Topics: Concentration Cell

Presented by:

Name: Md. Masud Rana

Registration No: 2018131006

Session: 2018-19

2nd year 2nd Second Semester, 2020

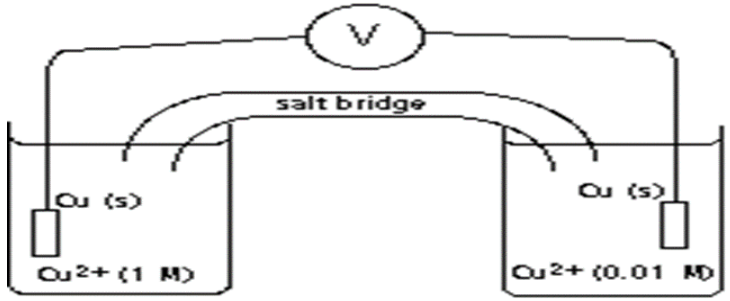
Department of Chemistry

Shahjalal University of Science and Technology,

Sylhet-3114, Bangladesh.

Defination: Any cell containing same redox couple in both the anode and cathode half cell is called concentration cell.

Cathode



Oxidation half cell:

Cu(s) → Cu^{2+}(0.01M, aq) + $2e^-$

Reduction half cell:

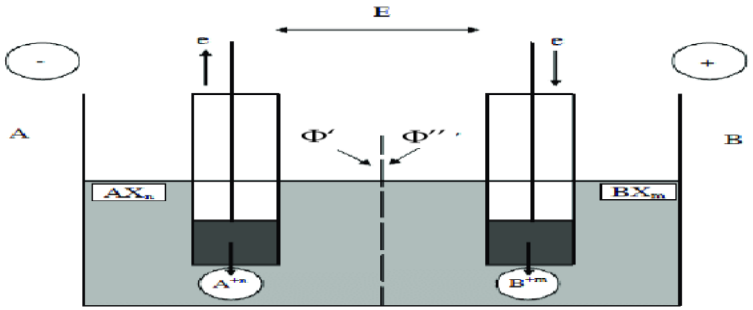
Cu^{2+}(1.0 M, aq) + $2e^-$ → Cu(s)

Overall Reaction:

Cu^{2+}(1.0M, aq) → Cu^{2+} (0.01M, aq)

- Here anode & Cathode are same.
- $E^0_{cell} = E^0$ anode $- E^0$ cathode $= 0$
- Concentration cell are two type
    1. Concentration cell with transference.
    2. Concentration cell without Transference.

Concentration cell with transference.



Cell Notation:

Pt $|H_2(1atm)$ |HCl(C_1) |HCl(C_2) |$H_2$1atm |Pt

Defination: The cell in which both side have the same components but inj different concentrations and which are separated by a porus partition.

- **Determination of cell potential of a concentration cell with transference.**

Step-1: Determine which side undergoes oxidation and which side undergoes reduction reaction.

Step-2: Calculation of cell potential using Nernst equation.

Nernst Equation:

$$E = E^0 - \frac{0.0592}{n} \log[Q]$$

Concentration cell without transference

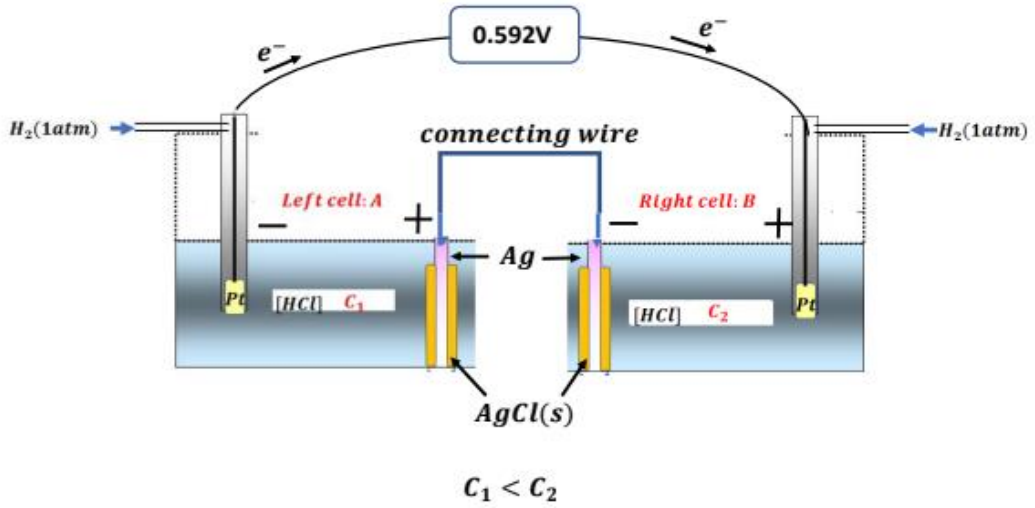


figure: Concentration cell without transferernce.

Defination: It consists of two half cells having two identical electrodes and identical electrolytes but with different concentration. EMF of this cell depends upon the difference of concentration.

Here concentration of two cell are C_1 and C_2 . Where the concentration difference between two cell is C_2 is greater than C_1.

Cell reaction of a concentration cell without transference.

Let a cell (A)

Pt $|H_2$(1atm) |HCl(C_1), AgCl(s) |Ag

The cell reaction:

$\frac{1}{2} H_2$1atm + AgCl(s) = HCl (C_1) + Ag .....(1)

Again:

Another cell (B)

Ag |AgCl(s), HCl(C_2) $|H_2$1atm |Pt

The cell reaction:

HCl(C_2) + Ag= $\frac{1}{2} H_2$(1atm) + AgCl (s) .....(2)

Now, if both cells are connected, the overall cell reaction will be sum of reaction (1) and (2).

The overall cell reaction will be

HCl(C_2)⟶ HCl (C_1) ..... (3)

Cell notation:

Pt $|H_2$(1atm) |HCl(C_1), AgCl(s) |Ag |AgCl(s) |HCl(C_2) $|H_2$(1atm) |Pt

Thank You

Topics: # Chemistry of Group-13 elements.

Presented by:

Name: **Md: Masud Rana**
Reg. No: **2018131006**
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Department of Chemistry

Shahjalal University of Science & Technology,

Sylhet-3114, Bangladesh.

***Electronic structures and oxidation state of Group-13 elements.

Element	Symbol	Electronic Configuration	Oxidation state
Boron	B	[He] $2s^2 2p^1$	III
Aluminium	Al	[Ne] $3s^2 3p^1$	III (I)
Gallium	Ga	[Ar] $3d^{10} 4s^2 4p^1$	III (I)
Indium	In	[Kr] $4d^{10} 5s^2 5p^1$	III (I)
Thallium	Tl	[Xe] $4f^{14} 5d^{10} 6s^2 6p^1$	III (I)

*+3 oxidation state are most stabe and abandent. Others are unstable given in parentheses.

***Physical Properties:

* Boron is hard black coloured high melting (Due to very strong crystalline lattice) non metallic solid.

*Others are soft metals with low melting point and high electrical conductivity.

*Density of the elements increases down to the group from Boron to Thallium.

*Ga is useful for measuring high temperature as it has low melting point and high boiling point.

*Ionic radii and covalent raddi and electronegativity values all are increasing down to the group Boron to Thallium, Excepts Gallium.

*** Extraction process and uses of group-13 elements.

*Boron: $Na_2[B_4O_5(OH)_4].8H_2O \xrightarrow{acid} H_3BO_3 \xrightarrow{heat} B_2O_3 \xrightarrow{Mg\ or\ Na} 2B + 3MgO$

borax orthoboric acid Boron

*Aluminium: $Al(OH)_3 + 3NaOH + 6HF \rightarrow Na_3[AlF_6] + 6H_2O$

* Others (Gallium , Indium , Thalllium) are found in small amount earth.

**Uses:

*Used to make boron steel or boron carbide control rods for nuclear reactors.

*Boron is used to make impact resistance steel, as it increase hardenability(that is the dept which it will harden) of steel.

* Aluminium is used as strucrtural metals in aircraft, ships, cars, and hrat exchangers. In buildings, doors, windows,and mobile home.

*For cooking utensils aluminium is widely used.

*To make electric power cables.

* Others elements are also important for various uses.

***Oxidation states and trend in chemical reactivity:

*Excepts B all are metals.

*Due to small size B dosen't form B^{3+} , it forms covalent compound.

*Aluminium(Al) form +3 cations.

*Gallium(Ga),Indium(In)and Thallium(Tl) forms +3 cations, and also +1 cations.

*The relative stability of +1 cations progressively down to the group due to inert pair effect.

*$BF_3, AlCl_3$ etc are behaves as lewis acid(as electron deficient molecule have the tendency to accept electron pair.

*The tendency to behave as lewis acid decreases down to the group.

*$AlCl_3$ achieves stability by forming dimer.

***Anomolus properties of Boron(B).

*According to Fazan's rule due to small size and high electronegativity it favours to form covalent compound .

*Due to the absence of 'd' orbitals that it favours the maximum covalece is 4.

***Inert pair effect:

The atoms in this group have an outer electronic configuration of s^2p^1. Monovalency is explained by the s electrons in the outer shell remaining paired, and do not participating in bonding. This is called 'inert pair effect'. The reason that they do not take part in bonding is energy.

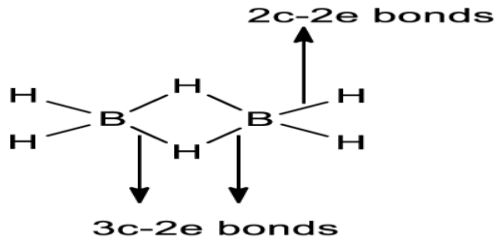
***Some important compounds of Boron:

*Diborane (B_2H_6)

* Preparation:(B_2H_6)

$2BF_3(\text{gas}) + 6\,\text{NaH} \xrightarrow{180^0c} B_2H_6(\text{gas}) + 6\text{NaF}.$

*Structure (B_2H_6)

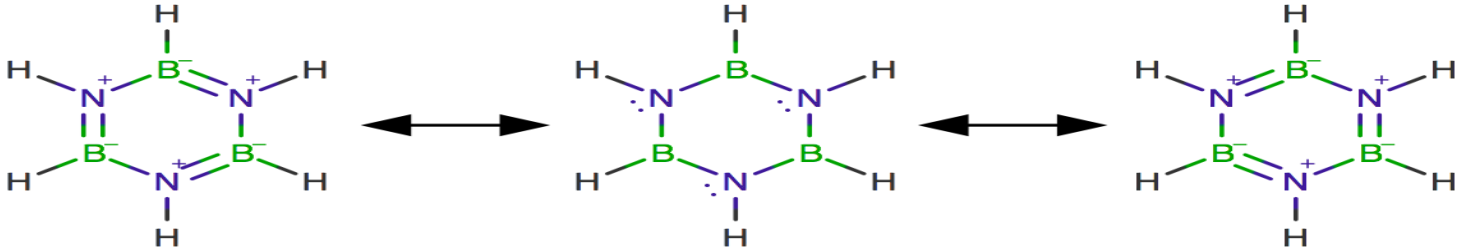


*** Borazine($B_3N_3H_6$)

*Borazine is sometimes called " Inorganic Benzene" because of its structure shows some formal similarities with benzene, with delocalize electrons and aromatic character. Their physical properties are also similar.

*preparation: $B_2H_6 \xrightarrow{2NH_3:1B_2H_6} B_3N_3H_6$ (at high temperature)

*Resonence Structure:



Thank You