analytical chemistry, **like** indicators, medical, drugs, wet metallurgy, metal separation for purification and catalysis. In terms of human life activities, the complex is significantly important, and metals in living body are existed **within the style of** complexes. The trace elements which **are** proved beneficial to **material body** are oxygen, carbon, hydrogen, nitrogen, calcium, phosphorus, potassium, sulfur, sodium, chlorine and magnesium. Most of them are existed with **the shape** of complexes with a special physiological function. While in medical clinic, drugs commonly used will display their biological effects after combining the metal ions in **frame**. Some drugs are toxic in treatment **due to** their strong irritation. The nonabsorbent feature makes some drugs inapplicable directly in clinic, and such drugs must be transformed into coordination

compounds **so as to cut back** toxicity and irritation. The ligand **may additionally** be used as an antidote.

People **are** allergic when overdose metal elements are inhaled. Some properties of ligand **may be accustomed** expel metal ions in **physical structure** through replacing metal ions with ligands. The earliest antidote is dimercaprolum **which might** be used as antidote for mercury, arsenic and other metal poisoning. It can form a water-soluble complex after combining with metal ions, **that the** toxicity **may be** eliminated and it excretes out. The **lanthanon** complex luminescent materials are widely used **and may** be used for **visual defect** studies **furthermore** as fluorescence analysis of biological macromolecule. Coordination chemistry is widely **utilized in industry** and **is particularly** unique **within the** chemistry and **industry**. Most heavy metals in water exist **within the variety of** complexes **and also the** reason is that organic and inorganic ligands are contained in water.

People realize that **there's a detailed** relationship between transfer and transformation of heavy metals and ligand when studying a series of laws of pollutants in water including migration, reaction and influence. **the mixture** of complex with water replaces the water-insoluble metal complex with a soluble metal complex. The ligand in waste water **is in a position** to melt the metal **within the** sediment [2]. The complexes can alter the surface holding and adsorption behavior of the solid, which is because the competition of metal ions on the solid surface **and also the** adsorption of metals are inhibited, Or because **a fancy** becomes **replacement** adsorption **conversion** absorption. **The standard** of complex **is set** by what **reasonably** pollutants it combines with, so it **is often** used biologically.

Emergence and Development of Coordination Chemistry

The first record of complex is Prussian blue, which was discovered and used as a pigment as early as 18th century and its **statement** is K [Fe (CN) 6Fe]. Cobalt and other complexes were found in 19th century whose chemical formulas and coordination theories were proposed by Swiss scientists. The secondary valence concept was also introduced.

The year 1923 saw British chemists reveal the relationships between ligancy **and therefore the** number of electron atomic in center by using EAN. **So as to see** whether the complex is stable, one **has got to** consider the relationships between effective **number and also the** central atoms with gas atomic numbers in same cycle. This law **isn't** universal for **it's** just applicable in some complexes. After **over** ten years, the American chemists **advocate** the

valence bond theory; **therefore the** nature of complex is clearly understood. **The idea is definitely** accepted because **it's** specific in model and clear in concept, so **it's ready to** react to **the overall** appearance of complexes, and to roughly explain properties of complexes. However, there are still shortcomings for **this idea because it** only qualitatively interprets the properties of complexes **and also the** discussion **is just** about basic properties. Two scientists research CFT which, as a theory, discusses division of central orbital **within the** quasi-electrostatic field on **the premise** of electrostatic theory. **The speculation** sees great development in later days. One shortcoming for this theory is that the model **is simply too** simple **to clarify** the effect of cloud-expanding. In later days, scientists introduce molecular orbital theory into the study of complex **attractive force**. The coordination **theory** refers to combining crystal field and molecular orbital theory **so as to check** complexes. **The speculation** holds that the ligand in bonding and metal atom orbit should be treated equally and it preserves crystal field theoretical model, convenient for calculation. This theory is widely **utilized in** studying properties and structures complexes. The coordination chemistry witnesses vigorous development after the establishment of valence bond theory, molecular orbital theory and **scientific theory**.

Crystal engineering is **a very important** aspect in supramolecular chemistry research, and its concept was proposed **within the** 1960s. The 1980s saw progress in experimental technology, and scientists further studies functions among molecules. In 1980s, people gradually accepted **the very fact** that crystal exists as a supramolecule **supported** a series of research results, **and thus** it becomes the mainstream topic to research crystal in supramolecular chemistry. While crystal engineering has become **a crucial style of** supramolecular synthesis whose chemists discover supramolecular compounds by virtue **of various** methods, however, **it's dangerous** to effectively determine supramolecular architecture in solution. Molecular crystals **may be thought to be** assembly by countless molecules **in line with** periods. The structure **will be** determined by X-rays, and conclusions **will be** drawn by measuring **an oversized** number of crystals. The solid structure in **expanse may be** used as a model of solution system and coordination solid supramolecules serves **a vital** part in crystal engineering. **so as to raised** analyze the intermolecular interactions, one can simplify identified features through supramolecular synthesis. The crystal engineering acts principles and methods of supramolecular chemistry on crystal indirectly by virtue of functions of molecular accumulation and interaction. From the macroscopic point of view, the studies about crystal theory are profound gradually and are widely applied in molecular materials,

identification, and devices day by day. The crystal engineering has become **an artificial** strategy for the formation **of recent** materials **like** light and electro-ion exchange. Serving as a boundary science, **it's** involved in organic and **chemistry**, thermochemistry, crystallography and other traditional areas.

The study about development of coordination chemistry was nearly empty before the founding **of recent** China. After the founding of this country and with the recovery and development of **financial set-up**, some **research** units and individual units began studies on coordination chemistry.

In the mid-1960s and even earlier, what the coordination chemistry research focused on was property, structure and synthesis of complexes which were only simple complexes. The contents of the research work are concentrated in some high-yielding elements, mainly separation and purification in China.

The research work includes solution equilibrium theory, **the soundness** of mixed complexes **et al**.

The content of **research** work **is comparatively** simple and smaller in scope, and **there's** still **a niche** to catch up with international standard.

After the reform and opening up, guided by relevant policies of the state, coordination chemistry research has developed rapidly and tremendous achievement is made; the year 1978 saw Nanjing University **founded a hunt** institute, and chemical association founded magazine in 1985, **and therefore the** international conferences were opened in 1987 in support of relevant departments. A series of events and achievements have shown that China's coordination chemistry is developing rapidly and walking towards **the planet**. **Within the** later development, important progress has been made in some aspects, **like** new complexes, thermodynamic and kinetic studies, solution ion extraction and isotropic catalysis.

Achievement and development process made in China's coordination chemistry research reflect characteristics in **some ways**. In terms of research objects, they combine life and materials science together, **and fasten** great importance **thereto** and molecular design gradually.

For instance the problem of metal ions bonding, partial boning is eliminated in vitamin B12 and the rest mostly combines with each other in the form of coordination bond. The composition of functional system is more complicated and it is necessary to place the correct species in corresponding positions in order to play its original functions. People attach great

importance to supermolecule research such as synthesis and assembly. Although progress is made in coordination chemistry in China, we have to clearly realize that such study in a certain areas is still insufficient, and further effort should be made in follow up researches. Our research in coordination chemistry makes tremendous progress in combining coordination chemistry and related chemical branches, and coordination of chemistry is promising in application and potential in development.

Classification and Characteristics of Complexes

Ligand and metal ions are related to the stability of complexes. Moreover, the chelating effect also affects the stability, and there is a direct ration between chelating degree and the stability of complexes, which means the former increases, its corresponding stability also increases. Organometallic compounds also are known as metal organic compounds, and many organometallic compounds exist with the form of complexes; metal atoms are sandwiched between two parallel carbon ring systems, known as sandwich compounds. Many complexes can be made directly by their composition compounds through addition, and when there are different oxidation states in metal ions, the different valence metal complexes can be made through ligand and oxidized metal ion complexes function in oxidizing agents. The key reactions that take place are acid-base reaction, chemical analysis, substitution reaction, electron transfer reaction and catalysis.

As for the preparation of cobalt hexachloride, one has to prepare solid NH4Cl, CoCl2•6H2O (C.P.), 6% H2O2(C.P.), 6 stronger ammonia water (C.P.), strong HCl solution (C.P.), 2mol / L HCl, ethanol (C.P.), activated carbon and ice, NH4Cl4g, 8ml H2O. 6gCoCl2 • 6H2O crystal, 0.3g activated carbon, 14ml concentrated aqueous ammonia and 14ml6% H2O2 solution, and after a series of reactions, the measurement calculation is conducted; according to the formula: 2CoCl2 • 6H2O + 10NH3 + 2NH4Cl + H2O2 ===2 [Co (NH3) 6] Cl3 + 14H2O, the products' quality theoretically is:

$$M = = \frac{6.0 \times 267.5}{237.9} = 6.77g$$

Conclusions

Coordination chemistry has won close attention from scientific researchers who summarize its property laws and apply it in different fields by studying complexes, which promotes the continuous development of coordination chemistry. While with the continuous development of technology, the study on chemical research shall be further profound, which is significantly important for the application of coordination chemistry.

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