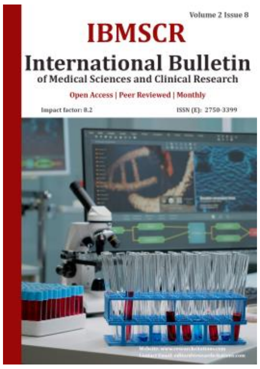

STUDY OF THE ISOMERISM OF COORDINATION COMPOUNDS

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https://doi.org/10.5281/zenodo.8375287

Annotation. The article presents to students the idea that coordination compounds, types of isomerism in these compounds, geometric, optical, conformational, ionization, hydrate isomers and their properties are studied.

Keywords: isomerism, geometric isomerism, optical isomerism, structural isomerism, ionization isomerism, racemate.

In coordination compounds, the phenomenon of isomerism is common, as in organic compounds. The separation of the isomerism found in them into two groups is possible. The first is structural isomerism, and the second is stereoisomerism. In the statistical aspect of stereochemistry, the phenomenon of isomerism of coordination compounds is central. The property of isomerism of chemical compounds was known even during the development of the classical theory of chemical structure. The isomerism of molecules was discovered in 1823 . Yu.Liebig, who discovered that the silver salt of rattlesnake acid and silver isocyanate have the same elemental composition, but different physical and chemical properties [1].

Isomerism is understood as the ability to have different mutual arrangement of atoms and atomic fragments in compounds of the same general composition, which dictates differences in the chemical and physical properties of the corresponding isomer compounds. In the case of coordination compounds, these differences may be related both to the specifics of the location of ligands in the inner coordination sphere and to the distribution of ligands between the inner and outer spheres.

Isomerism is directly related to the presence or absence of certain symmetry elements in the connection: pivoting axes, mirror-pivoting axes, center and planes of symmetry. The stereochemical configuration characterizes the relative spatial arrangement of atoms or groups of atoms in a chemical compound molecule. The meaning of this term depends on the specific spatial arrangement of atoms in the structure of the complex. It is used to describe a figure or polyhedron together with an additional definition characterizing the specifics of the spatial arrangement of atoms. So, we can talk about cis- or trans-configuration; D(d), L(l), DL(dl)-respectively right-, left-rotating configuration, racemate [2].

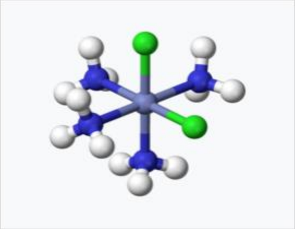
There are two types of isomers:

1) compounds in which the composition of the inner sphere and the structure of the coordinated ligands are identical (geometric, optical, conformational, coordination positions);

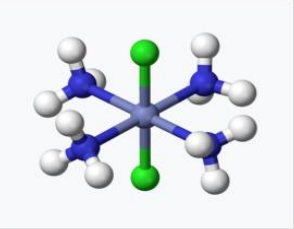
2) compounds for which there may be differences in the composition of the inner sphere and the structure of ligands (ionization, hydration, coordination, ligand).

Spatial (geometric) isomerism. This type of isomerism is caused by the unequal placement of ligands in the inner sphere relative to each other. A necessary condition for geometric isomerism is the presence of at least two different ligands in the inner coordination sphere.

Geometric isomerism is manifested mainly in complex compounds having an octahedral structure, the structure of a flat square or a square pyramid. With an increase in the number of different ligands in the inner sphere, the number of geometric isomers increases [3].



цис-$[CoCl_2(NH_3)_4]^+$

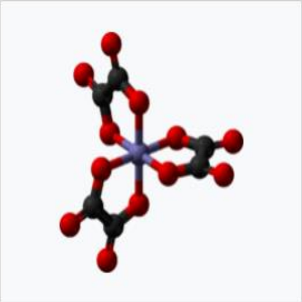


транс-$[CoCl_2(NH_3)_4]^+$

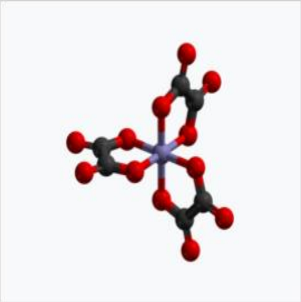
Гран- (fac-) граневой- $[CoCl_3(NH_3)_3]$

Ос- (mer-) реберный- $[CoCl_3(NH_3)_3]$

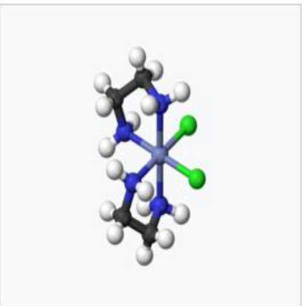
Optical isomerism. Optical isomerism is associated with the ability of some complex compounds to exist in the form of two forms that are not combined in three-dimensional space and are a mirror image of each other, like the left hand and the right. Therefore, optical isomerism is sometimes also called mirror isomerism.



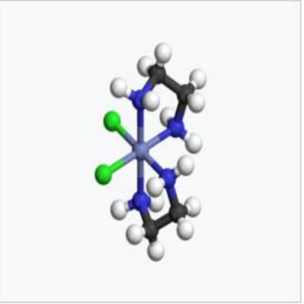
Λ-$[Fe(ox)_3]^{3-}$



Δ-$[Fe(ox)_3]^{3-}$



Λ-*цис*-$[CoCl_2(en)_2]^+$



Δ-*цис*-$[CoCl_2(en)_2]^+$

Structural isomerism. Hydrate (solvate) isomerism consists in the different distribution of solvent molecules between the inner and outer spheres of the complex compound, in the different nature of the chemical bond of water molecules with the complexing agent. For example: $[Cr(H_2O)_6]Cl_3$ (purple), $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$ (light green), $[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$ (dark green).

The ionization isomerism is determined by the different distribution of charged ligands between the inner and outer spheres of the complex and characterizes the ability of coordination compounds with the same elemental composition to give different ions in solution. Connection examples: $[Co(NH_3)_5Br]SO_4$ (красно-фиолетовый), $[Co(NH_3)_5SO_4]Br$ (red) [4].

Coordination isomerism is associated with the transition of ligands from one complexing agent to another: $[Co(NH_3)_6][Cr(CN)_6]$ и $[Cr(NH_3)_6][Co(CN)_6]$.

Isomers of a complex compound are not always stable in the same way. Its unstable isomers can transition to more stable states. The speed of this process depends on the properties of the central atom. For example, in platinum coordination compounds this process is very slow, whereas in palladium coordination compounds it occurs quickly. Palladium coordination compound containing $[PdCl_2(NH_3)_2]$, it passes from a cis-isomeric state to a trans-isomeric one. If the rate at which two isomers transform into each other is mutually different, then only their stable isomer exists.

Complex (coordination) compounds are the largest and the class of diversity. Complex compounds are of great importance, the compounds of which are used in the national economy, agriculture, medicine and pharmaceutical industry [5]. Complex compounds are widely used for the extraction and purification of platinum metals, gold, silver, nickel, cobalt, copper, separation of alkali metals and a number of other technological processes, as well as in chemical analysis. Respiration plays an important role in photosynthesis, biological oxidation, enzymatic catalysis and other necessary biological processes.

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