ELECTROCHEMISTRY 1

Introduction
Difference between Galvanic cell and electrolytic cell
Daniel cell, representation
Salt bridge, its functions

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ELECTROCHEMISTRY

Electrochemistry is the area of Chemistry dealing with the inter conversion of electrical energy and chemical energy.

Applications of electrochemistry in every day life

Batteries

Control of corrosion

Metallurgy and

Electrolysis

ELECTROCHEMICAL CELL

- **Electrochemical cell is a device which converts chemical energy into electrical energy or electrical energy into chemical energy using an electrochemical redox reaction.**

These can be classified into two types,

- **1. Galvanic cell or Voltaic cell: This is the one which converts chemical energy into electrical energy. Eg: Daniel cell**

Galvanic cell

- Galvanic cell is further classified into three types.
- **a. Primary Cell (Irreversible): In this, the cell reaction is not reversible. They are not rechargeable. Eg: Dry cell.**
- **b. Secondary Cell (reversible): In this, cell reaction is completely reversible and rechargeable. Therefore we use over and over again. These are called as storage cells. Eg: Ni - Cd cell, Lead - acid cell.**
- **c. Concentration Cell:**

Concentration Cell

- **These types of cells are made up of the same metal immersed in a solution of same ions with different concentrations. Eg: Zn | Zn^{2+} C1|| Zn^{2+} C2| Zn.**
- **Potential difference arises due to transfer of substance from a solution of higher concentration to a solution of lower concentration.**

2. Electrolytic cell

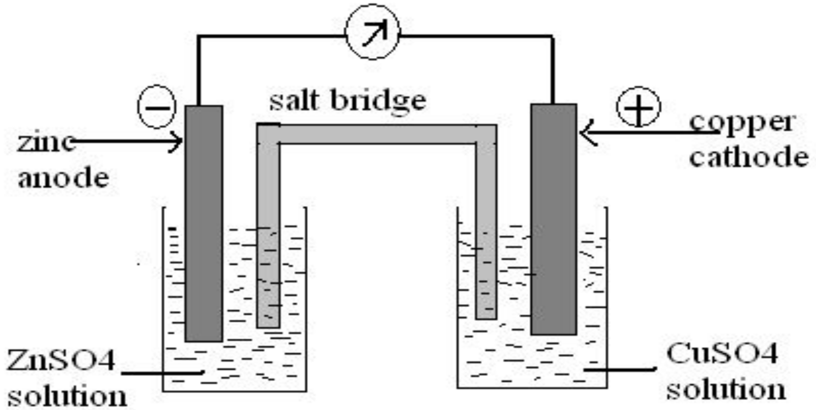
This is the one which converts electrical energy into chemical energy. Eg: Electroplating, electrolysis.

Differences between Galvanic and Electrolytic cells

SL No	Galvanic cell	Electrolytic cell
1	It requires no source of external energy	It requires a source of electrical energy
2	It converts chemical energy to electrical energy.	It converts electrical energy into chemical energy.
3	The redox reaction is spontaneous	The redox reaction is non-spontaneous
4	The electrodes used are dissimilar metals.	The electrodes used may be dissimilar or same metals.
5	Each metal electrode is dipped in its own ionic solution and both have separate compartments.	Both the electrodes are immersed in the same electrolyte solution . (single compartment)
6	Salt bridge is required.	No salt bridge is required
7	Cathode is positive electrode and anode is negative electrode.	Cathode is negative electrode and anode is positive electrode.

DANIEL CELL

In Daniel cell, Zn rod dipped in 1M solution of $ZnSO_4$ forms a half cell and Cu rod dipped in 1M solution of $CuSO_4$ forms another half-cell. The two half cells are internally connected by a salt bridge, filled with KCl solution and the two ends of the salt bridge are plugged with a porous material. The two electrodes are connected externally by a wire through voltmeter.



DANIEL CELL

- The two half-cell reactions are represented as follows:
- At Anode: Zn is oxidized to Zn^{2+} liberating two electrons.
- $Zn \rightarrow Zn^{2+} + 2e^-$
- At Cathode: Cu^{2+} is reduced to Cu by accepting two electrons.
- $Cu^{2+} + 2e^- \rightarrow Cu$
- Thus the net cell reaction: $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$
- Cell representation/ cell diagram:

$$Zn(s)|Zn^{2+}(1M)||Cu^{2+}(1M)|Cu(s)$$

DANIEL CELL

- The electron liberated at the zinc half-cell builds up an electrical potential difference. i.e., electrons move from the zinc electrode to the copper electrode producing a current in the circuit which is indicated by voltmeter.
- In the galvanic cell, the electrode where oxidation takes place is referred to as anode which is assigned with a negative sign and the electrode where reduction takes place is referred to as cathode which is assigned with a positive sign .

Function of salt bridge

1. During the cell reaction either Cl^- ions diffuse into the zinc half-cell or Zn^{2+} ions diffuse into the salt bridge to keep the zinc half-cell electrically neutral. Similarly K^+ diffuses into the copper half-cell or SO_4^{2-} ions diffuse into the salt bridge to keep the copper half-cell electrically neutral. **Thus it maintains electric neutrality.**
2. The salt bridge allows the current to flow through the cell without allowing the contents to mix. Without the salt bridge no electrical current would be produced and electrolytic contact must be maintained for the cell to function.

Conventions used in representing electrodes and cells

- Galvanic cell is represented as
- $Zn|ZnSO_4$ (1M) || $CuSO_4$ (1M) |Cu
- 1. The electrode at which oxidation occurs (anode) is written on the left hand side whereas the electrode at which reduction occurs (cathode) is always written on the right hand side.
- 2. Single vertical line indicates the phase boundary between the metal and the solution.
- 3. Double vertical line indicates the salt bridge.
- $Zn|ZnSO_4$ (1M) || $CuSO_4$ (1M) |Cu
- 4. The concentration of corresponding solutions is represented in the parenthesis
- 5. The arrow mark indicates the direction of flow of electrons.
- 6. The term electrode potential always refers to reduction potential and is represented as $E_{M^{n+}/M}$

Thank You