Stability of oxidation states of transition metal oxide

1. The highest oxidation states of transition metals are found in fluorides and oxides since fluorine and oxygen fluorine and oxygen are the most electronegative elements.
2. Mostly ionic bonds are formed in lower oxidation states but in higher oxidation covalent bond is formed because of that stability of transition metal oxides in higher oxidation state increases.

Catalytic property of d-block elements

The first row transition elements exhibit catalytic properties due to the presence of unpaired electrons which can form complexes. Iron and vanadium are the most important catalysts. Iron is used as catalyst in the manufacture of ammonia. Vanadium is used in the form of vanadium pent oxide in the manufacture of sulphuric acid.

Magnetic property of d-block elements

1. Due to the presence of unpaired electrons in the (n-1)d-orbitals , most of the transition metals ions and their compounds are paramagnetic i.e. they are attracted by the magnetic field.
2. As the number of number of unpaired electrons increases from 1 to 5 , the magnetic moment and hence paramagnetic character also increases.
3. Those transition elements which have paired electrons are diamagnetic i.e.they repelled by magnetic field.
4. Metals like Co and Ni posses high para magnetism where they obtain permanent magnetic moment and are refereed as ferromagnetic.

Interstitial compounds of d-block elements

All the first row transition metals form interstitial compounds with the elements of the s and p-blocks. The elements that occupy the interstitial sites in their lattices are H, C and N. Both the elements combine and form bonds which are hard.

Alloy of d-block elements

When one metal mixes up with another metal, alloys are formed. As the d-block elements have same atomic sizes they can easily take up positions of one another. This causes alloy formation. For example: Cr, V, Mn are used in formation of alloy steels.

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General trends of group 3 elements of transition metals

Group 3 transition metals show some common trends which continue in complete group.
1. Physical state : 1st and 2nd member of the series are soft even this characteristic continue till lanthanum which is soft, ductile, silvery white element.
2. Metallic nature : Transition metal elements of group three are mostly metallic except few.this nature remain till the end of group .
3. Group 3 elements generally obtain in nature.

General trends in group 4 elements

It contains the elements Titanium (Ti), zirconium (Zr), hofmium (Hf) and rutherfordium (Rf). The first three members of the group share similar properties. All three are hard refractory metals under standard conditions. However, the fourth element Rf , has been synthesized in the laboratory.

General characterisitic of group 5 elements of transition metals

Group 5 contains vanadium (V), Niobium (Nb), tantalum Ta) and dubnium (Db). This group lies in the d-block of the periodic table. It belongs to the broader grouping of the transition elements. First three elements form various inorganic compounds, generally in the oxidation state of +5. Lower oxidation states are also known, but they are less stable, decreasing in stability with atomic mass increase.

Group 7 elements general trends

They are Mn, Tc, Re, and Bh. All known elements of group 7 are transition metals. Bohrium has not been isolated in pure form, and its properties have not been conclusively observed; only manganese, technetium, and rhenium have had their properties experimentally confirmed. All three elements are typical silvery-white transition metals, hard, and have high melting and boiling points.

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General trends in group 8,9,10 elements of transition metal

1. The group 8,9,10 contain iron (Fe), cobalt(Co) and Ni(Ni) as 1st elements of their groups.
2. They are all transition metal.
3. Hence the general trends of these groups remain same as transition metal series.

General trends in group 11 transition metals

1. Copper, Silver, Gold and Roentgenium belongs to group 11.
2. As atomic number increase from Cu to further atomic size also increase because electrons enters into new shells. This lead to change in physical and chemical properties.
3. As atomic number increases this metals become less reactive hence in group 11 copper is more reactive while gold is unreactive.

Group 12 elements of transition metal

Zinc, Cadmium, Mercury and copernicium belongs to these family . As 1st three elements are d-block metals but they are not transition elements because they have completely filled outermost orbitals. Hence their physical and chemical properties are same whereas last member of these series is radioactive.

Characterisitic of halides of transition elements

The reaction of a transition metal with a halogen involves a high activation energy and therefore requires a high temperature for initiation.This is why transition metals react with halogens at high temperature to form halides. The halides of transition metals in higher oxidation states exhibit a greater tendency for hydrides.

Sulphides of transition elements

1. Transition elements when reacts sulphur they form sulphides of the respective transition elements.
2. The transition metal sulphides are generally formed in the lower oxidation states of metals, because sulphur is not a good oxidizing agent.
3. Hence sulphides of transition elements are basic in nature.
4. They have low solubility in water.

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5. Some transition metal sulphides are highly covalent which give rise to their semiconductor property.

Methods of prepation of potassium dichromate

Potassium permagnate is prepared by chromite ore from following steps:
Step (1) Concentration of ore : Powered ore is concentrated by washing with current of water in hydraulic classifier.Lighter gangue is carried away and heavier chromite ore settles at the bottom.
Step(2) Roasting : Concentrated ore is converted in its oxide by roasting and converted to sodium dichromate.
Step(3) Conversion of sodium chromate to sodium dichromate : sodium chromate with sulphuric acid produces sodium dichromate.
Step (4) Conversion of sodium dichromate to potassium dichromate : Concentrated solution of sodium dichromate is treated with calculated amount of potassium chloride which gives potassium chromate.

Reason why volumetric titration of KMnO4 takes place in presence of dilute H2SO4

1. Volumetric titration in presence of hydrochloric acid or nitric acid is not performed because permagnate ion oxidize hydrochloric acid to chlorine.

Method of prepration of silver nitrate

1. From nitric acid(cold and diluted).
2. From nitric acid (hot and concentrated).

Uses of silver nitrate

1. Silver nitrate is the least expensive salt of silver. It is non-hygroscopic, in contrast to silver perchlorate .
2. It is relatively stable to light.Hence it is used as precursor to other silver compounds.
3. Silver nitrate is used in other organic synthesis.

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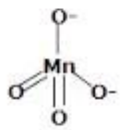
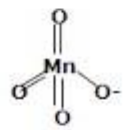
Structure of permagnate and permagnate ion



Manganate ion
(Paramagnetic, green)



Permanganate ion
(Diamagnetic, purple)

1. The magnate and permagnate ions are tetrahedral, the green color magnate ion is paramagnetic and permagnate ion is diamagnetic.

Purple of cassius

Purple of Cassius is a **purple** pigment formed by the reaction of gold salts with tin(II) chloride. It has been used to impart glass with a red coloration and to determine the presence of gold as a chemical test.

Properties of f-block elements

- The lanthanoides and actinides series make up the inner transition metals.
- The lanthanide series includes elements 58 to 71, which fill their 4f sublevel progressively.
- The actinides are elements 89 to 103 and fill their 5f sublevel progressively.
- Actinides are typical metals and have properties of both the d-block and the f-block elements, but they are also radioactive.
- Lanthanoides have different chemistry from transition metals because their 4f orbitals are shielded from the atom's environment.

Define lanthanoids

The series of fifteen metallic elements from lanthanum to lutetium in the periodic table (atomic numbers 57-71).

oxidation state of lanthanoids

In the lanthanide , La and Ln compounds are predominant species. However , occasionally +2 and +4 ions in solution or in solid compounds are also obtained. This irregularity arises mainly from the extra stability of empty, half-filled or filled f sub shell.

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Magnetic property of f-block elements

Lanthanide have largest magnetic moment of all elements. In the series from La To Lu 4f sub shell is successively changed. Hence they show magnetic properties.

Colour of f-block elements

1. The lanthanide are silvery white metals.
2. However, most of the trivalent metal ions are colored, both in the solid and aqueous state .
3. This is due to the partly filled f-orbitals which permit f-f transition.

Atomic and ionic radii of lanthanids

The overall decrease in atomic and ionic radii from lanthanum to lutetium is a unique feature in the chemistry of the lanthanide.

Lanthanoid contraction

1. As we move along the lanthanide series, the nuclear charge increases by one unit at each successive element.
2. The new electron is added into the same sub shell.
3. As a result, the attraction on the electrons by the nucleus increase and this tends to decrease the size.
4. Further , as the new electron is added into the f-subshell, there is iimperfect shielding of one electron by another in the same sub - shell .
5. However , the shielding of one 4-f electron by another is less than one d electron by another with the increase in nuclear charge along the series.
6. This imperfect shielding is the reason for lanthanide contraction.

Causes and consequences of lanthanoid contraction

Due to imperfect shielding of one electron by another in the same sub-shell is the cause for lanthanoid contraction. Due to lanthanoid contraction the size of the atoms of lanthanoid series decrease with increase of atomic number.

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Characterisstic of lanthanoids.

All the lanthanoids are silvery white soft metals and tarnish rapidly in air. The hardness increases with increasing atomic number, samarium being steel hard. Their melting points range between 1000 to 1200 K but samarium melts at 1623 K. They have typical metallic structure and are good conductors of heat and electricity.

Uses of lanthanoids

1. Auer metal is one of a series of mixed lanthanide alloys known as misch metals.
2. The misch metals are composed of varying amounts of the lanthanide metals, mostly cerium and smaller amounts of others such as lanthanum, neodymium, and praseodymium.
3. It has long been used as a flint in cigarette and gas lighters.

Example of actinoids

1. The Actinide series contains elements with atomic numbers 89 to 103 and is the third group in the periodic table.
2. The series is the row below the Lanthanide series, which is located underneath the main body of the periodic table.
3. Actinium, Thorium, uranium curium are the some example of Actinides series.

Oxidation states of actinoids

The most common oxidation state exhibited by actinoids is +3. Besides this, they also show other oxidation states like +2, +4, +5, and +7.

Ionic radii of actinoids

The ionic radii of actinoids decrease regularly across the series.

Actinoid contraction

The ionic radii of actinoids decreases regularly across the series. This phenomenon is called as actinoid contraction. This is due the poor shielding of the nuclear charge of 5f-electrons.

Characteristic of actinoids

1. Occurrence : The first four elements of the series occur's in the earth crust. The remaining are prepared artificially.
2. Colours of ions : Most of the actinoids are coloured .
3. Magnetic property : Many of the actinoid cations exhibit paramagnetic behavior.

Uses of actinoids

All actinides are radioactive and release energy upon radioactive decay. Naturally occurring uranium, thorium, and synthetically produced plutonium are the most abundant actinides on Earth. These are used in nuclear reactors and nuclear weapons.

Complex compounds and alloys of f-block elements

As compared to d-block transition elements , lanthanoids form only few complexes and less readily .Lanthanoids are highly dense metals posses high melting points.They radilly forms alloy with other metals especially iron.

Transition elements

1. Those elements which have partly or incompletely filled (n-1) d orbitals in their elementary state or in any of their common oxidation states is called as transition elements.
2. According to this definition the elements Zn, Cd, Hg and Uub are to be excluded from transition series as they have completely filled (n-1) d orbitals.
3. Examples: Fe, Sc, Ni, Cu etc.

Classification of d-block element into transition element

The d-block elements are classify as ,
a) 3d series.
b) 4d series.
c) 5d series.
d) 6d series.

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General characteristics of d-block elements

1. Metallic nature: All the elements are metal and exhibit all the properties which are characteristics of metals.
2.Thermal and electrical conductivity: They have high thermal and electrical conductivity.
3.Melting and boiling points: They show very high melting and boiling points.
4. Ionic radii: The ionic radius is similar to the pattern of atomic radii. Thus, for ions of a given charge the radius decreases slowly with increase in atomic number.
5. Ionization potentials: Transition elements have high ionization energy due to their small size.
6. Atomic radii : The atomic radii shows variation.

General characteristics of transition metals

1) Except for mercury which is a liquid,all transition elements have typical metallic structure and show typical metallic properties such as conductivity, malleability and ductility, lustre, high tensile strength etc.
2) Their atomic radii are in between those of s- and p-block elements. In a series, they decrease with increase in atomic number but the decrease is small after midway.
3) They have high melting and boiling points, high enthalpies of hydration of their ions.
4) Their first ionization energies are higher than those of s-block elements and less than those of p-block elements.
5) They are electropositive in nature.

General characteristics of transition and post transition elements

Transition elements are hard, having high melting points, are electro-positive in nature. Post transition elements are weakly electro-positive. They have smaller atomic size, higher ionization potential, less tendency to lose 3 valence electrons.

General trends in the properties of transition elements

Following are the properties of transition metals:
1. Nearly All transition elements(except few) shows metallic properties like hardness, lustrous surface, malleability, ductility, high tensile strength, high thermal and electrical conductivity.
2. High melting and boiling points.
3.Most of the compounds of transition metals are colored in their solid and solution form because

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they absorb visible radiation.
4.Ionization enthalpies of d-block metal is higher than those s-block elements and lower than those p-block elements.
5.Atomic and ionic radii of d-block elements shows gradual decrease up to Cr and then remains almost constant for few more elements and then slightly increases towards the end of the series.

atomic radii and ionic radii of d-block elements.

In general, ions of the same charge in a given series show progressive decrease in radius with increasing atomic number. This because new electrons enters d-orbital each time the nuclear charge increases by unity.

Mettalic character of d-block elemets

Most of the transition elements of the first row form metallic bonds due to the presence of incomplete outermost energy level. So, all the transition elements exhibit metallic characters. The strength of the metallic bond depends upon the number of unpaired d-electrons. As the number increases the strength also increases. Due to the absence of unpaired electrons Zn is not a hard metal.

Melting and boiling point of d-block elements

The transition metals are very hard and have low volatility. Their melting and boiling points are high. The high melting point of these metals are attributed to the involvement of greater number of electrons from (n-1)d in addition to the ns electrons in the inter atomic metallic bonding.

Density of d-block elements

Density of d-block elements are high due to their small atomic size and high mettalic bonding.

Ionization enthalpy of d-block elements

1. The ionization energies of first row elements gradually increases with increase in atomic number.
2. For d-block elements it is between s-block and p-block.
3. The ionization energy of Zn is very high than all the other metals which is due to its fully filled d-orbital.

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stability of higher oxidation states of transition metal halides

1.Higher oxidation states of transition metals are stabilized by atoms of high electro negativity like O and F.

2.In higher oxidation states covalent bonds are formed because of that the compounds of higher oxidation state of d-block elements are stable.

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