Ministry of Higher Education and Scientific Research

Al-Muthanna University

College of Science

وزارة التعليم العالي والبحث العلمي

جامعة المثنى

كلية العلوم

قسم الكيمياء

Electrochemistry

Lecture (1)

Stage 3

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Referrers

1- Fundamentals of Physical Chemistry, ed. Abdul Alim Suleiman. a. D. Fatima Hafez Kamal.

2- Physical Chemistry.Dr. Musallam Abdul Mohammed (found in Free Education).

3- Electrochemistry. Edmond Mikhail Hanna.

4- Kinetics and electrochemistry. D. Abdul Majeed Mohammed Al-Dabbagh.

5- Atkines

Curriculum:

1. A brief overview of electrochemistry.

2- Electrolytes.

3- Electrolysis dissolution.

4- Varday (I+II) laws for electrolytic materials.

5- Electrolytic conductance

6- Specific conductance

7- Types of electrolytes and the effect of concentration on conductivity

-8 Kohlaraschs low and is application

-9 Ionic mobilities

-10 Application of conductance measurement

A- Finding the solubility of scarce salts.

Determination of solubilities of sparingly soluble salts.

B- Finding the degree of disintegration of weak electrolytes:

Degree of dissociation of weak electrolytes.

C. Calibration by conductometric titration.

1- strong base with strong acid.

2- weak acid with strong base.

11 . The migration if ions.

12- Electrochemical cells.

13- electrodes used in electrochemistry.

A- Metal electrodes immersed in solutions containing its ions.

B- Metal electrodes covered with a layer of scarce melting salt immersed in a solution

Contains negative salt ions.

c. Glass electrode.

D. Standard hydrogen electrode.

Electrochemistry

It is one of the branches of chemistry that studies reactions on the surface of conductors

Electrodes made of metals (Electrodes and semiconductors) (Semiconductors) Like Irvette and ionic solutions like electrolytes.

Electrolytes . Or is it the science that studies the interchange between chemical energy?

And electrical energy within the framework of oxidation reactions and sister Azel which forms a large section

Very important of chemical reactions (oxidation reactions and sister reduction

(and oxidation reaction abbreviated as Redox .

Electrochemical reaction:

Every reaction is done thanks to a voltage when a current passes or generates a voltage

or electric current. It's called an electrochemical reaction .

The electrochemical process is either an insulating sister's reaction due to an electric voltage connected to it from

External (as in electrolysis) or electric current arises from a chemical reaction between

Suitable materials that form voltage (as in a galvanic cell) or batteries.

Note:

The mere movement of electrons between molecules, ions or yartes is not considered a process

Electrochemical, but the formula of chemical processes is that it is characterized by the separation of a place of flow

The oxidation reaction is about the place of flow of the reaction of the sister Azel.

P.S.

The process of oxidation and sister Azel characteristic of electrical chemistry occurs on the separating surface:

Between the electrode and the electrolyte.

That is why electrochemistry can be defined: it is the science of the processes that take place on surfaces.

The interval between the phases of the celebratory i.e. between the electrode and the electrolyte. One of the most important **applications of chemistry**

Electrical are:

The most important applications of Electro chemistry

1- Life applications.

2. Analytical applications.

3. Power systems.

Life Applications:

1. Preparation of hydrogen gas from the process of electrolysis of water.

2. Voltage measurement is an example of which is the measurement of current and voltages.

3. Preparation of ozone gas.

4. Production of chemicals and an example of which is the sister of the seamel of mineral salts for the production of minerals for

Electrophoresis route for molten salts, such as the preparation of lithium, sodium,

and calcium , potassium , aluminum.

Power Systems Applications:

Preparation of electric current , especially for mobile devices:

1- Production of the galvanic cell.

2- Batteries of all kinds.

3- Sia Art battery.

4- fuel batteries.

Electricity: It is a torrent of electrons and therefore this torrent of electrons must go

During conductive materials which in turn are divided into two types:

1. Metals (metal conductors). (Metal conductors)
2. Electronic Materials: Ionic Solutions (Ionic Solutions).

Electrolyte :

Any substance that contains free ions (when disintegrating) forms an electrically transmitted medium .

Electrolytes are either in the form of Aqueous Solutions, an example of which is

Aqueous solution of sulfuric acid consisting of positive hydrogen ions

and negative sulfate ions.

$$H_2SO_4 \leftrightarrows 2H^+ + SO_4^=$$

Electrolytes may be melts or electrolytes.

Solid as it is found in dry batteries.

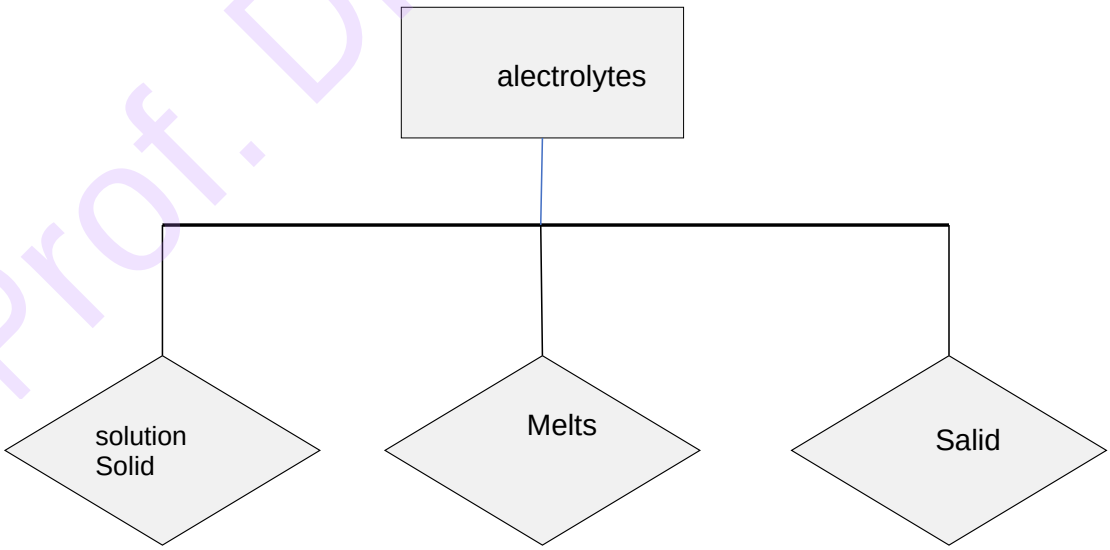
NaCl Ordinary Salt which is classified as

Chlorides , sulphates and nitrates

Examples of electrolytic materials

N

$$NaCl \leftrightarrows Na^+ + Cl^-$$



Electrolysis :

We can explain the mechanism of the electrolytic solution that conducts the electric current

on this picture. It must have an electric cell as in the figure

(1) Contains an electrolyte solution as well as two platinum electrodes Inert dipped in solution and connected to an external circuit with a Leckie battery

Electric charge can go back to its beginning. The B electrode is connected to the tip.

Battery negative where electrons enter the solution and a process occurs The Irn is called the positive electrode (cathode) and the pole (A) is connected to the tip.

The positive is in the battery and then the electrons are released, leaving the solution to return to

The battery and then the oxidation process occurs, and it is called the negative electrode (Anode).

According to Arinius' theory of electronic disintegration (electronic conductor) which must

It contains cationic (+) ions and negative ions (-) anion

which is in a state of continuous motion, and the positive ion can be metal. or hydrogen ion , while a negative ion can be a halogen ion or

Hydroxyl ion , and when the circuit is closed a current will pass through the solution.

And the cations tend to move towards the cathode, and then the process of equivalence occurs, leaving

Metal or hydrogen at the surface of the cathode (Operation Sister Azel), and in turn

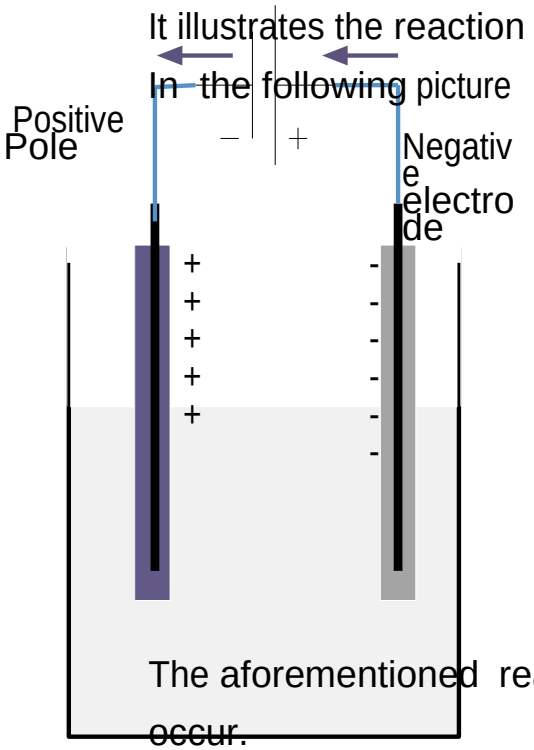
Anions that move in the opposite direction to the anode, and at this pole

Electrons move, leaving the material uncharged, which appears as

Halogens are free or in the form of oxygen (oxidation process).

It illustrates the reaction that occurs at the electrodes as

In the following picture



(M. stands for $M^+ + e^- \rightarrow M$

• Turns into a free metal at the cathode

metal

$$2H^+ + e^- \rightarrow H_2 \dots\dots\dots\dots (1)$$

(x, stands for $2x^- - 2e^- \rightarrow x2$

At anode halogens)

$$4OH^- \rightarrow O_2 + H_2O + 4e^- \dots\dots (2)$$

The aforementioned reactions are called migraines where they often occur.

At the electrodes and the interaction of each cell maybe it can be written by adding the reaction when

The cathode to the reaction that occurs at the anode and to balance the reaction we multiply the reaction

(1) In . (2)

The flow of electricity through a conductor involves the transfer of electrons from the voltage zone

Greater negative to the lower region, (Electron transfer mechanism to solution)

Electrolyte We must have an electric cell as in Figure 1 contains

Electrolyte solution plus two inert platinum electrodes dipped in the solution

Electrolyte and connected to an outgoing circuit with a battery and when a second voltage of a certain voltage is shed

Chemical reactions are observed on both poles, at which point the analysis process occurs.

Electrolysis, the positively charged electrode is called the electrode that

It has a charge or decrease in electrons when the voltage is shed by anode and the electrode with

Negative charge in other words an excess amount of electrons called a cathode

Cathode thus includes connectors that are elevator and landing

For electrons in solution. Inert electrodes such as platinum wires are commonly used that

It is only a means of transporting electrons to and from the solution where these electrodes do not share

By reactions, according to Arinius' theory of electron disintegration (electrolytic conductor)

Must contain positive cations and negative anions

They are in a state of continuous and free motion, and the positive ion may be metal or ion.

Hydrogen Either a negative ion can be halogen and it may be an ion

And the cations tend to move towards the cathode (negative pole) either

Heroxide

Anions they tend to move towards the anode (positive electrode) when they reach

Cations (metal) i.e. cathode it gains electrons and the break-even process occurs leaving

Metal or hydrogen on the surface of the cathode (Operation Reduction

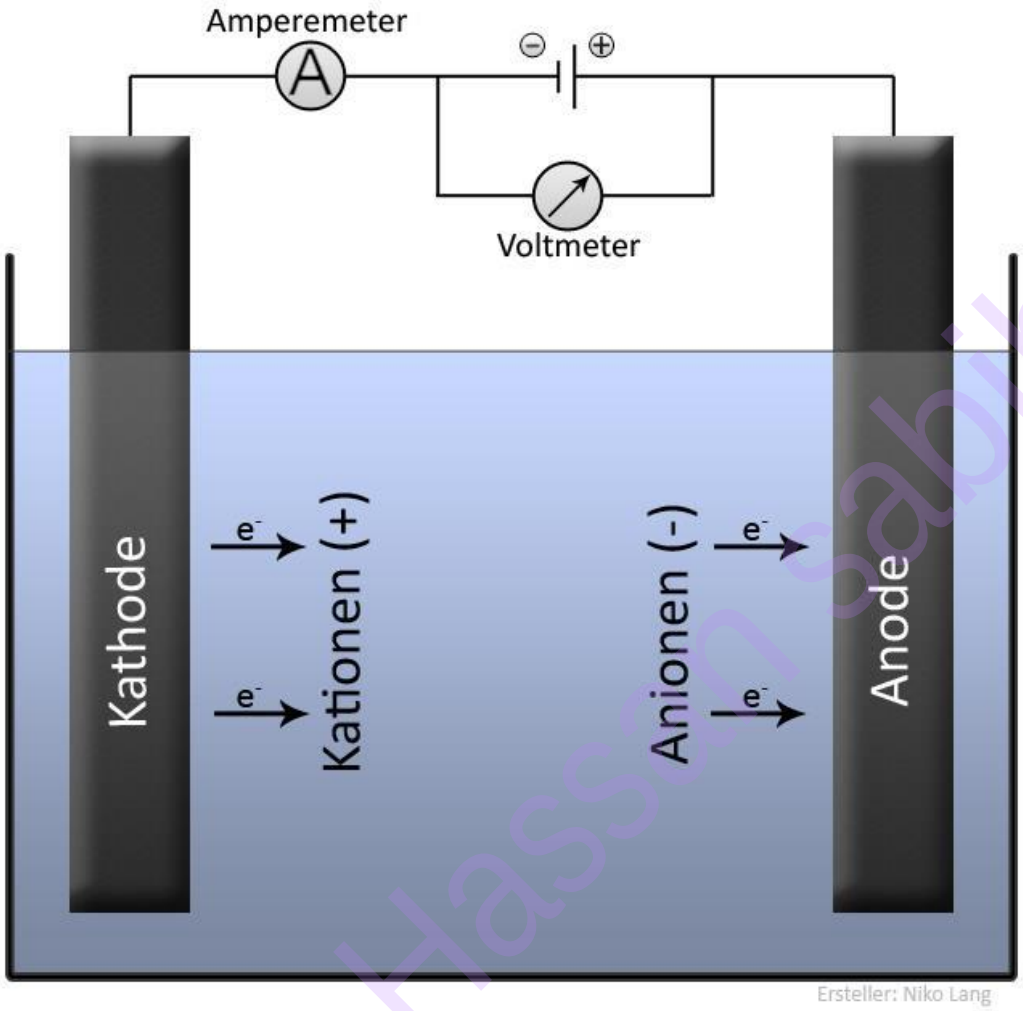


Figure 1 Electrolysis Cell

Negative ions of anion, such as halogens, move towards the anode and create a process.

oxidation leaving the anode missing the charge that appears as halogens

Free or .

It shows the reaction that occurs at the electrodes as in the following image

$M^+ = +e \rightarrow M$

At the cathode.

It's going to turn into a free metal.$2H^+ + 2e^- \rightarrow H_2(gas)$

When the anode will convert to halogens$2x^- + 2e^- + x2$

$$4OH^- \rightarrow O_2 + 2H_2O + 4e^-$$

These reactions are called half-reactions , where they often occur at the electrodes.

The cell reaction can be written by adding the reaction at the cathode to the reaction that occurred about

Anode

$$2M^+ + e \rightarrow 2M$$
$$2x^- + 2e^- \rightarrow x_2$$
$$2M^+ + 2x^- \rightarrow 2M + x_2$$

The reaction is weighed to multiply the reaction number 2 ×1

Cell interaction

∴ electrolysis can be defined: it is the movement of both aniones and cations towards

Research electrodes with accompanying chemical charges in an electrolyte solution under the influence of

A suitable electric field called electrolyte conductivity or electrolysis.

Electrolytic conductance or electrolysis

Examples of electrolysis

A. Electrolysis of sodium chloride molten

Electrolysis of Molten NaCl /NaCl Sodium chericle.

The electrolyte solution contains ions, liberated, and can be transmitted.

The process of sister Azal occurs at the right electrode (cathode) and during the electrolysis process

To a metal i.e. a half-reaction occurs at the cathode (Pole Researcher) he reduces

About cations) to acquire one electron and to have one neutral atom as in the equation:

At cathode (reduction reaction)$Na^+ + e^- \rightarrow Na$

At the anode, the electrode that searches for anions, the oxidation process occurs and the chlorine atom is formed.

The Artan Chlorine combines to form a binary molecule Neutral, i.e., yes, I want to liberate the kidney.

The atom is released in the form of chlorine gas and this process is called oxidation

Anode

Oxidation reaction

$$2Cl^- \rightarrow Cl_2(gas) + 2e^-$$

And here we notice in the interactions the use of electrical energy to transform both

at the cathode poles and anode respectively and by adding

The two equations must be taken into account in writing the word electrolysis in order to know that such as

This reaction has used an electric current.

At cathode $2Na^+ + 2e \rightarrow 2Na$

At anode $2cl^- \rightarrow Cl_2(g) + 2e^-$

Cell interaction

$$2Na^+ + Cl^- \xrightarrow{electrolysis} 2Na + 2Cl_2(g) \uparrow$$

2. **Electrolysis of aqueous sodium chloride molten**

Electrolysis of molten Sodium chloride (aqueous)

In this case, we observe the exit of hydrogen gas at the cathode and the exit of chlorine gas.

At the anode, how can this phenomenon be explained?

We know that water will disintegrate by a very small percentage 1 10 (=) and in general the

resulting from the disintegration of water, but

The solution contains ions of both

It oxidizes to, by removing electrons and a sister dies, and it gives,

By adding electrons and these reactions that can occur

$$Na^+ + e^- \rightarrow Na \ldots\ldots\ldots (1)$$
$$2H_2O + 2e^- \rightarrow H_2(g) + 2OH^- \ldots\ldots\ldots\ldots (2)$$
$$2H^+ + 2e^- \rightarrow H_2(g) \ldots\ldots (3)$$

In general, such three interactions are not easy to predict and in general,

Hydrogen gas and not metallic sodium is formed during electrolysis

For aqueous sodium chloride solution , and in this solution there is no concentration (KBR)

In order to make equation 3 certain as a final change , so electrolysis

For aqueous sodium chloride solution , equation number (2) is what always occurs when

The cathode , during the electrolysis process, the component moves away from the cathode.

To reach the anode and the sodium ions move inside the cell to keep the tie

Electrophoresis and at the anode these two reactions are possible and they are.

$$2cl^- \rightarrow cl_2(g) + 2e^- \dots\dots\dots(4)$$

$$2H_2O \rightarrow O_2 + 4H^+ + 4e^- \dots\dots\dots(5)$$

The positive ion that carries electric current is a sister whose temperature is harder than the ion of H in water.

Lead to the formation of

$$2H_2O + e \rightarrow H_2(g) + 2OH^-$$

The transmission of ions

That is, the difficulty of the sister of removing the positive ion leads to the disintegration of water on the negative electrode.

As for the escalation of chlorine gas in

And so it takes electrons and makes up ,

Equation (3) is the accident and whenever the chloride ion is deficient around the anode, the more

Migrates within the region, moves outwards, and the totality of the interactions that occur

For sodium chloride solution are

$$2H_2O + 2e \rightarrow H_2(g) + 2OH^-$$

$$2Cl^- \rightarrow Cl_2(g) + 2e^-$$

$$2cl^- + 2H_2O \xrightarrow{Electrolysis} H_2(g) + cl_2(g) + 2OH^-$$

As shown by the total reaction, during electrolysis the hydrogen molecule is formed.

The concentration of ion increases contained in the solution And the chlorine molecule , here the concentration of the hydrogen ion decreases. Which in turn interacts with Hydroxyl ions

To form sodium hydroxide (white gel precipitate) on the cathode.

Q: When preparing chlorine gas by electrolysis method we notice the formation of hydroxide

Sodium as a by-product within the cell.

• On the cathode leads to the disintegration of water on The difficulty of sister removed the positive ion)

, which in turn The negative electrode and thus takes electrons (sister of eternity) and is and

It will combine with the positive ion (forming a gelatinous white precipitate at the cathode).

Electrolysis of sodium sulfate solution:

Electrolysis of aqueous sodium sulphate.

The electrolysis products of sodium sulfate is the release of a gas ↑ at The cathode releases oxygen gas ↑ at the anode.

At cathode $2H_2O + 2e^- \rightarrow H_g(g) + 2OH^- \ldots..(1)$

At anode $2H_20 \rightarrow O_2(g) + 4H^+ + 4e^- \ldots.(2)$

$4H_2O + 4e^- \rightarrow 2H_2(g) \uparrow + 4OH^-$ ٢× ١

$2H_2O \rightarrow O_2(g) + 4(H)^+ + 4e^-$

$6H_2O \xrightarrow{electrolysis} 2H_2(g) + O_2(g) + 4OH^- + 4H^+$

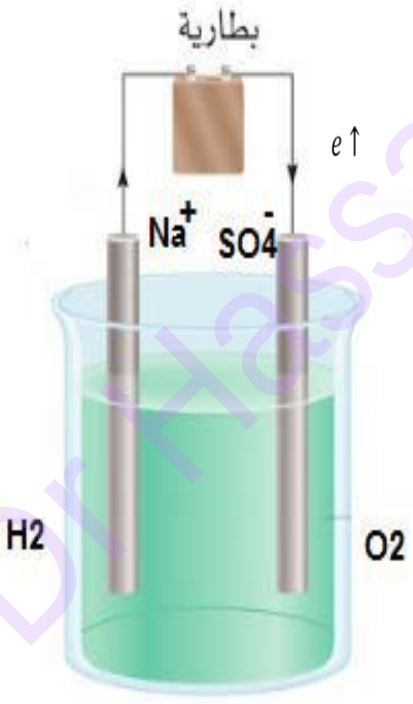
$4OH^- + 4H^+ \rightarrow 4H_2O \rightarrow (3)$

$$2H_2O \xrightarrow{electrolysis} 2H_g(g) + O_2(g) \ldots\ldots(4)$$

Question? Notes that the concentration of sodium capridate does not change?

• Not involved in interaction with inert platinum electrodes where electrolytes)

Its role was only in the transport of electrons (it was only a carrier medium for electrons).



Ohm's Law and Electrical Units

Electrolytic solutions such as metal conductors obey Ohm's law and according to this law,

$$I = E/R$$

The current passing through a conductor is given in the following relationship:

=It is current and is measured in amperes

= Electric driving force (voltage difference on both ends of the conductor) measured in volts

= Conductor resistance and measured in ohms Ω h .

Definition of current: is the intensity of the variable current that passes through a solution of the silver net art and which

It precipitates 0.0001118 g of silver per second.

Definition of ohms: is the resistance of a column of mercury 1.063 g long of silver and a section

Transverse to weigh a value of 14.452 10 kg toss at zero degrees HCentennial .

Definition of voltage: as the voltage difference required to flow a current ofone ampere during resistance

It's worth one ounce.

– (Electricity units are measured and depending on global measurement systems)

In the collum and symbolizes it

Definition of colum: is the amount of electricity when a current of oneampere passes per second

So the amount of electricity is given by the following equation.

=

= Number of colomers (amount of electricity).

= Represents the current in amps.

= Represents time in seconds.

Other units of electricity quantity used in calculations are alpha ardai .

It is symbolized by the symbol and one thousand ardai is equal to 96.478 ≈ close to 96.500 coulombs.

Definition of alpha-ardee: is the amount of electric charge per mole of electrons

Question: What is the relationship between Avocadro and Alpha Ardai?

Electron charge = 10 × 1.6 coulombs.

∴ Alpha Arday = Electron Number of Avocadro Charge of $\frac{\text{Electron}}{}$

10×6.023 = Electron which is the number of avocadro

P.S.

Each one P Ardai attaches 10×6.023 charged particles or one equivalent of the substance

Chemical, one equivalent of positive ions is missing this number of Electrons, while one equivalent of negative ions possesses an excess of this number

of electrons.

International system

Physical Quantity	Name of Unit	Unit Symbol	Unit Expressed In terms of Base Units
Force	Newton	N	$m.Kg.s^{-2}$
Energy	Joule	J	$N.m$ or $m^2.Kg.s^{-2}$
Power	Watt	W	$J.s^{-1}$
Quantity of electricity	Coulomb	C	A.s
Electromotive force	Volt	v	$J.A^{-1}.s^{-1}$
Electro resistance	Ohm	Ω	$V.A^{-1}$ or $m^2.Kg.s^{-3}.A^{-2}$
Electric conductance	Siemens	S	Ω^{-1}
Electrical capacitor	Farad	F	$A.v^{-1}.s$ or $m^{-2}.Kg^{-1}.s^4.A^2$
Current density	Current	i	$A.cm^{-2}$
Current	Amper	I	A