



ENGINEERING CHEMISTRY

Department of Science and Humanities

ENGINEERING CHEMISTRY

Electrochemical equilibria



Module content:

- ***Electrode potential and cell potential***
 - ***Nernst Equation***
- ***Types of electrodes***
- ***Reference electrodes***
- ***Concentration cells***
- ***Ion-selective electrodes***

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Electrochemical equilibria



Class content:

- *Origin of electrode potential*

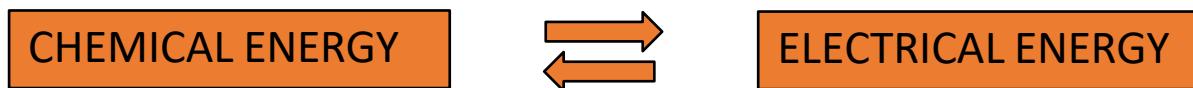
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Electrochemical equilibria



Electrochemistry

- Deals with the inter conversion of chemical energy and electrical energy

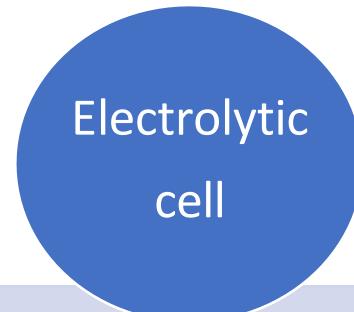


- Two types of cells:



Converts chemical energy to electrical energy

Batteries and fuel cells



Converts electrical energy to chemical energy

Cells used in electroplating

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Electrochemical equilibria

Electrochemical studies:

- Redox reaction
- Electrodes- Anode (oxidation)
Cathode (reduction)
- Electrolytic conductance through electrolyte due to movement of ions
 - Acid, alkali or salt solutions
 - Molten electrolytes
 - Solid electrolytes

Electrode potential

- When a metal rod is dipped in a solution of its own ions, the electrical potential developed at the interface of the metal and its solution
- It is denoted by E



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Origin of Electrode potential

When a metal M is in contact with solution containing its ions M^{n+} , two reactions are possible:

1. Ionisation (Oxidation)



2. Deposition (Reduction)

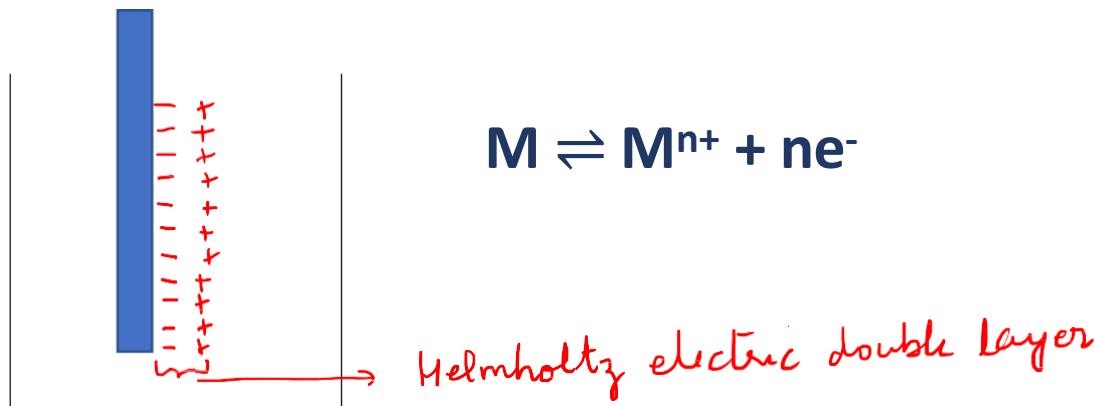


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Electrochemical equilibria

➤ Case I : If ionization is faster than deposition

- the metal acquires net negative charge, consequently retards the rate of ionization and increases the rate of deposition. This ultimately lead to the establishment of equilibrium
- the metal electrode gets negatively charged and attracts the layer of positive ions at the interface
- an electrical double layer is formed at the interface of metal and solution known as **Helmholtz electrical double layer**

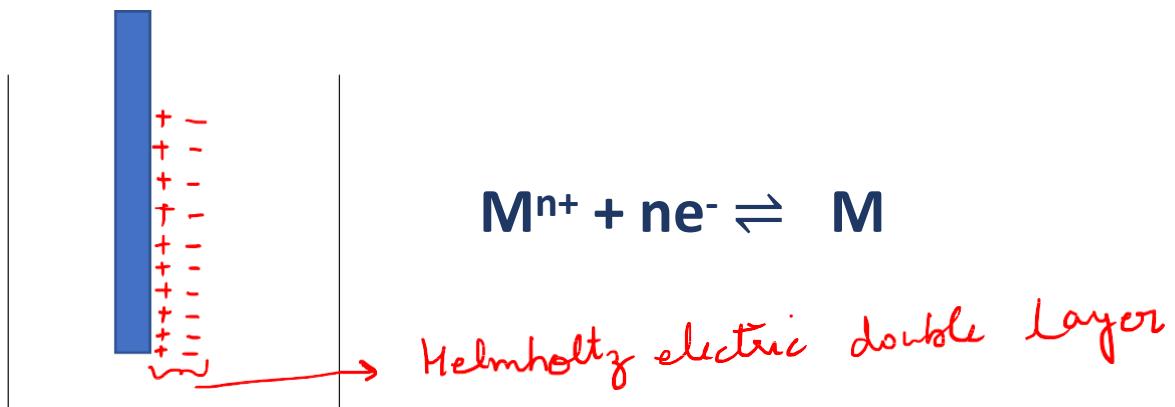


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Electrochemical equilibria

➤ Case II : deposition is faster than ionization

- the metal acquires net positive charge, consequently retards the rate of deposition and increases rate of ionization. This ultimately lead to the establishment of equilibrium.
- The metal electrode gets positively charged and attracts the layer of negative ions at the interface,
- an electrical double layer is formed at the interface of metal and solution known as **Helmholtz electrical double layer**



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Standard electrode potential

- The potential developed at the interface of metal and solution, when the metal is in contact with a solution of its own ions having unit concentration at 298 K
- In case of gas electrodes the partial pressure of gas is maintained at 1 atmospheric pressure.
- It is represented as E°

Electrochemical Cell

Single electrode potentials cannot be measured hence two electrodes are coupled together to form a cell

Cell notation

e.g. Daniel cell:





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THANK YOU

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