



A Phase of Crystal Field Theory in Metal Complexes

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DESCRIPTION

The basic concept of Crystal field theory describes the net change in crystal energy which results from the orientation of the d orbitals. The transition metal cation presents inside a coordinating group of anions also known as ligands. The main feature of transition metals is their tendency to form into complexes.

This is a bonding model type of theory that explains many important properties of transition-metal complexes, and their stability, magnetism, colors, structures, and reactivity. The central assumption of Central field theory is that metal ligand interactions are only electrostatic in nature.

To understand the concept of crystal field interactions occurs in transition metal complexes, it is necessary to understand spatial disposition or geometrical of d orbitals. The d orbitals are degenerated only in free gaseous metal ions. When the transition metals are not bonded to any ligand then d orbitals are degenerated by same energy.

Complex ion having the greater number of unpaired electrons is called as high spin complex and low spin complex contains the less number of unpaired electrons. High spin complexes having weak field ligands whereas the crystal field splitting energy is small for this type of complexes. Low spin complexes contains strong field ligands having maximum pairing of electrons in the set of three atomic orbitals.

Octahedral compound which having six ligands surrounding the metal atom, observe repulsion between the electrons in ligand electrons and d orbitals.

The splitting of degenerate d orbitals of a metal atom into 2 levels in a tetrahedral crystal field represents the two sets of orbitals as Td. The electrons present in dx^2-y^2 , dz^2 orbitals are less repelled by the ligands than the electrons present in dxy , dyz , dxz orbitals. Then the energy of dxy , dyz , and dxz orbital sets increased while that of the dx^2-y^2 and dz^2 orbitals are lowered.

Crystal field theory splitting depends upon the field produced by an ligand and the charge present on the metal ion.

Determined series based on the absorption of light by coordination of compound with different ligands are known as spectro chemical series.

This kind of repulsion is experienced in the case of dx^2-y^2 and dz^2 orbitals as they point towards axes with the direction of the ligand.

So, they have higher energy than average energy in an spherical crystal field.

- The main advantage of this theory is to describe the stability of complexes and greater the crystal field splitting energy, then greater in their stability.
- Complexes spectra and colour can be explained by using this theory.
- Crystal field theory explains complexes magnetic properties.

Crystal field theory is most widely used theory for explaining coordination of complex bonding. Hans Bethe came up first with the idea by treating atoms as hard spheres and their interaction is purely electrostatic. The central metal ion is positively charged while the ligands are surrounded as negatively charged ions. When this negatively charged ion approaches positively charged ion electrostatic attraction which causes changes in the metal ion's energy levels and eventually bonds to form an ion complex. Crystal field theory was able to explain the bonding in majority of coordination complexes.

CONCLUSION

Crystal field theory explains several of the features of complexes that could not be challenged by the valence bond theory. Crystal field theory is unquestionably superior to valence bond theory. Slight temperature changes may impact the magnetic characteristics of some of the compounds which is extremely close to Pressure. According to valence bond theory, only explain magnetic behaviour by specifying the number of unpaired electrons. The Crystal field theory provides basis for understanding and predicting fluctuations of the magnetic moments along with temperature as well as magnetic properties of complexes. The assumptions that Valence bond theory and

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Crystal field theory are based on are completely different. The difference is both are how they describe the orbitals which are not occupied in low spin states. Link between the metal ion and the ligand is covalent according to Valence bond theory, but merely ionic according to Crystal field theory. Bond is currently seen as having ionic and covalent properties. Crystal field theory provides a framework for quickly interpreting tetragonal

distortions. The interaction between a metal ion and a ligand is caused by the attraction between the metal ion positive charge and the ligand unpaired electrons. This theory is mainly based on the changes that occur in five degenerated electron orbitals. When a ligand approaches a metal ion then the unpaired electrons are closer to d orbitals of the metal ion. This leads to loss of degeneracy.