كلية العلوم- قسم الكيمياء
جامعة جنوب الوادي

مقرر: Course of

الكيمياء العامة 2

الفرقة الثانية تربية الغردقة - شعبة تعليم أساسي – علوم

English Programme

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العام الجامعي

2021 / 2022م

بيانات أساسية

الكلية: التربية الغردقة – جامعة جنوب الوادي

الفرقة: الثانية – شعبة تعليم اساسي

التخصص: Science

عدد الصفحات: 100

القسم التابع له المقرر : قسم الكيمياء بكلية العلوم بقنا

الرموز المستخدمة

🎞 **فيديو للمشاهدة.**

📖 **نص للقراءة والدراسة.**

🔗 **رابط خارجي.**

❓ **أسئلة للتفكير والتقييم الذاتي.**

📋 **أنشطة ومهام.**

🖥 **تواصل عبر مؤتمر الفيديو.**

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- 4. The effect of pressure (Henry's law)

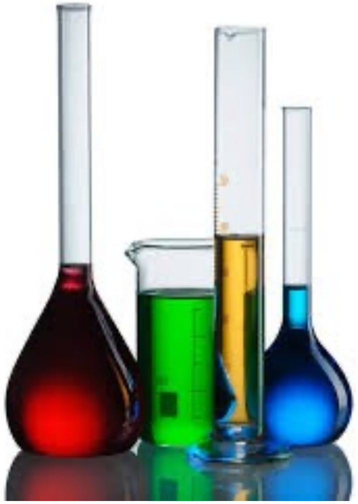
فيديو : كل المحاضرات على قناة اليوتيوب الخاصة باستاذ المادة والمتخصصة في المحاضرات للطلاب.

اسم القناة: Dr. Ibrahim A. I. Hassan

رابط القناة: https://www.youtube.com/user/ihassanify

General Chemistry (II)

2^{nd} Primary Students -Sci. Group (English Program)
Faculty of Education (Hurghada)



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Lect. 1:

Electrochemistry

Electrochemistry

Which concerns with the study of chemical reactions and ions which involve an electrical current.

Some basics of Electrochemistry:

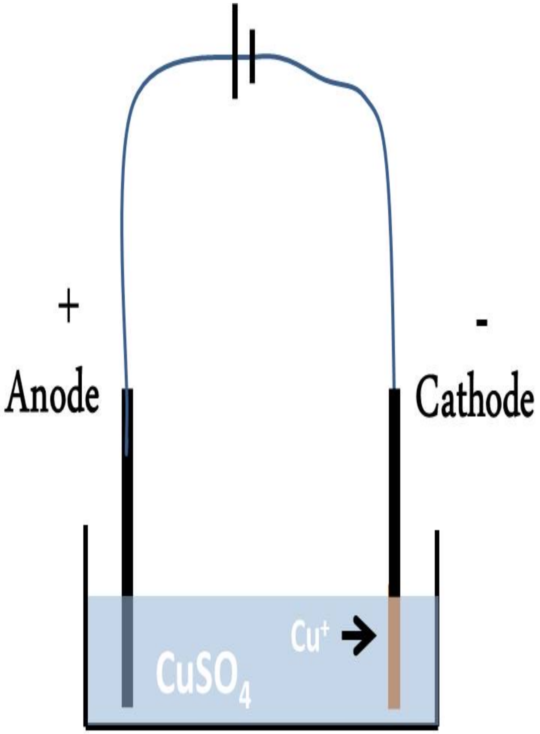
1. All metals are conductors such as Cu, Fe and Al.
2. Most of non-metals are insulators such as P, S, and gasses.
3. Semiconductors are between conductors and insulators.

Electrochemistry

4. Electrolyte is the liquid (soln.) which connects electricity (e.g. NaCl soln.)
5. Non-electrolyte: is the liquid (soln.) which doesn't connect electricity (e.g. Sugar soln.).
6. Molten of some insulators are good conductors, such as PbI_2 molten.
7. Solution of some insulators are good conductors.
8. Pure water is insulator, while tap water is connector.

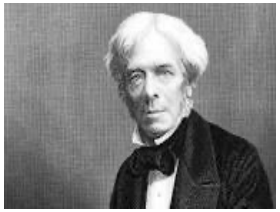
9. **Electrodes**: can be made from Carbon or any metal at which electrons enter or leave the electrolyte solution as current. These electrodes such as:

- ✓ **Anode**: is the electrode at which the electrons enter the external circuit.
- ✓ **Cathode**: is the electrode at which the electrons leave the external circuit.



Electrochemistry

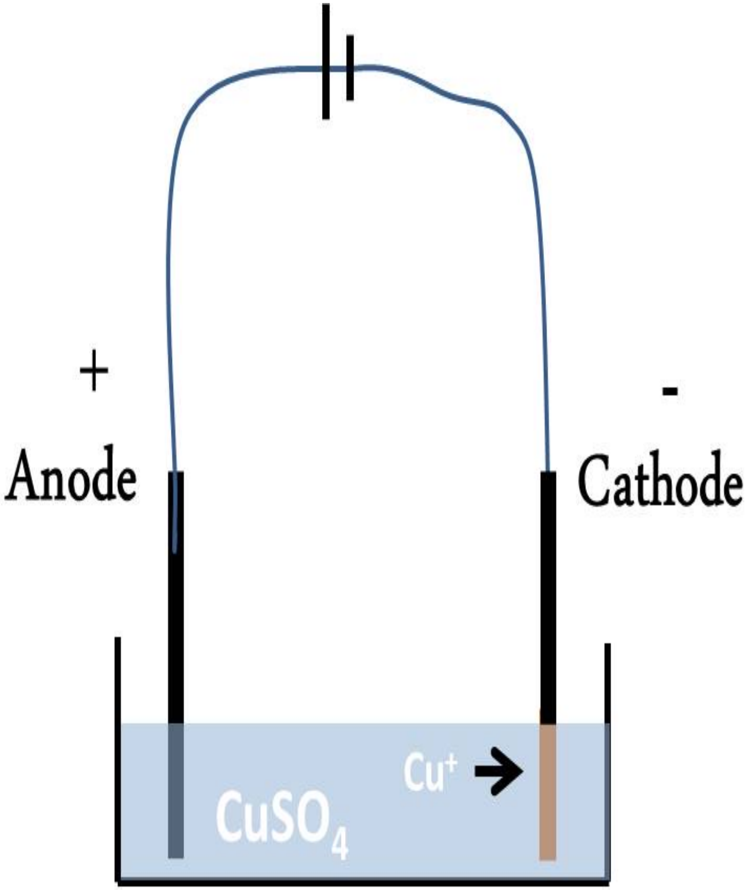
Faraday



Faraday's Electrolysis experiments 1833:-

Electrolysis of $CuSO_4$:

Cu deposited on Cathode, which discovered that there are positive and negative ions in solutions.



Ionic (Arrhenius) theory 1880

Arrhenius

It explained the electrolysis and it states that:-

- There are electrically conductor solutions called electrolytes which contain ions produced from atoms. These ions either positive such as H^+ and metal ions (basic part in salts) or negative ions such as non-metals ions or acidic part in salts. The number of charge represents the atom charge.

e.g. in NaCl ; Na^+ is positive and Cl^- is negative.

- Ions are formed from atoms through losing or gaining of electrons:

$$S + 2e \longrightarrow S^{--} \qquad Ca - 2e \longrightarrow Ca^{++}$$

Ions and atoms for the same element have different properties:

For examples:

- Chlorine (Cl_2) is yellow and remove the colours, while chloride (Cl^-) doesn’t have these characters.
- Sodium (Na) attacks water releasing explosive Hydrogen, while Na^+ doesn’t have this effect.

Electrolytes

1. **Strong Electrolytes:** Which is completely ionised such as mineral acids (HCl) and strong alkalises (NaOH) and strong salts (NaCl).
2. Weak electrolytes: Which is partially ionised such as CH_3COOH.
3. Moderate electrolytes: such as CCl_3COOH which is more ionised than CH_3COOH but less than HCl.

Non-Electrolytes

Which found in its molecular formula and can't be ionised in aqueous solns. Such as trichloro-Methane ($CHCl_3$), Cane Sugar ($C_{12}H_{22}O_{11}$), Alcohols (C_2H_5OH), and Urea (CON_2H_4)

water as electrolyte:

- Water is very weak electrolyte.

$$H_2O \rightleftharpoons OH^- + H^+$$

- It was found that in 600 m molecules of water; there is only one ionised molecule. So it is very weak conductor (insulator).

- If H^+ and OH^- were removed by electrolysis of water, water should be ionised to compensate the lose of ions to keep K_w as constant as 10^{-14}.

Experiment of electrical ions movements:

- If a crystal of $KMnO_4$ was put on a wet paper under a microscope.
- By applying 20 V potential the violet color (MnO_4^-) will move towards Anode in 15 minutes.

Any Questions

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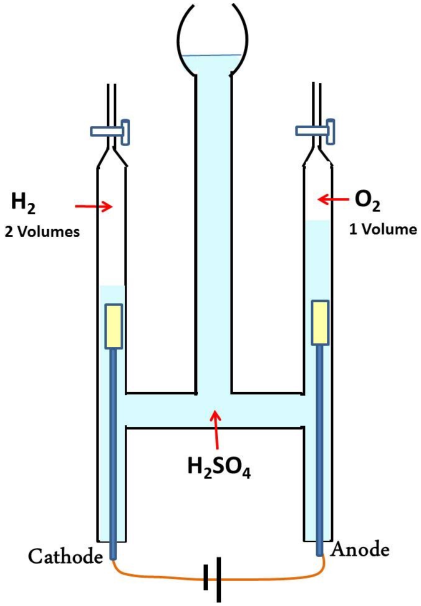

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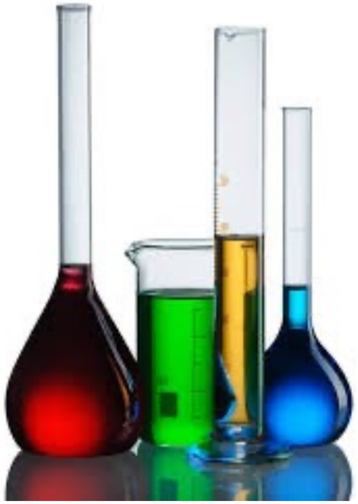

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Lect. 2:

Electrochemical Cells.

Electrochemical Cells

Electrochemical Cell:

In which a chemical reaction is taken place either producing or consuming electricity.

Types of electrochemical Cells:

1. Electrolytic cell:

In which an electrolysis of a chemical compound is taken place through consuming electricity.

2. Galvanic Cell:

In which a chemical reaction is taken place producing electricity.

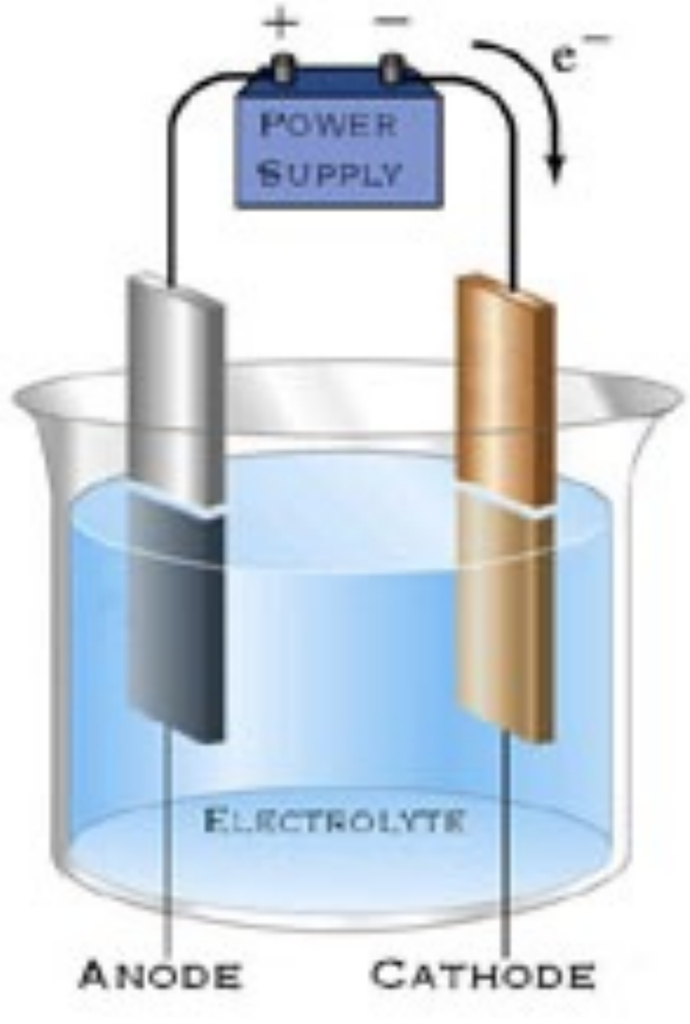
Anode and Cathode in Electrochemical Cells

electrolytic cell

Cathode and Anode

- **Cathode (-):** is the electrode at which the electrons enter to electrolyte (leave the external circuit).

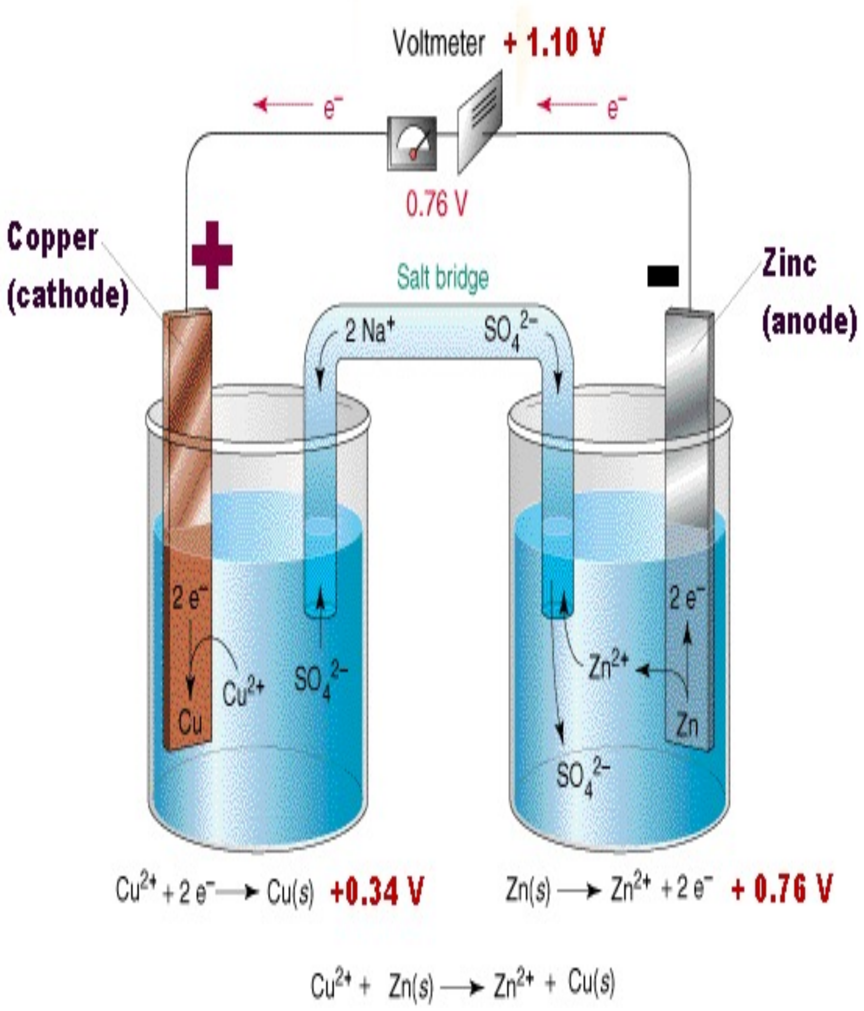
- **Anode (+):** is the electrode at which the electrons leave the electrolyte (enter the external circuit).



Galvanic cell

- **Anode (-)** : is the electrode at which the electrons leave the electrolyte (enter the external circuit).

- **Cathode (+)** : is the electrode at which the electrons enter to electrolyte (leave the external circuit).



$Cu^{2+} + 2e^- \rightarrow Cu(s)$ **+0.34 V**

$Zn(s) \rightarrow Zn^{2+} + 2e^-$ **+ 0.76 V**

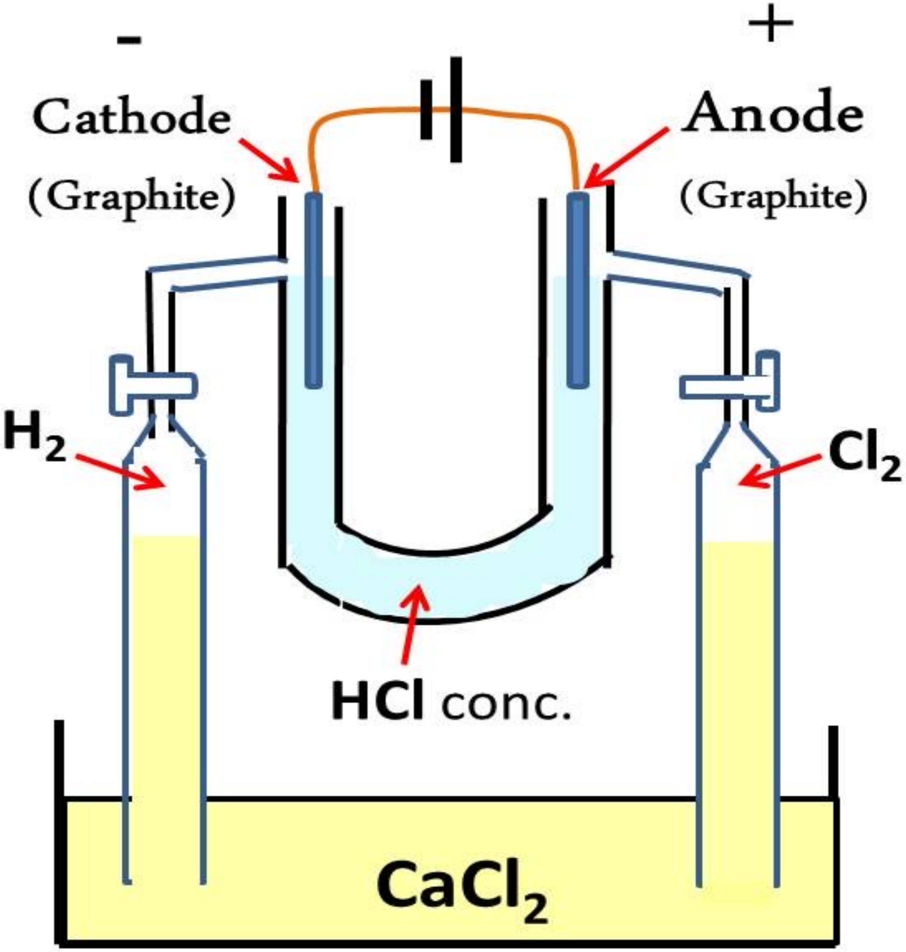
$Cu^{2+} + Zn(s) \rightarrow Zn^{2+} + Cu(s)$

Electrolysis
via
Electrolytic cells

Mechanism of electrolysis

1. Electrolysis of conc. HCl

- H^+ will be reduced at Cathode forming colourless hydrogen gas.
- Cl^- will be oxidised at Anode producing Chlorine.



Mechanism of electrolysis

At Cathode:

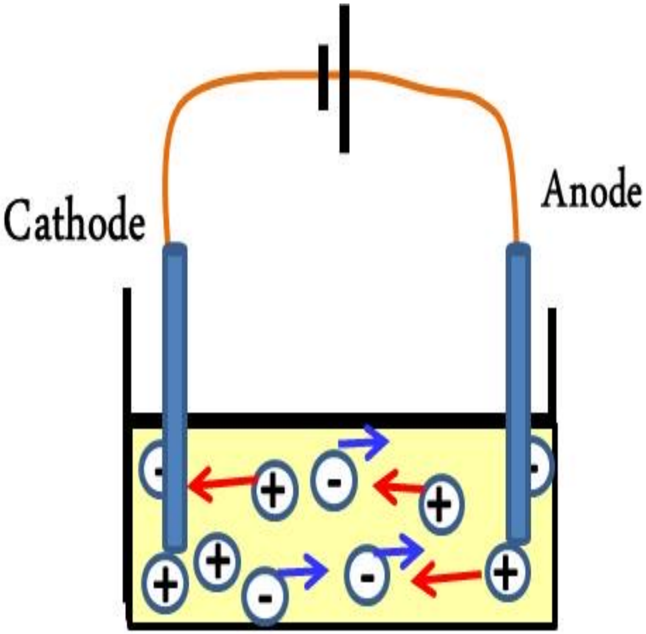
$$H^+ + e \longrightarrow H$$

$$H + H \longrightarrow H_2$$

At Anode:

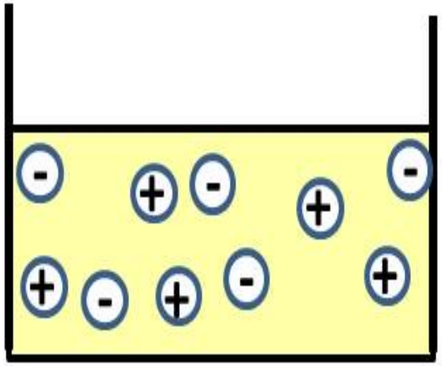
$$Cl^- - e \longrightarrow Cl$$

$$Cl + Cl \longrightarrow Cl_2$$



Ions movement

towards electrodes



H^+ and Cl^- ions

Selective discharge of ions

Selective discharge of ions:

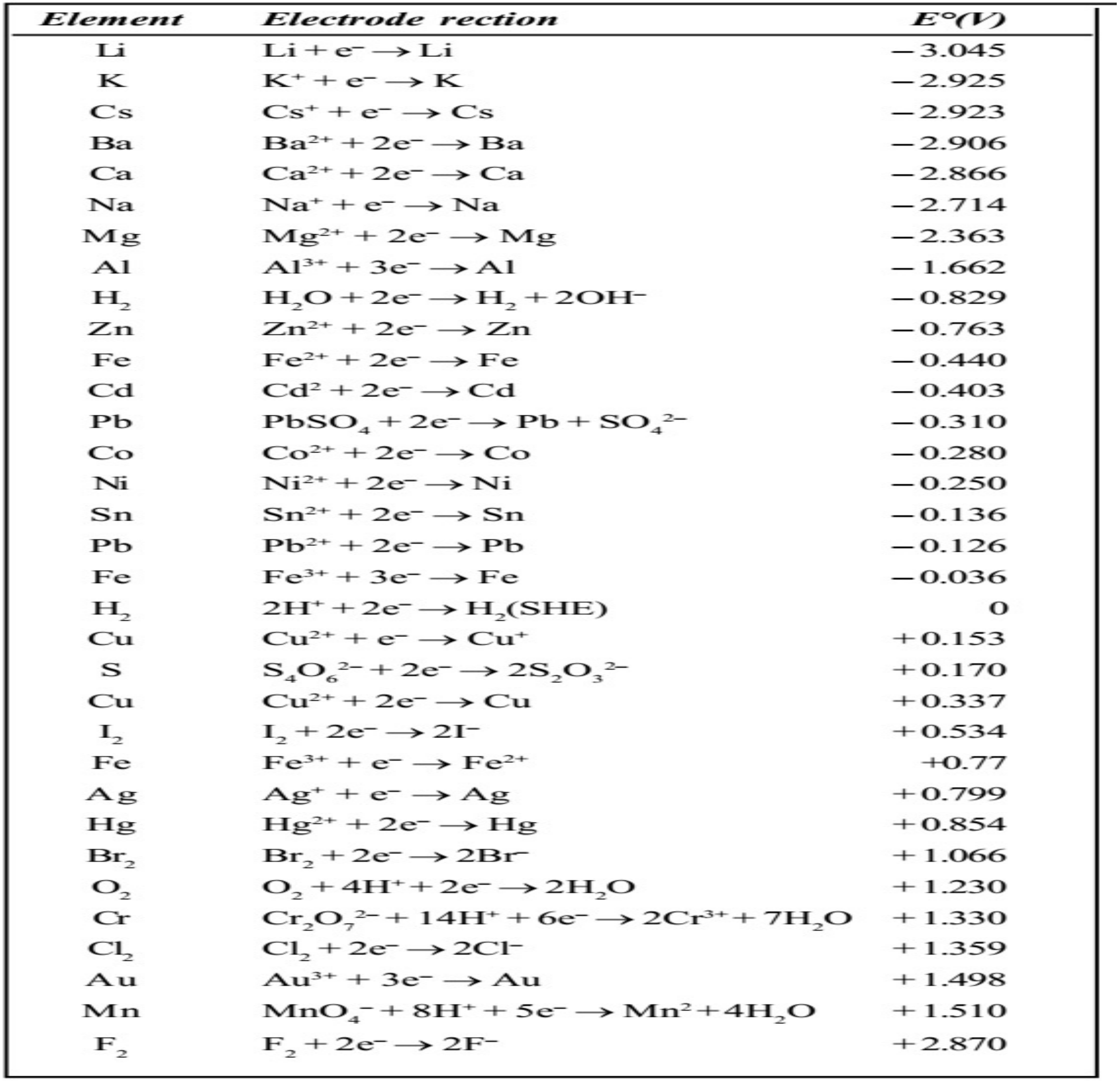
In case of presence more than one ion with the same charge such as $SO4^{2-}$, OH^{-} or Na^{+}, H^{+}, one of these ions will be preferred to be discharged than the others.

Factors affecting on Selective discharge of ions:

1. Element location at electrochemical series?!

Electrochemical series

Electrochemical Series



Element	*Electrode rection*	*E°(V)*
Li	$Li + e^- \rightarrow Li$	−3.045
K	$K^+ + e^- \rightarrow K$	−2.925
Cs	$Cs^+ + e^- \rightarrow Cs$	−2.923
Ba	$Ba^{2+} + 2e^- \rightarrow Ba$	−2.906
Ca	$Ca^{2+} + 2e^- \rightarrow Ca$	−2.866
Na	$Na^+ + e^- \rightarrow Na$	−2.714
Mg	$Mg^{2+} + 2e^- \rightarrow Mg$	−2.363
Al	$Al^{3+} + 3e^- \rightarrow Al$	−1.662
H_2	$H_2O + 2e^- \rightarrow H_2 + 2OH^-$	−0.829
Zn	$Zn^{2+} + 2e^- \rightarrow Zn$	−0.763
Fe	$Fe^{2+} + 2e^- \rightarrow Fe$	−0.440
Cd	$Cd^2 + 2e^- \rightarrow Cd$	−0.403
Pb	$PbSO_4 + 2e^- \rightarrow Pb + SO_4^{2-}$	−0.310
Co	$Co^{2+} + 2e^- \rightarrow Co$	−0.280
Ni	$Ni^{2+} + 2e^- \rightarrow Ni$	−0.250
Sn	$Sn^{2+} + 2e^- \rightarrow Sn$	−0.136
Pb	$Pb^{2+} + 2e^- \rightarrow Pb$	−0.126
Fe	$Fe^{3+} + 3e^- \rightarrow Fe$	−0.036
H_2	$2H^+ + 2e^- \rightarrow H_2(SHE)$	0
Cu	$Cu^{2+} + e^- \rightarrow Cu^+$	+0.153
S	$S_4O_6^{2-} + 2e^- \rightarrow 2S_2O_3^{2-}$	+0.170
Cu	$Cu^{2+} + 2e^- \rightarrow Cu$	+0.337
I_2	$I_2 + 2e^- \rightarrow 2I^-$	+0.534
Fe	$Fe^{3+} + e^- \rightarrow Fe^{2+}$	+0.77
Ag	$Ag^+ + e^- \rightarrow Ag$	+0.799
Hg	$Hg^{2+} + 2e^- \rightarrow Hg$	+0.854
Br_2	$Br_2 + 2e^- \rightarrow 2Br^-$	+1.066
O_2	$O_2 + 4H^+ + 2e^- \rightarrow 2H_2O$	+1.230
Cr	$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$	+1.330
Cl_2	$Cl_2 + 2e^- \rightarrow 2Cl^-$	+1.359
Au	$Au^{3+} + 3e^- \rightarrow Au$	+1.498
Mn	$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^2 + 4H_2O$	+1.510
F_2	$F_2 + 2e^- \rightarrow 2F^-$	+2.870

Selective discharge of ions:

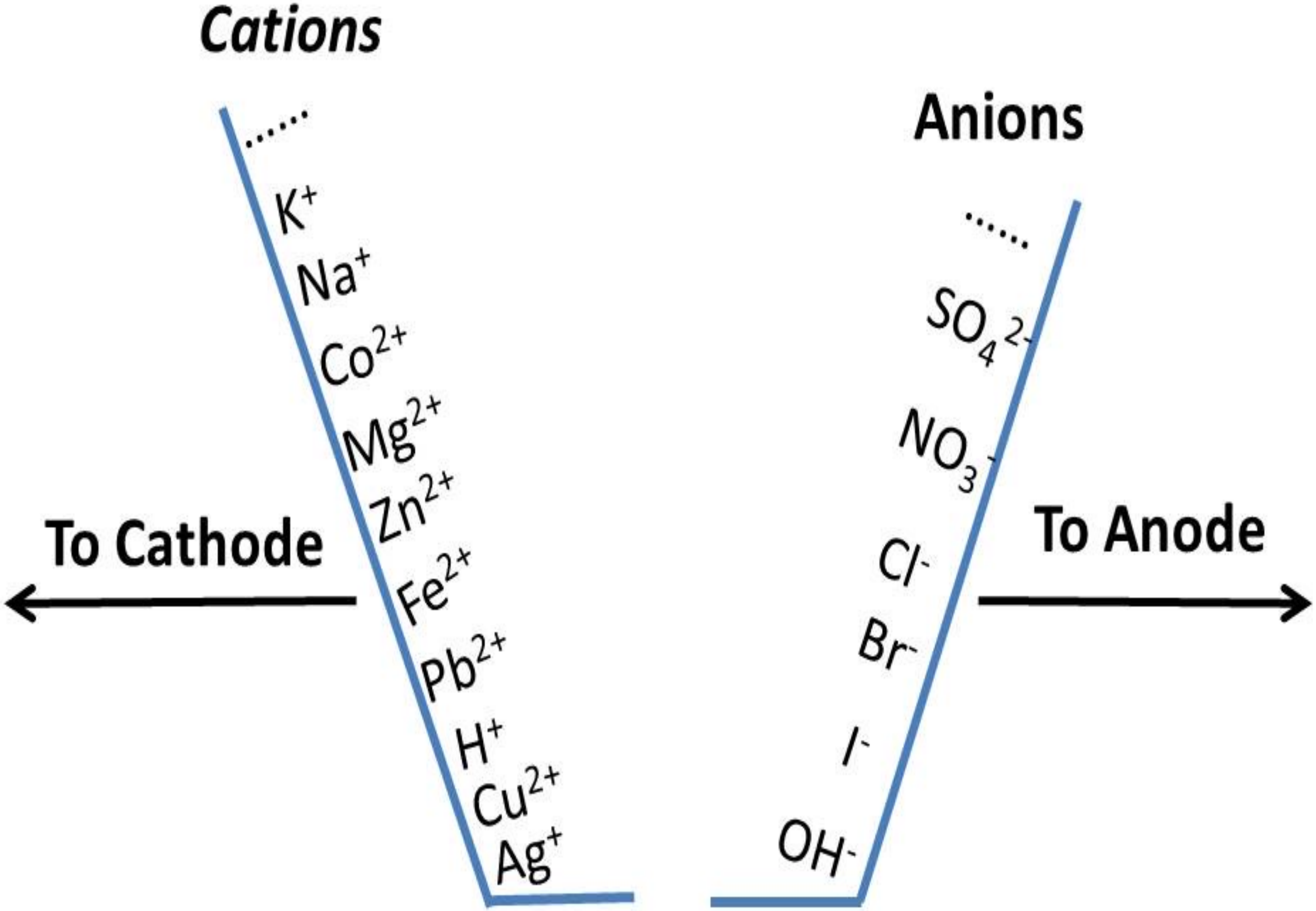
Factors affecting on Selective discharge of ions:

1. Element location at electrochemical series:

Ions discharged according to their location in the electrochemical series

- e.g. in NaOH soln., it contains H^+ (from water), Na^+ so it is preferred to discharge H^+ before Na^+.
- In $CuSO_4$, discharge OH^- before SO_4^{-2}.

Electrochemical Series



Cations

……

K^+

Na^+

Co^{2+}

Mg^{2+}

Zn^{2+}

Fe^{2+}

Pb^{2+}

H^+

Cu^{2+}

Ag^+

To Cathode

Anions

……

SO_4^{2-}

NO_3^-

Cl^-

Br^-

I^-

OH^-

To Anode

Factors affecting on Selective discharge of ions:

2. **Concentration:** If the ions were found in high concentration, that will help in their discharge.

In conc. HCl which contains OH^- (from water) and Cl^-, the Cl^- is much higher concentration, so it will be discharged first. But if the acid was diluted, OH^- discharging will be preferred.

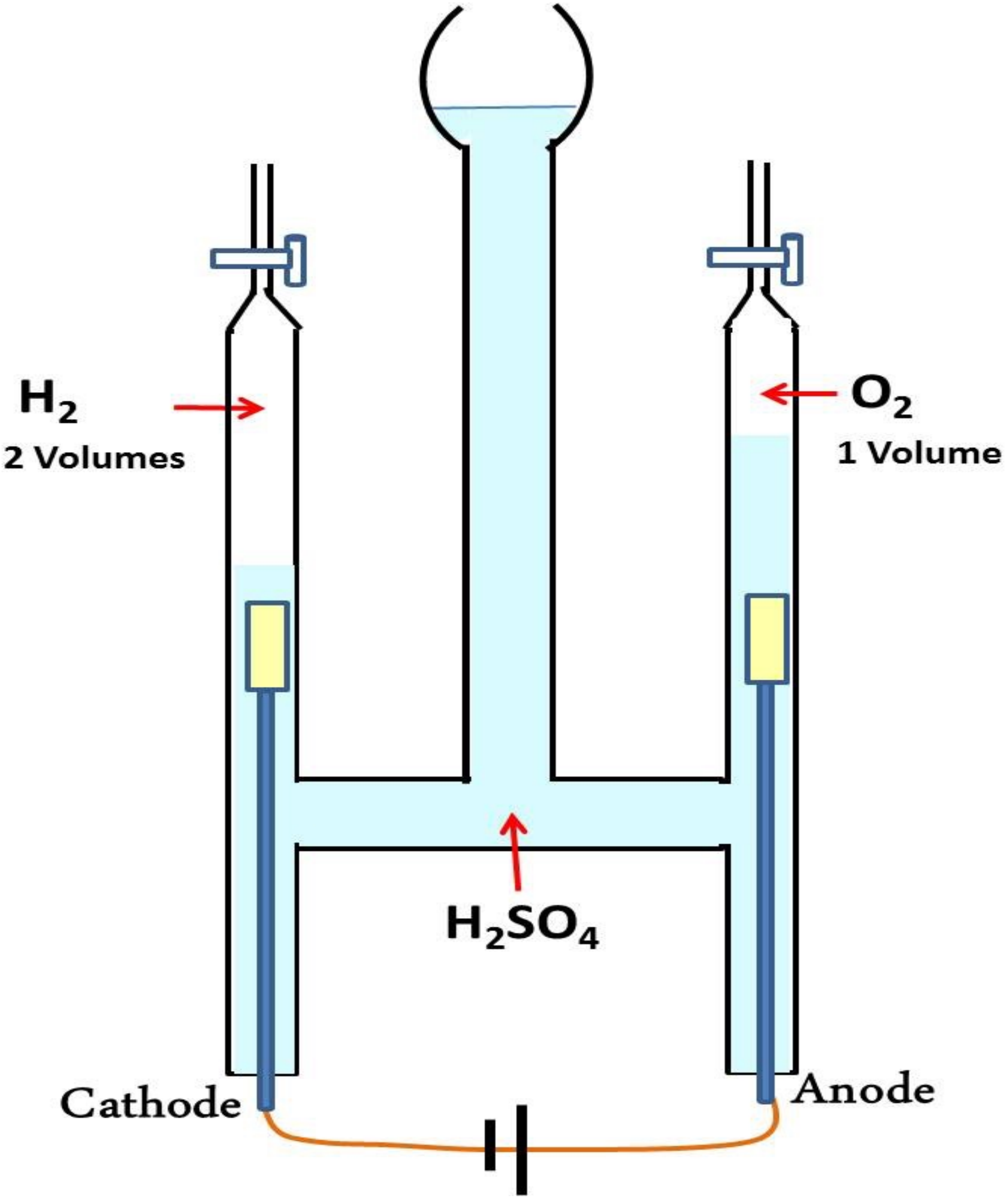
3. **Electrode type:** some electrodes are selective in ions discharging.

e.g. In case of electrolysis of NaCl by using Pt as Cathode, H^+ (from water) will be discharged before Na^+ (according to electrochemical series).

While if Hg was used as Cathode, Na^+ will be discharged first to form amalgam with Hg.

Electrolysis of dil. H_2SO_4

(it called H_2O electrolysis)



Anode

$SO_4^{2-}{}_{(aq)}$ & $OH^-{}_{(aq)}$

$OH^-{}_{(aq)} - e^- \longrightarrow OH_{(aq)}$

$OH_{(aq)} + OH_{(aq)} \longrightarrow H_2O_{(l)} + O_{(aq)}$

$O_{(aq)} + O_{(aq)} \longrightarrow O_{2\,(gas)}$

$H_2O_{(l)} \rightleftharpoons H^+{}_{(aq)} + OH^-{}_{(aq)}$

H^+ and SO_4^{2-} increase

Acidity increases

1 Volume Oxygen

Cathode

$H^+{}_{(aq)}$

$H^+{}_{(aq)} + e^- \longrightarrow H_{(aq)}$

$H_{(aq)} + H_{(aq)} \longrightarrow H_{2\,(gas)}$

H^+ decreases

Acidity decreases

2 Volumes Hydrogen

Electrolysis of NaOH

Cathode

$H^+_{(aq)}$ and $Na^+_{(aq)}$

$H^+_{(aq)} + e^- \longrightarrow H_{(aq)}$

$H_{(aq)} + H_{(aq)} \longrightarrow H_{2\,(gas)}$

$H_2O_{(l)} \rightleftharpoons H^+_{(aq)} + OH^-_{(aq)}$

Na^+ & OH^- increase

Basicity increases

2 Volumes Hydrogen

Anode

$OH^-_{(aq)}$

$OH^-_{(aq)} - e^- \longrightarrow OH_{(aq)}$

$OH_{(aq)} + OH_{(aq)} \longrightarrow H_2O_{(l)} + O_{(aq)}$

$O_{(aq)} + O_{(aq)} \longrightarrow O_{2\,(gas)}$

$H_2O_{(l)} \rightleftharpoons H^+_{(aq)} + OH^-_{(aq)}$

H^+ increases

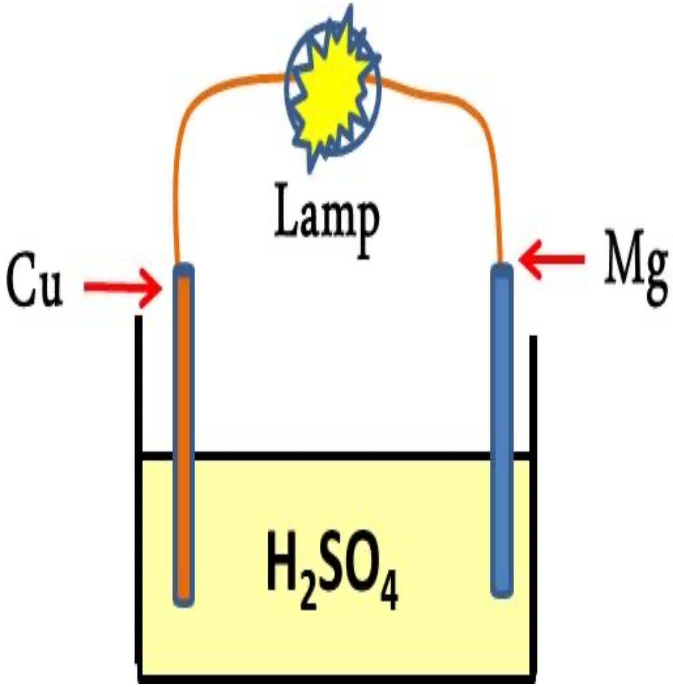
Basicity decreases

1 Volume Oxygen

Producing electricity
Via
Galvanic Cells

Conversion of Chemical reaction into electricity

- Cu-Mg Galvanic cell is constructed by connecting the two electrodes together and immersed them partially in H_2SO_4 solution (as shown).
- This cell gives 1.25 V.
- In this cell Mg is ionised producing 2 electrons which transfer through the wire into Cu electrode.



- Hydrogen will be reduced forming gas bubbles which prevents the contact of Cu to the electrolyte causing polarisation

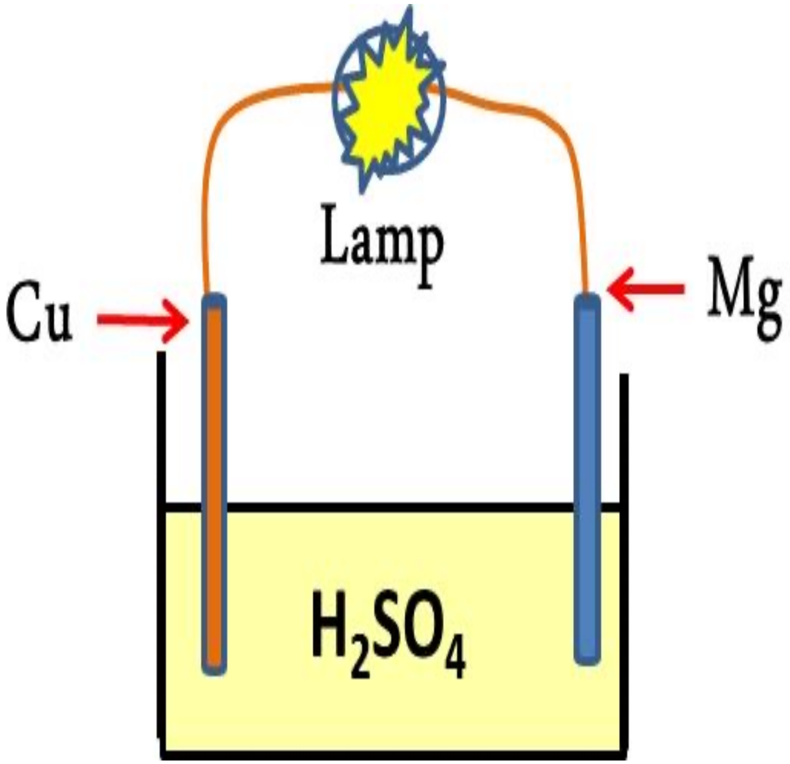
Conversion of Chemical reaction into electricity

At Mg electrode:

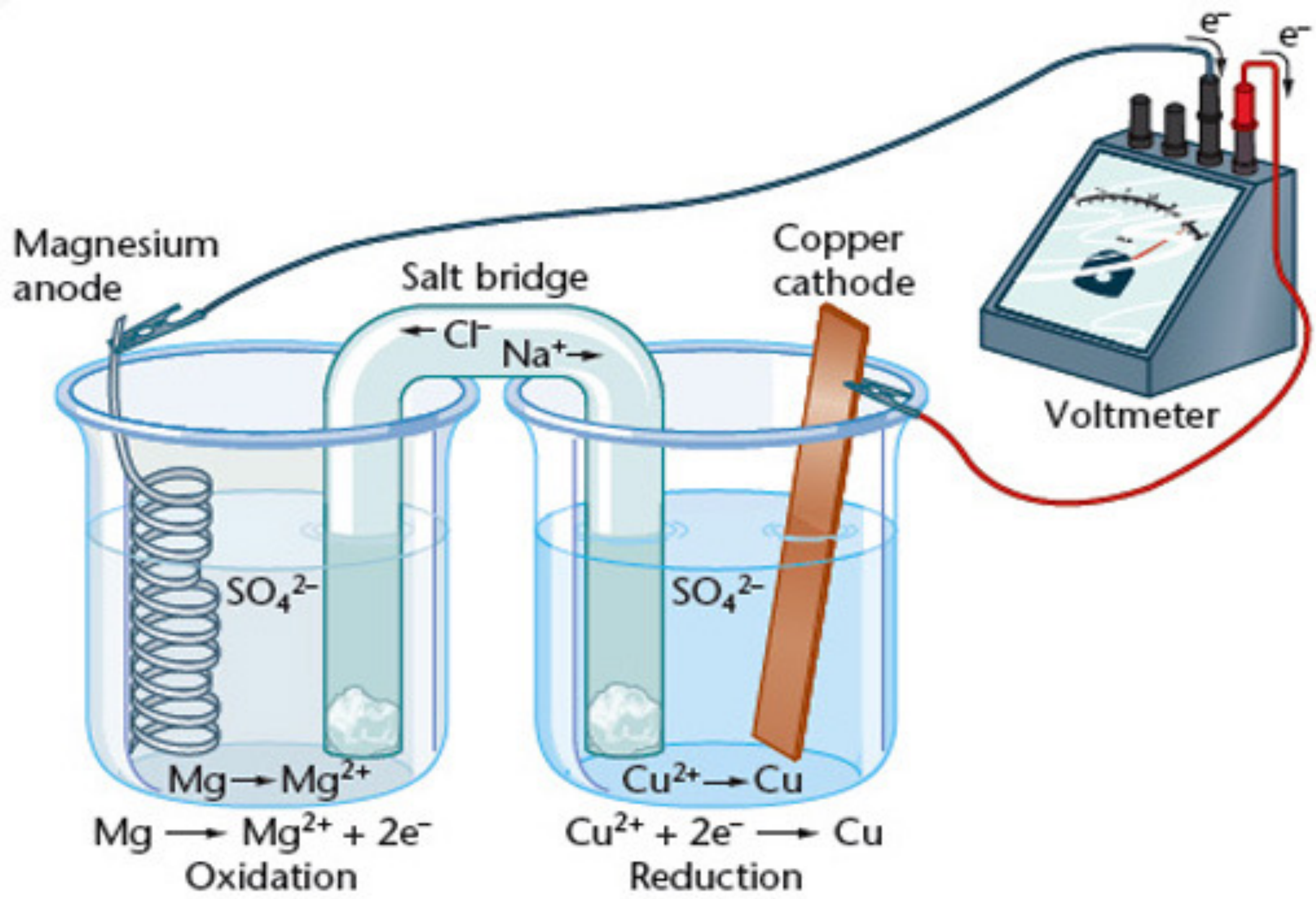
$$Mg_{(s)} \longrightarrow Mg^{2+}_{(aq)} + 2\,e^-$$

At Cu electrode:

$$2H^+_{(aq)} + 2\,e^- \longrightarrow H_{2(gas)}$$



Conversion of Chemical reaction into electricity



leclanche cell

a primary electrochemical cell having a zinc Anode in contact with ammonium chloride (as a solution or a paste) as the electrolyte, and a carbon Cathode in contact with a mixture of manganese dioxide and carbon powder.

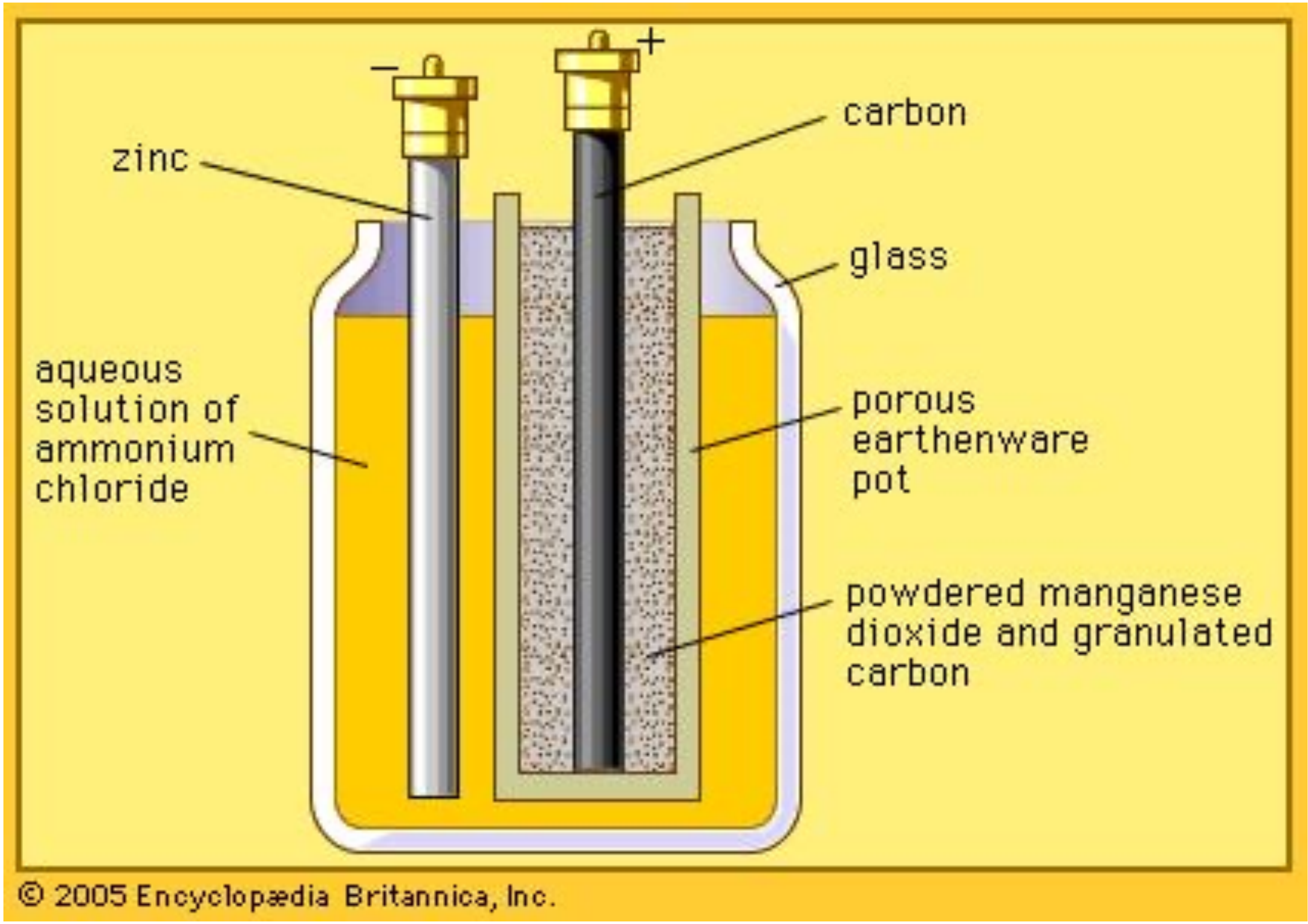
Cathode (+) = Carbon. Anode (-) = Zn. Electrolyte = NH_4Cl soln.

Cell working Mechanism

- when the two electrodes are connected, Zinc dissolves into its ions giving electrons which transfer to Carbon electrode through the wire doing the wanted work (e.g lightning the lamp).
- NH_4^+ is reduced at the Cathode into NH_3 producing hydrogen gas which is oxidised by using MnO_2.

Conversion of Chemical reaction into electricity

leclanche cell



Car Battery: is a rechargeable Battery

Cathode(+): Pb-Sb net

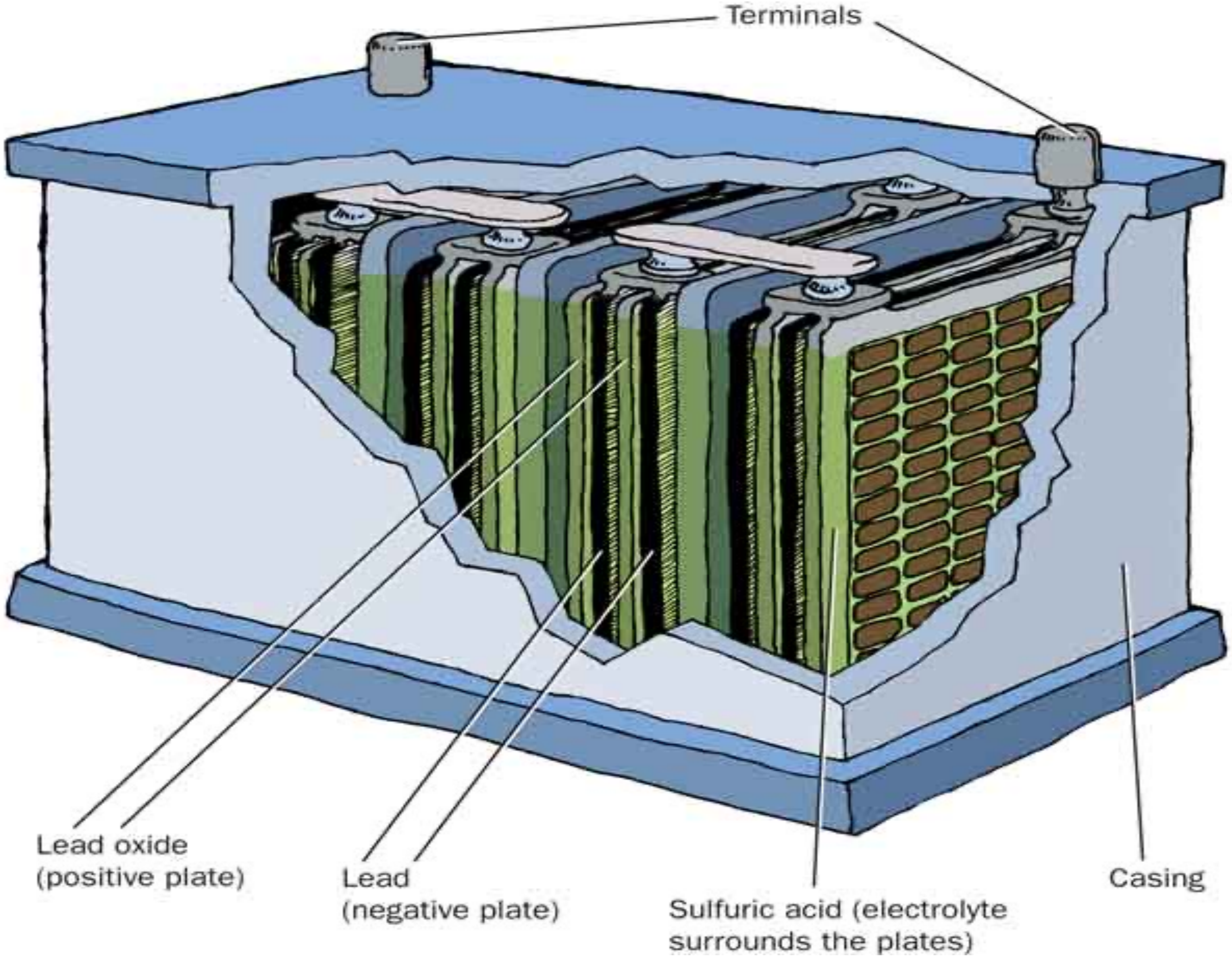
Anode (-) : Pb-Sb net

Electrolyte: H_2SO_4 soln.

Mechanism

- Both of Anode and Cathode nets are filled with $PbSO_4$ paste.
- Charging and discharging processes occur.

Conversion of Chemical reaction into electricity



Charging Process:

- It occurs through passing an electrical current in one direction thorough the battery.

At Cathode

$$Pb^{2+}_{(aq)} + 2e^- \longrightarrow Pb_{(s)}$$

SO_4^{2-} into solution

At Anode

$$Pb^{2+}_{(aq)} + 2H_2O_{(l)} - 2e^- \longrightarrow PbO_{2\,(s)} + 4H^+_{(aq)}$$

SO_4^{2-} into solution

Charging Process:

- At charging process the filled paste of Cathode (-) net will be mainly Pb, and that for Anode (+) will become mainly PbO_2.
- Charging process will lead to accumulation of $2SO_4^{-2}$: $4H^+$ which leads to increase the acidity.
- By full charged battery can provide 2 V e.m.f.

Discharging process:

At Anode (-)

$$Pb_{(s)} \longrightarrow Pb^{2+}_{(aq)} + 2e^-$$

SO_4^{2-} taken from soln

$PbSO_4$ precipitated

At Cathode (+)

$$PbO_{2(s)} + 4H^+_{(aq)} + 2e^- \longrightarrow Pb^{2+}_{(aq)} + 2H_2O_{(l)}$$

SO_4^{2-} , H^+ taken from soln

$PbSO_4$ precipitated

Discharging process:

- The produced electrons at Anode (-) will pass through the external circuit doing the required electrical work and they will consumed at Cathode (+).

- By consuming SO_4^{-2} at Anode area and H^+ at Cathode area with the ratio 2 : 4 respectively, that will lead to consume H_2SO_4, so the e.m.f will decrease. So charging process should be taken place.

Any Questions

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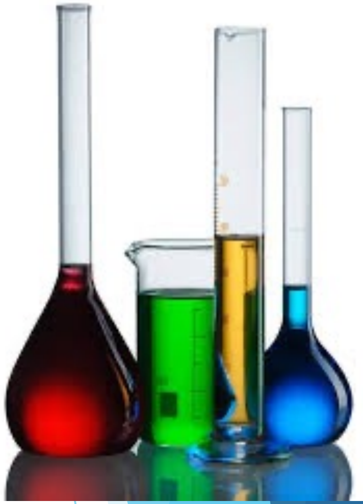

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Lect. 3

Colloids

Solutions

- Homogeneous mixtures
- **Solvent** = dissolving medium and presents in the larger amount
  - often liquid; frequently water
  - gas in air and other gas solutions
  - rarely a solid
- **Solute(s)** = dissolved material(s) and present in the smaller amount(s)
  - solids, liquids, or gases
  - often more than one solute

Solutions

A **saturated solution** contains the maximum amount of a solute that will dissolve in a given solvent at a specific temperature.

An **unsaturated solution** contains less solute than the solvent has the capacity to dissolve at a specific temperature.

A supersaturated solution contains more solute than is present in a saturated solution at a specific temperature.

Solutions *vs* Colloids

- Solution
  - Solute particle are of ionic or molecular size (a few nm across)
  - Transparent to ordinary light
  - Stable unless solvent evaporated
- Colloids
  - Solute (called “dispersed phase”) typically -1 nm to 1000 nm
  - Giant molecules (or “clumps” of smaller ones)
  - Not totally transparent – Tyndall Effect
  - Dispersed phase may separate out (similar to separation of mayonnaise).

Suspensions and Colloids

Suspensions and colloids are NOT solutions.

Suspensions: The particles are so large that they settle out of the solvent if not constantly stirred.

Colloids: The particle is intermediate in size between those of a suspension and those of a solution.

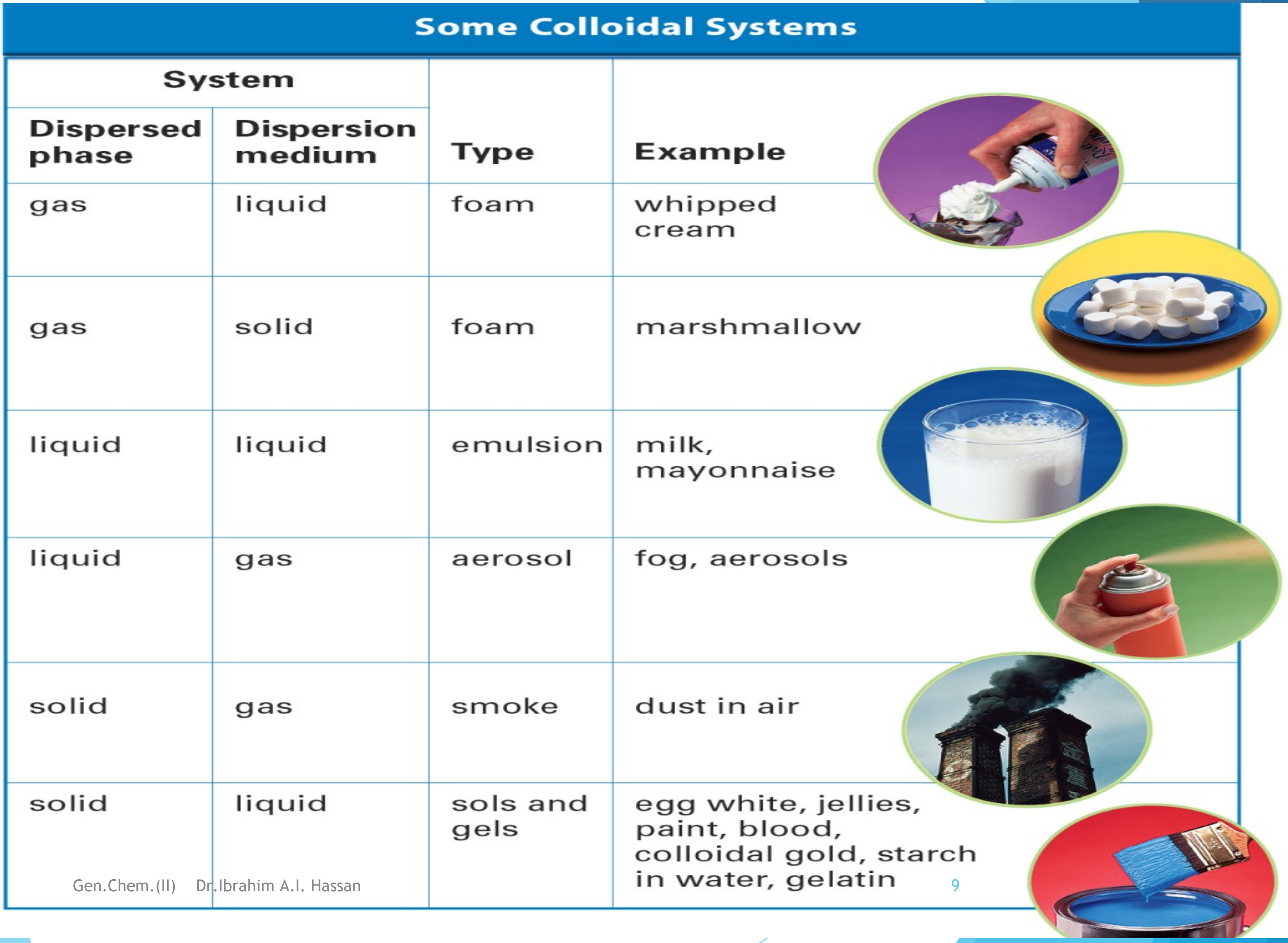
Solutions	Colloidal Dispersions	Suspensions
Transparent (but often colored)	**Often translucent or opaque, but may be transparent**	**Often opaque but, may appear translucent**
No Tyndall effect	**Tyndall effect**	**Not applicable**
No Brownian movement	**Brownian movement**	**Particles separate unless system is stirred**
Cannot be separated by filtration	**Cannot be separated by filtration**	**Can be separated by filtration**

Colloids

- Colloids are everywhere
    - In the human body
    - Washing powder, soup, toothpaste, etc.
    - Many foods (yogurt, butter, milk)
    - Nanotechnologies are based on chemistry of colloids

Types of Colloids

Examples	Dispersed Substance	Dispersing Medium	Colloid Type
Fog, aerosol sprays	Liquid	Gas	Aerosol
Smoke, airborne bacteria	Solid	Gas	Aerosol
Whipped cream, soap suds	Gas	Liquid	Foam
Milk, mayonnaise	Liquid	Liquid	Emulsion
Paint, clays, gelatin	Solid	Liquid	Sol
Marshmallow, Styrofoam	Gas	Solid	Solid foam



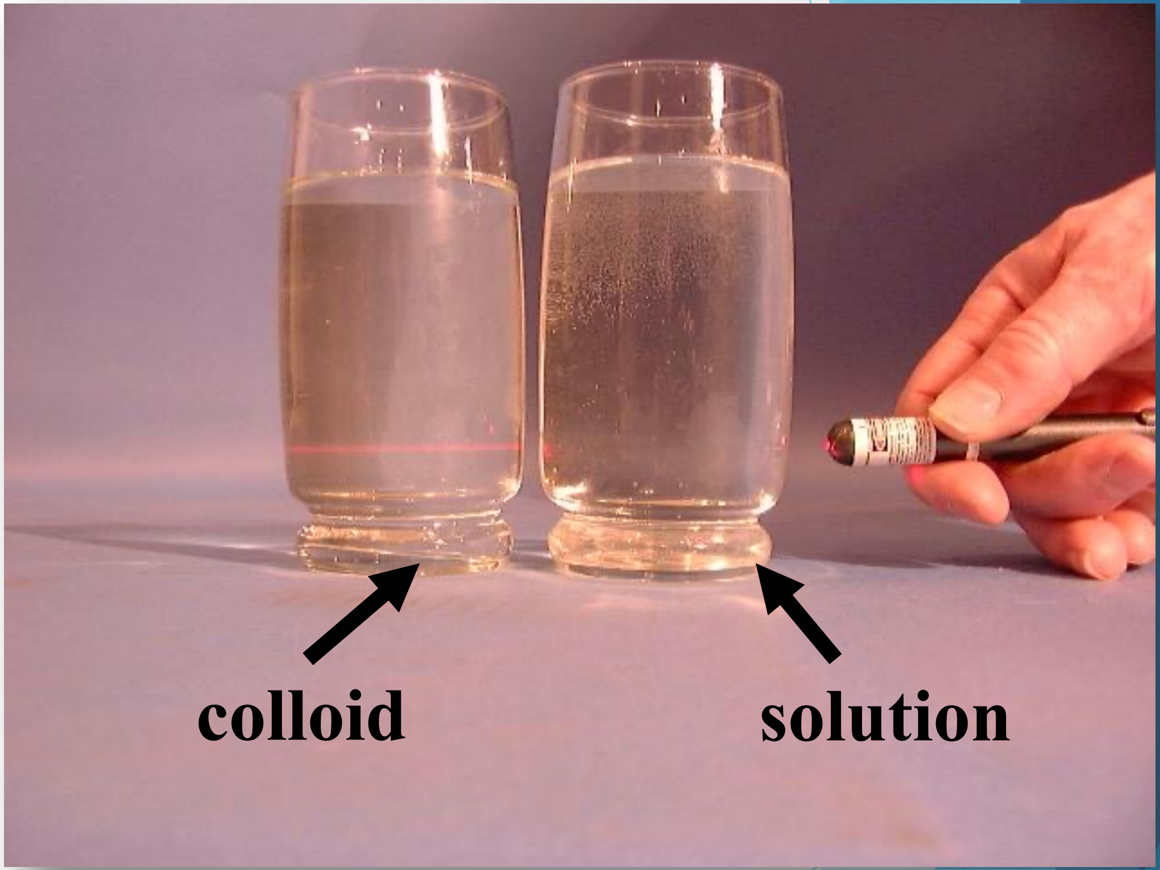
Some Colloidal Systems

System		Type	Example
Dispersed phase	Dispersion medium		
gas	liquid	foam	whipped cream
gas	solid	foam	marshmallow
liquid	liquid	emulsion	milk, mayonnaise
liquid	gas	aerosol	fog, aerosols
solid	gas	smoke	dust in air
solid	liquid	sols and gels	egg white, jellies, paint, blood, colloidal gold, starch in water, gelatin

The Tyndall Effect

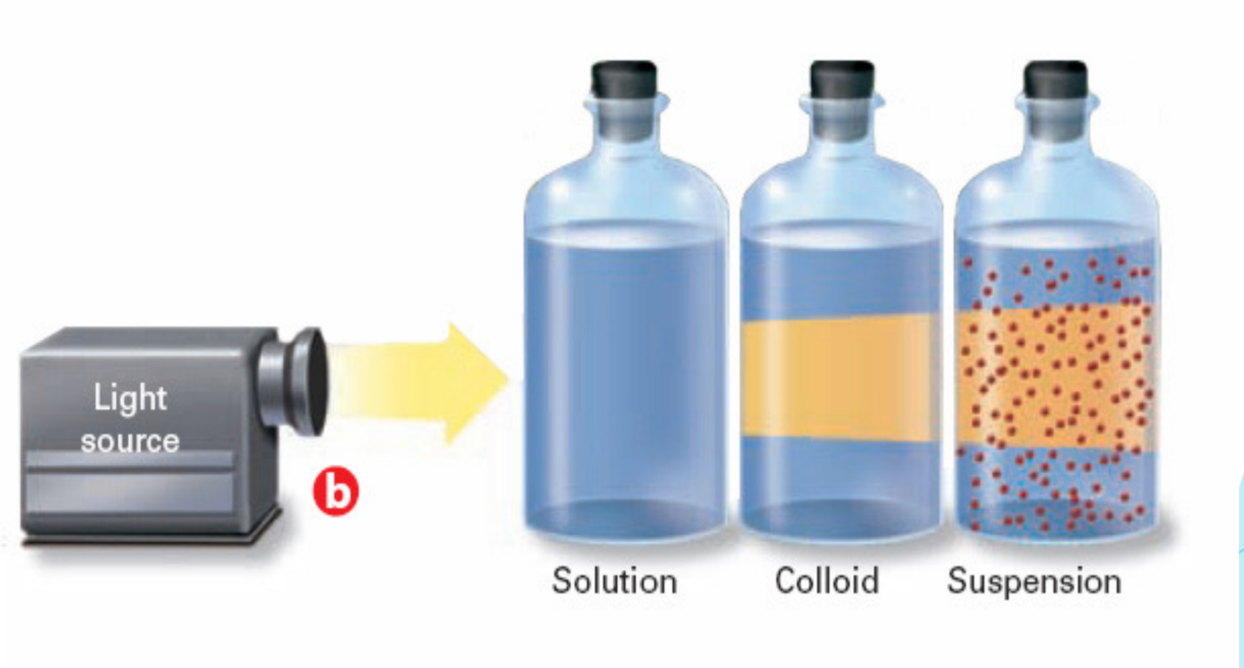
Colloids scatter light, making a beam visible. Solutions do not scatter light.

Which glass contains a colloid?



Colloids

Particles in colloids and suspensions reflect or scatter light in all directions. Solutions do not scatter light.



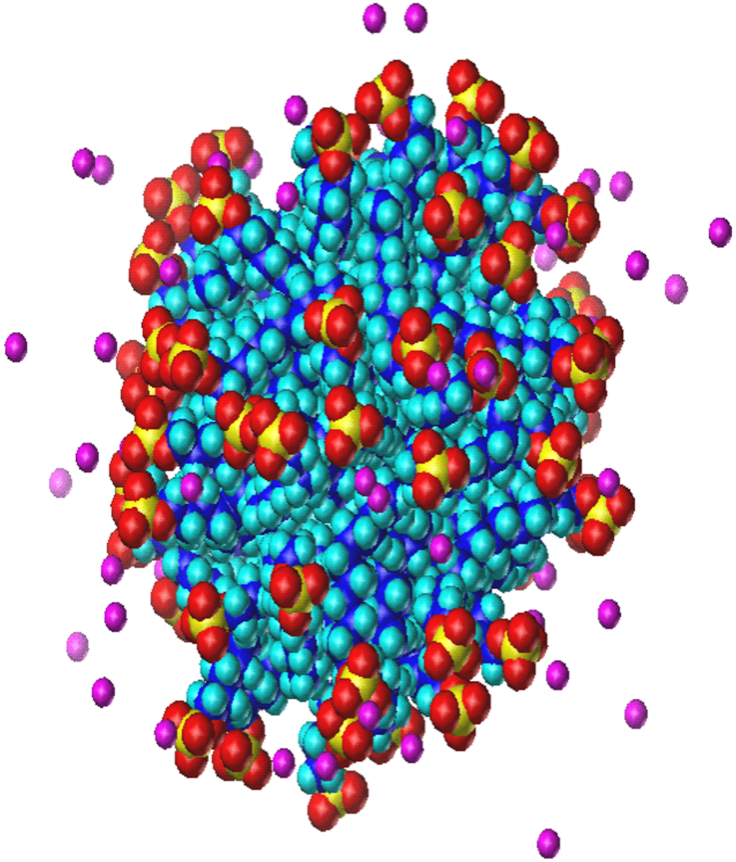
Colloids

Brownian Motion

- The chaotic movement of colloidal particles, which was first observed by the Scottish botanist Robert Brown (1773–1858), is called **Brownian motion.**
- Brownian motion is caused by collisions of the molecules of the dispersion medium with the small, dispersed colloidal particles.

Removal of Colloidal Particles

- ❑Colloid particles are too small to be separated by physical means (e.g. filtration).
- ❑Colloid particles are coagulated (enlarged) until they can be removed by filtration.



Removal of Colloidal Particles

Methods of coagulation:

- ☐Heating: (colloid particles move and are attracted to each other when they collide);
- ☐Adding an electrolyte: (neutralize the surface charges on the colloid particles).
- ☐Dialysis: using a semipermeable membranes separate ions from colloidal particles.

Lyophilic & Lyophobic Colloids

- ❑If the colloids in water, it called Hydrophilic & Hydrophobic Colloids

- ❑“Water loving” colloids: hydrophilic.
- ❑“Water hating” colloids: hydrophobic.

Any Questions

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Lect. 4

Preparation of Colloids

Colloids

Preparation methods of Colloids

There are two methods: Dispersion method and Condensation method.

I- Dispersion method :

- **The substance is crushed into small particles until its diameter reaches between (1 : 100 nm), then added to the dispersed medium with stirring.**
- **For examples: starch in hot water, and cappuccino coffee .**

I- Dispersion method :

1- Electrical Disintegration (Bredig’s Arc Method):

- It is the combination of dispersion and condensation.
- This technique is most commonly used for the preparation of colloidal solutions of metals such as gold, silver, platinum, etc.
- It involves the use of two metal electrodes dipped in a dispersion medium.

I- Dispersion method :

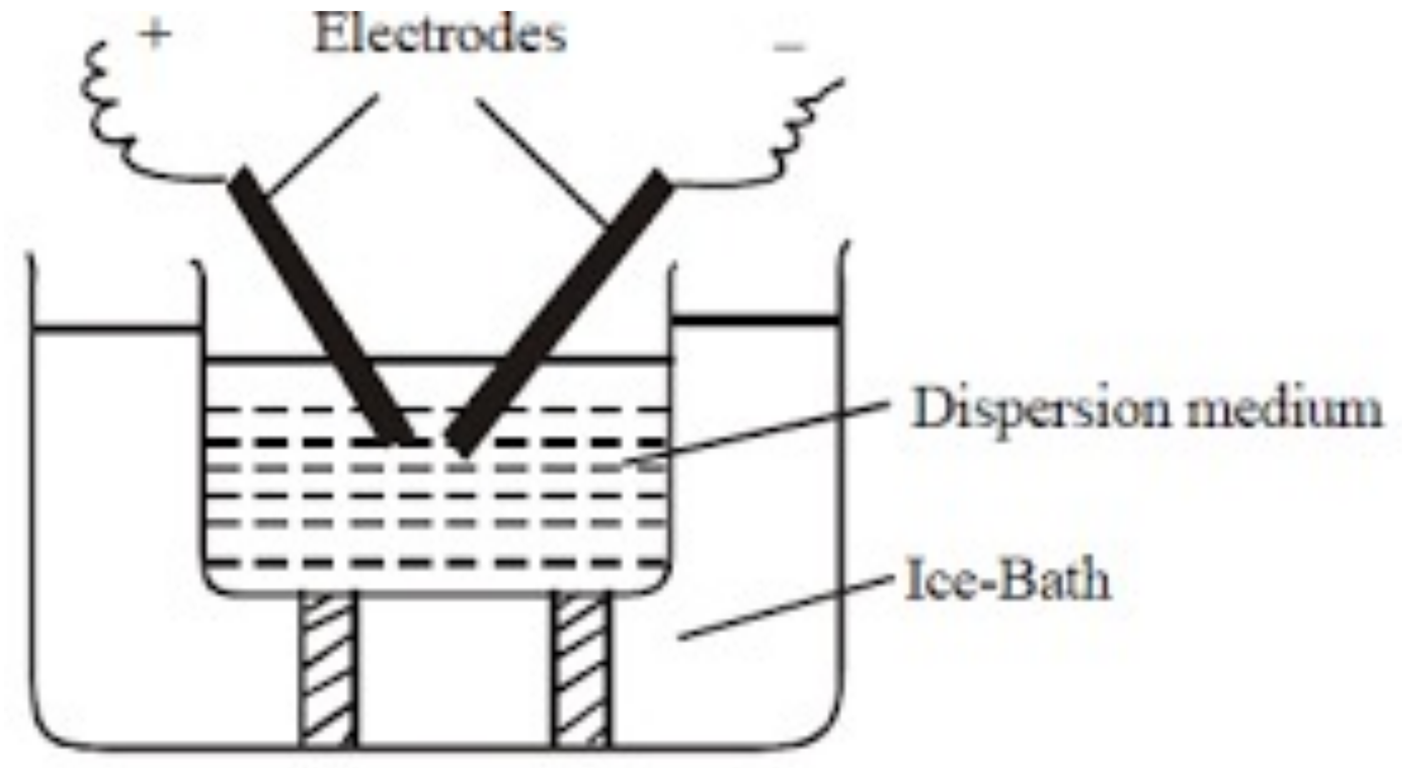
1- Electrical Disintegration (Bredig's Arc Method):

- **An electrical arc of intense heat is produced, vaporizing some of the metal.**
- **The vapours condense to form precipitate in colloidal dimensions.**

Preparation methods of Colloids

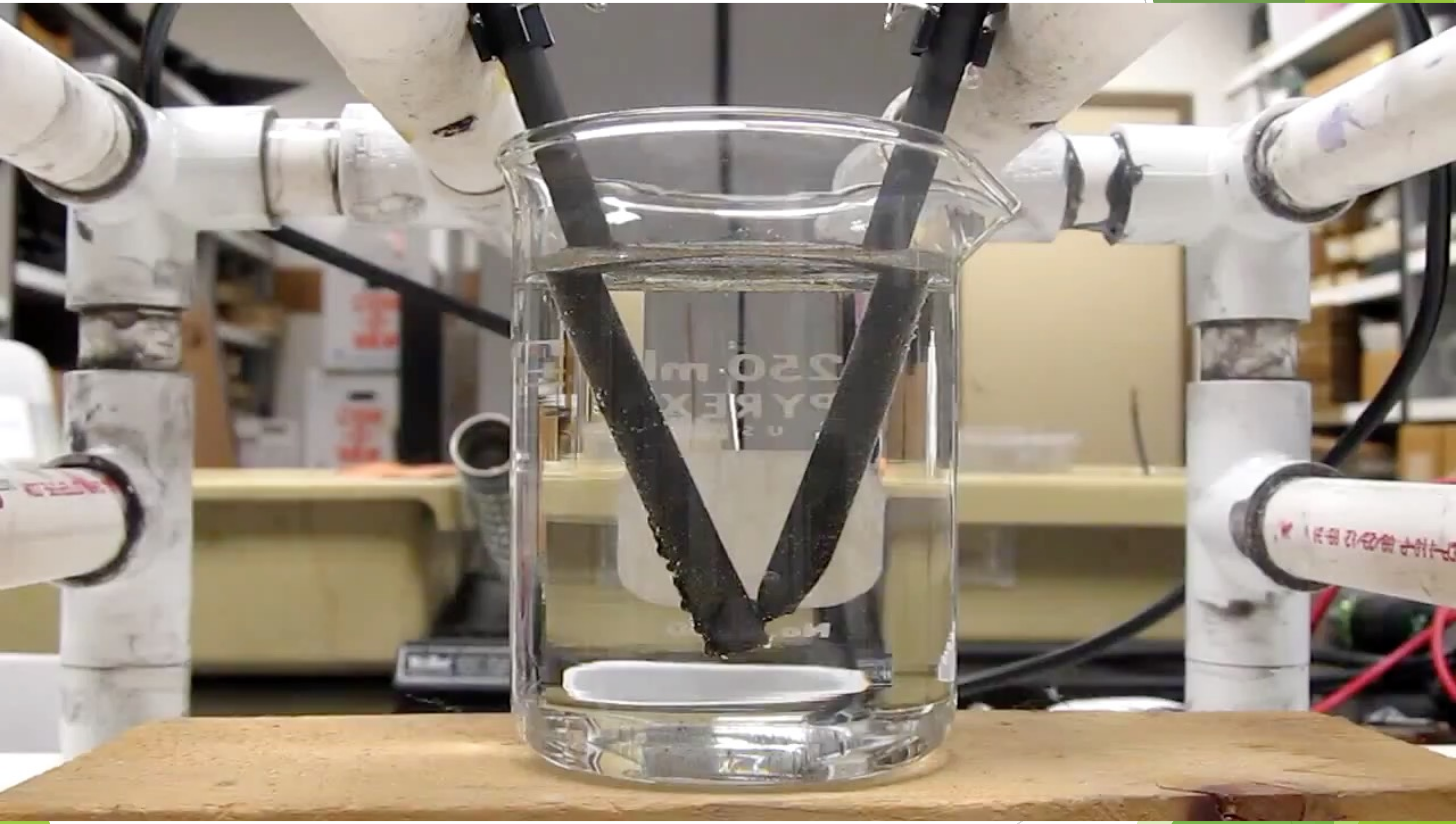
I- Dispersion method :

1- Electrical Disintegration (Bredig's Arc Method):



- *Preparation of colloidal solution by Bredig's Arc Method*

Preparation methods of Colloids



Preparation methods of Colloids

I- Dispersion method :

2- Peptization:

Precipitate can be converted into colloidal form by shaking with dispersion medium in the presence of small amount of peptization agent (an electrolyte used to convert fresh precipitate into a colloidal solution).

For example: Adding Dilute HCl (as peptizing agent) to AgCl precipitate, so we can get a colloidal solution.

Preparation methods of Colloids

II- Condensation method:

The small particles are collected together into larger particles having the same volume of the colloid particles, by some processes like: Double Decomposition Technique, Oxidation, reduction, Hydrolysis, and Exchange of Solvent.

Preparation methods of Colloids

II- Condensation method:

a- Double Decomposition Technique:

When hydrogen sulphide is passed through a solution of arsenious oxide in distilled water, we get a colloidal solution of arsenious sulphide.

$$As_2O_3 + 3H_2S \rightarrow As_2S_3 + 3H_2O$$

Preparation methods of Colloids

II- Condensation method:

b- Oxidation Technique:

Such as; in the reaction of hydrogen supplied with Sulphur dioxide, where the atoms of Sulphur in water forms colloid.

$$2H_2S + SO_2 \rightarrow 2H_2O + 3S$$

Or exploring H_2S to air for a long time.

$$H_2S + [O] \rightarrow H_2O + S$$

II- Condensation method:

c- Reduction Technique:

Another technique of preparing colloidal solutions of metals such as silver, gold as well as platinum involves the use of reducing agent for reduction of the salt solutions of these metals. Example of reducing agent include stannous chloride.

Preparation methods of Colloids

II- Condensation method:

d- Hydrolysis Technique:

It involves the use of boiling water to obtain colloidal solution of Ferric Hydroxide by adding drops of Conc. ferric chloride.

$$FeCl_3 + 3H_2O \rightarrow Fe(OH)_3 + 3HCl$$

II- Condensation method:

e- Exchange of Solvent

It involves the formation of a colloidal solution of an element by addition of its alcoholic solution to excess water. This colloidal formation can take place only when the element is more soluble in alcohol as compared to water.

Preparation methods of Colloids

II- Condensation method:

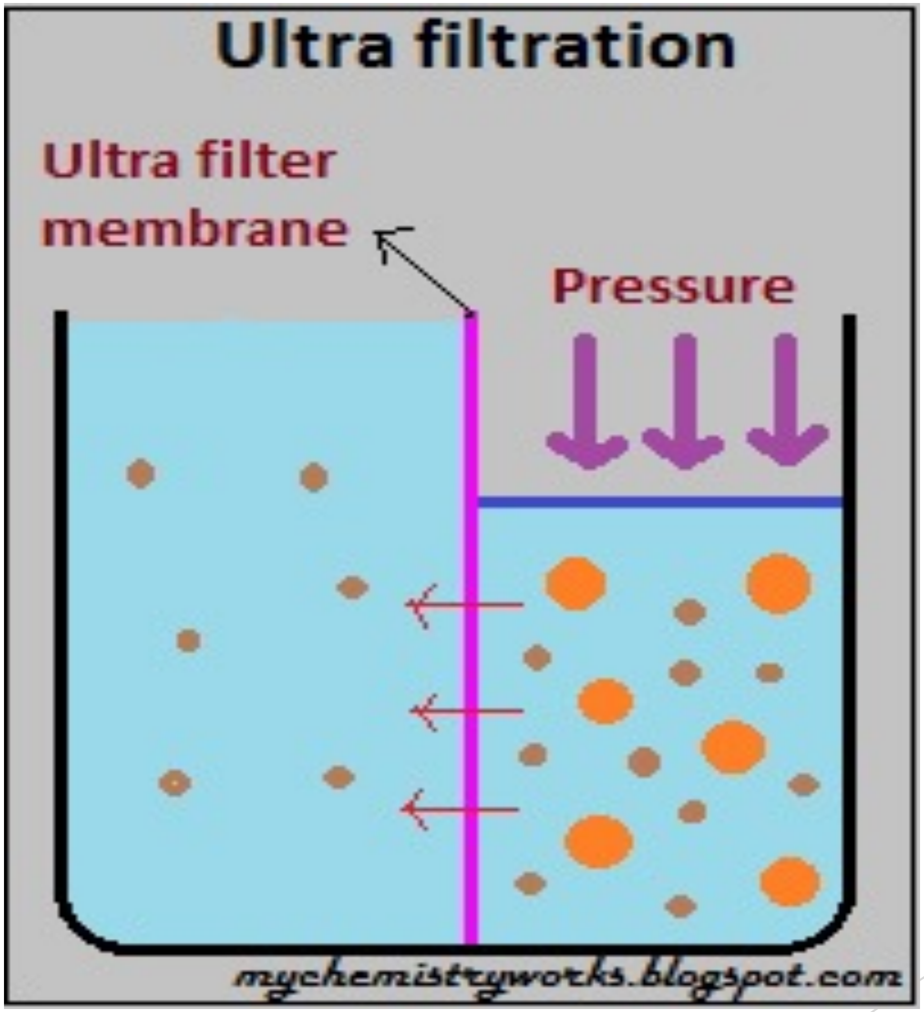
e- Exchange of Solvent

Example:

When an alcoholic solution of sulphur is made to pass through excess water it yields a colloidal solution of sulfur. This is because the solubility of sulphur is more in water as compared to alcohol.

Purification of Colloids:

1- Ultrafiltration:



Purification of Colloids:

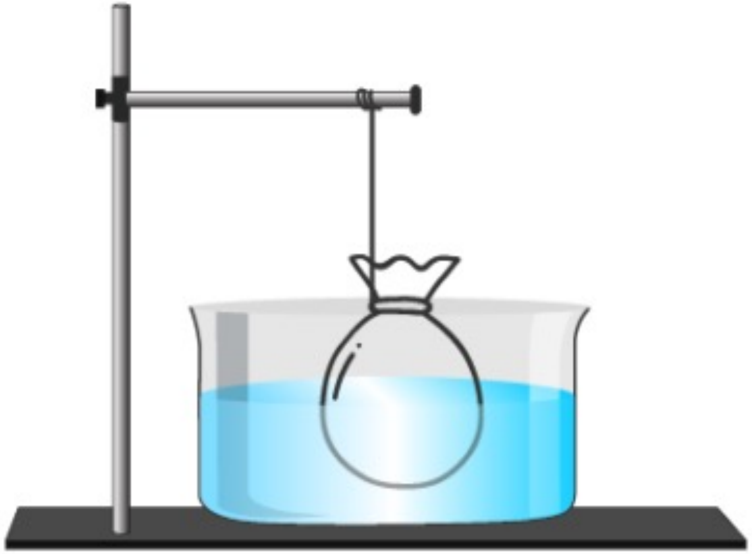
2- Dialysis and Electro-dialysis

After the preparation of the colloid, it becomes necessary to remove the excess electrolyte from the sol to impart stability to the sol. One could think of filtering the colloidal system, wash the colloid and re-disperse. But even the finest filter paper will retain little or none of the colloid.

Purification of Colloids:

2- Dialysis and Electro-dialysis

Electrolytes or other soluble materials in sols are removed by putting the sol in a membrane of cellophane or parchment surrounded by water.



Purification of a colloid

Purification of Colloids:

2- Dialysis and Electro-dialysis

The salts can pass through the membrane of parchment and are gradually washed away by running water whereas the colloid-is left inside the Vessel. This process of separation of colloid and Graham’s `crystalloid’ is called dialysis. Graham himself insisted on the importance of dialysis.

Purification of Colloids:

2- Dialysis and Electro-dialysis

The membrane through which dialysis is earned out serves as a sieve of extremely fine pore size so that only the small molecules or ions can pass, but not the relatively larger colloidal particles or large molecules of high polymers.

Purification of Colloids:

2- Dialysis and Electro-dialysis

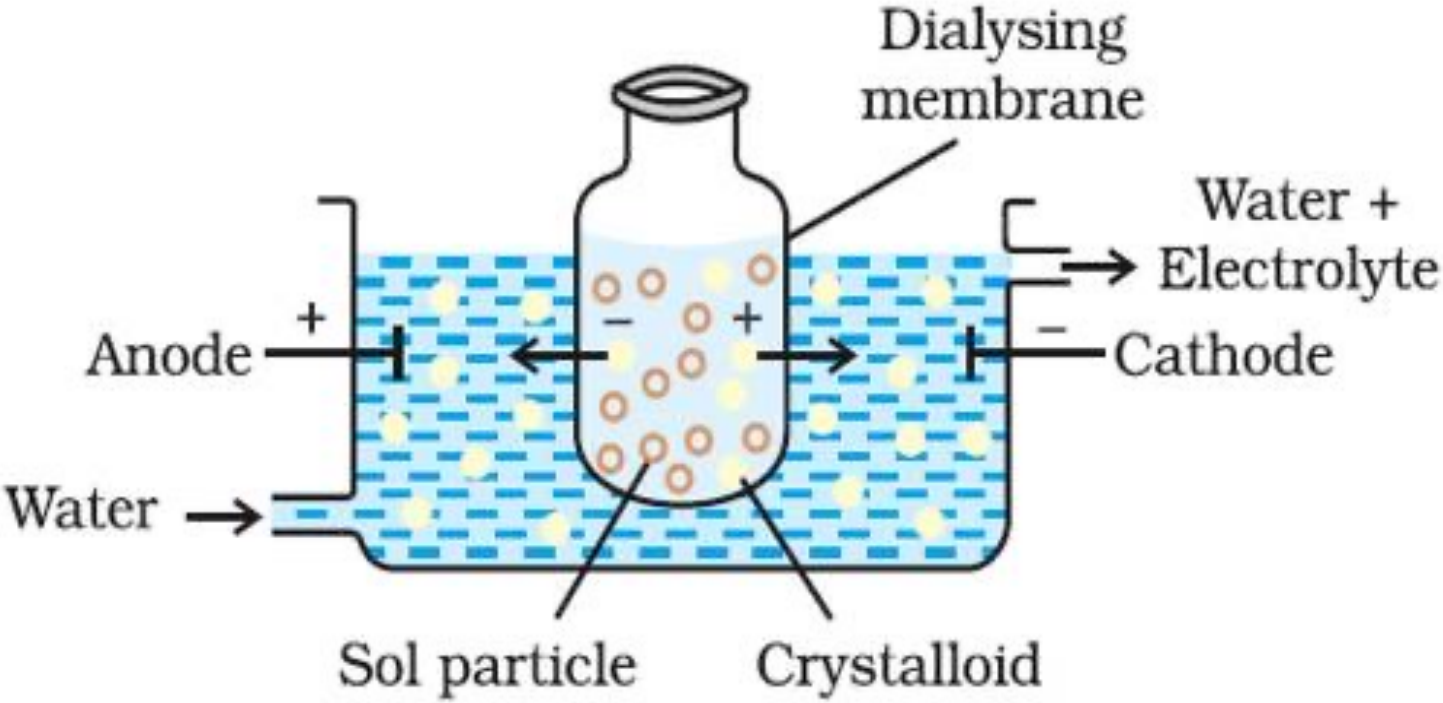
Electrodialysis

The dialysis can be improved and made faster if the assembly is subjected to a suitable electric field. The migration of the ion of the electrolytes through the membrane becomes fast in the electric field and makes the process rapid. This is known as electrodialysis.

Purification of Colloids:

2- Dialysis and Electro-dialysis

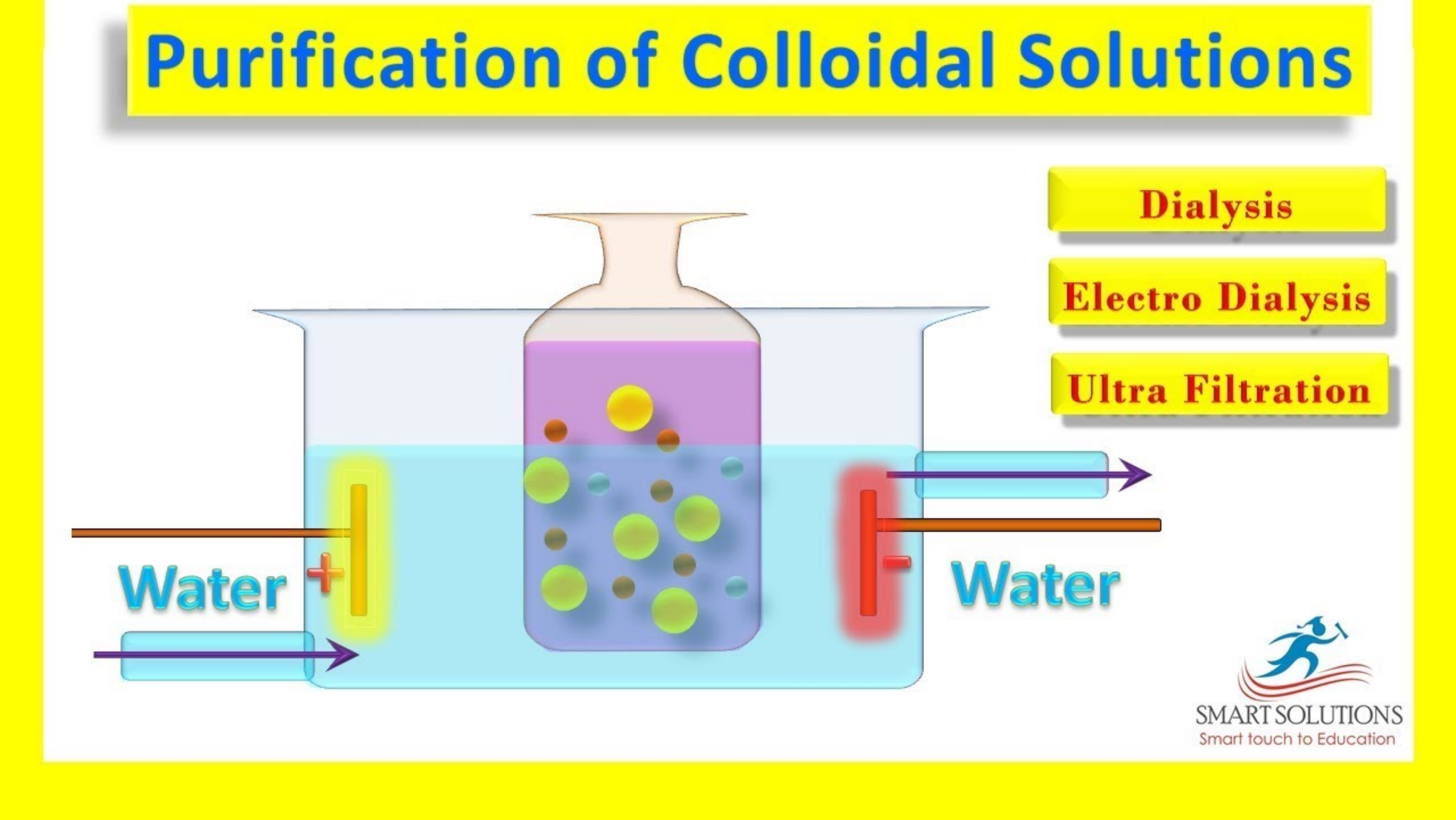
Electrodialysis



Purification of Colloids:

2- Dialysis and Electro-dialysis

Electrodialysis



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Lect. 5

Charge on Colloids

Charge on Colloids

Gen.Chem.(II) Dr.Ibrahim A.I. Hassan

The source of the charge on the colloidal particles: -

Adsorption:

The source of the charge on the colloidal fines may be that the colloidal particles adsorb some of the charges present as impurities in the colloidal solution.

The source of the charge on the colloidal particles: -

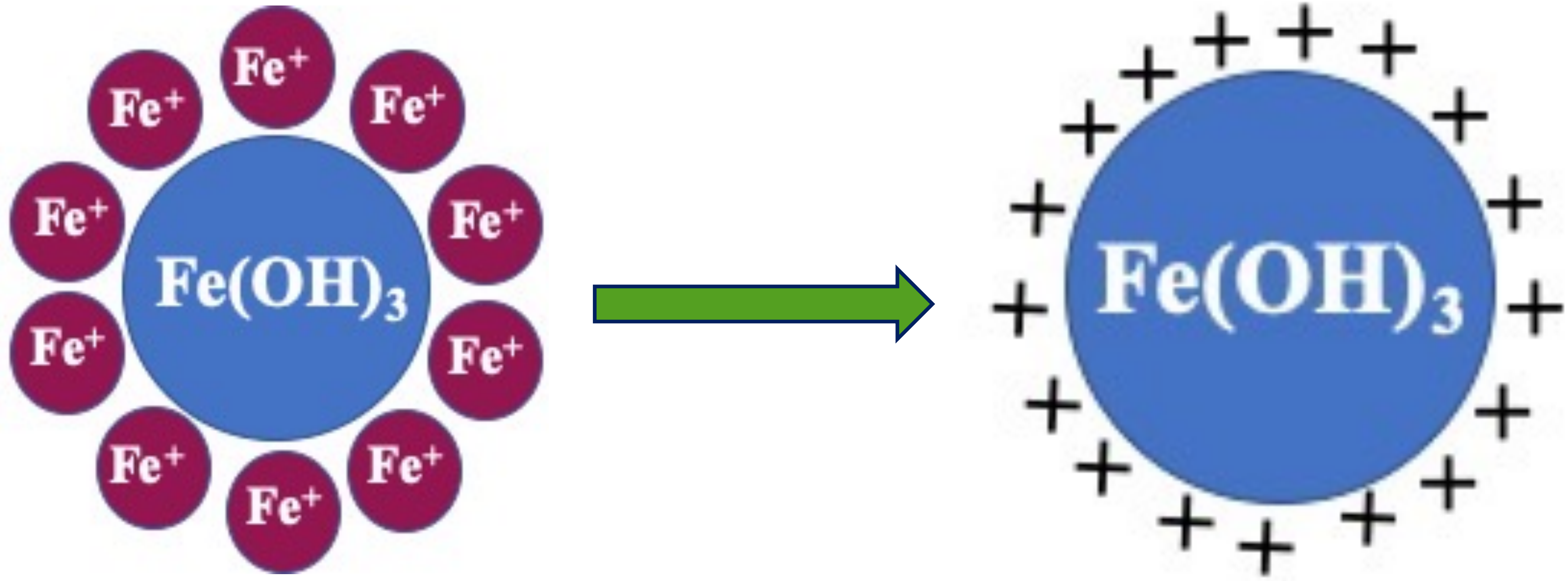
Adsorption:

Example:

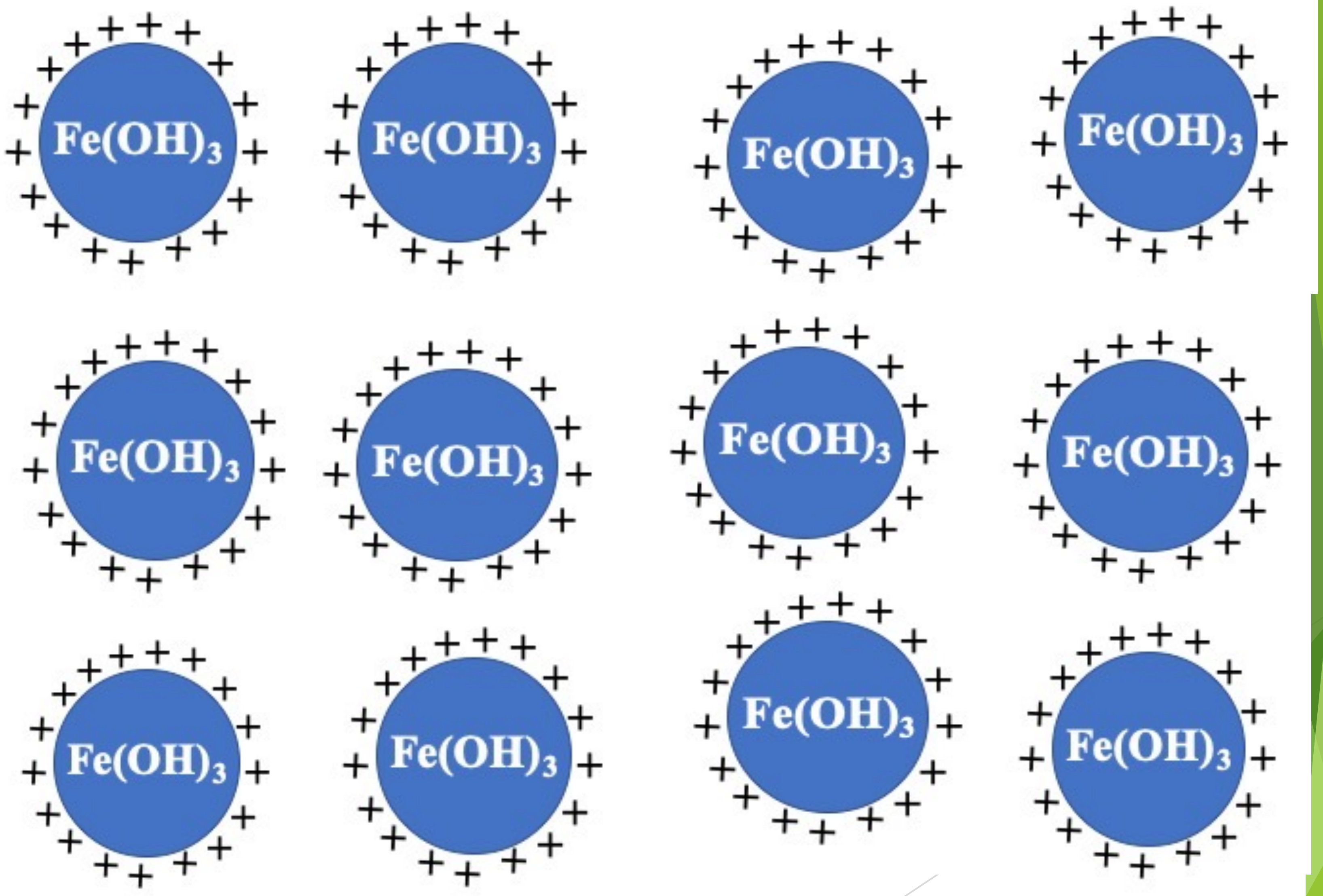
When preparing ferric hydroxide from hydrolysis of ferric chloride, by adding it to boiling water, there are leftover (positively charged) ferric ions (as impurities) and the colloidal particles adsorb them and acquire a positive charge.

The source of the charge on the colloidal particles: -

Adsorption



The dissonance between colloidal minutes leads to its stability



The source of the charge on the colloidal particles: -

- The charge is formed on colloidal particles, depending on the medium in which they are found.

Examples:

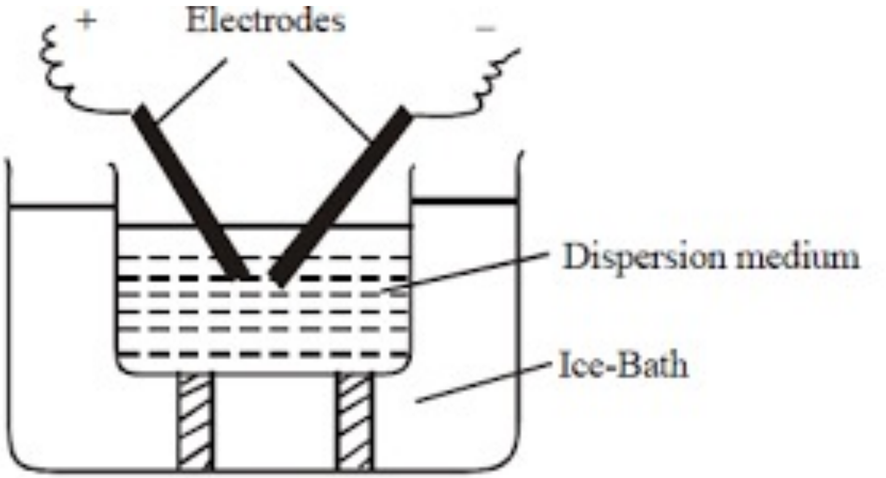
1. Proteins: they are colloids. If they are present in an acidic medium, the colloidal particles become positively charged, but if the medium is basic then the colloidal particles have a negative charge.

The source of the charge on the colloidal particles: -

Adsorption

Examples

2. **Gold**: The colloidal solution of gold, prepared by the Bredig's arc method ,is not stable unless it contains a very small amount of alkali.



2 : *Preparation of colloidal solution by Bredig's Arc Method*

The source of the charge on the colloidal particles: -

Adsorption

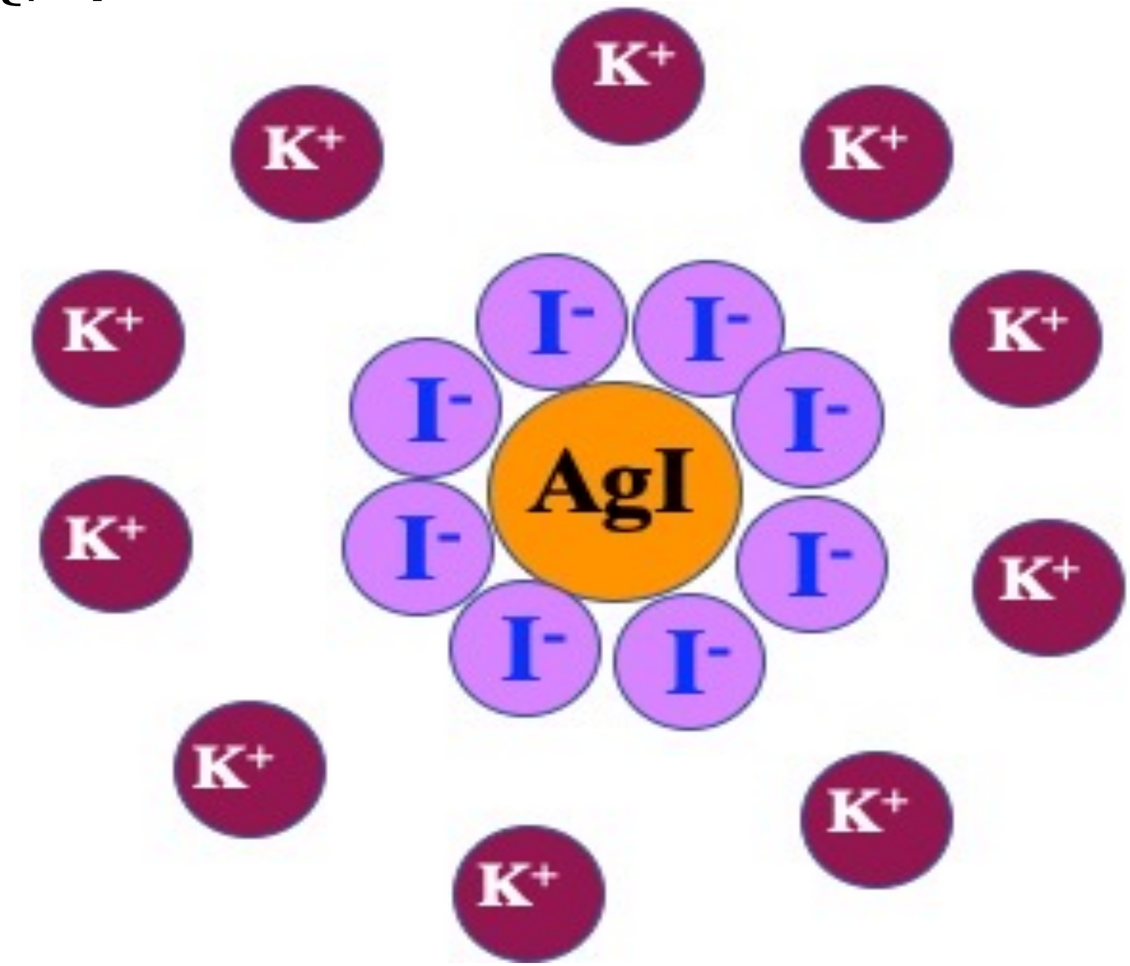
Examples

3. When adding a dilute solution of $AgNO_3$ to an excess of KI solution; Negative Sol formed: This can be explained by the fact that colloidal particles adsorb negative iodide ions on their surface due to the presence of an increase of these ions, and potassium ions are arranged around them in the solution, and colloidal particles can be represented: **$[AgI]\ I^- K^+$?**

The source of the charge on the colloidal particles: -

Adsorption

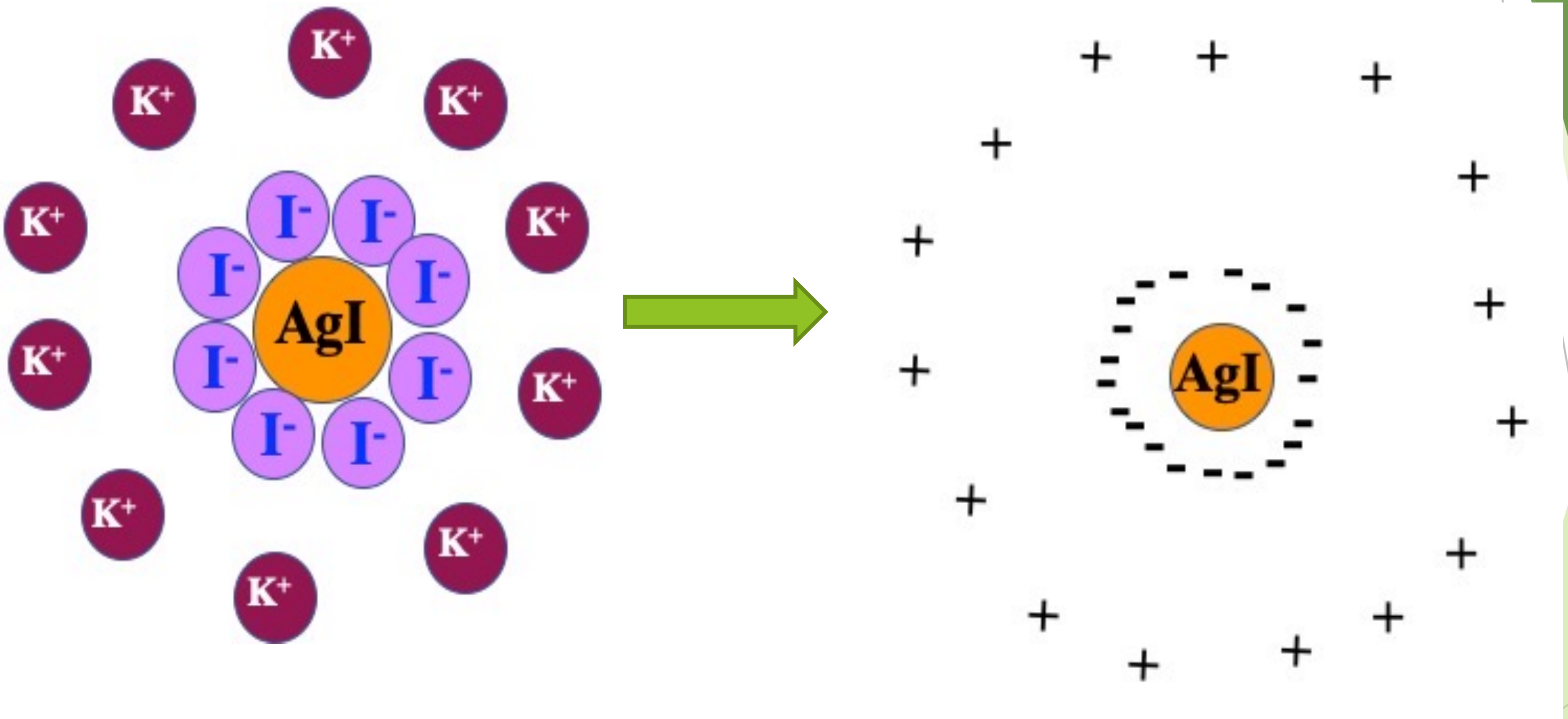
$[AgI]\ I^-\ \ K^+$



The source of the charge on the colloidal particles: -

Adsorption

$[\,AgI\,]\, I^- \quad K^+ \;?$

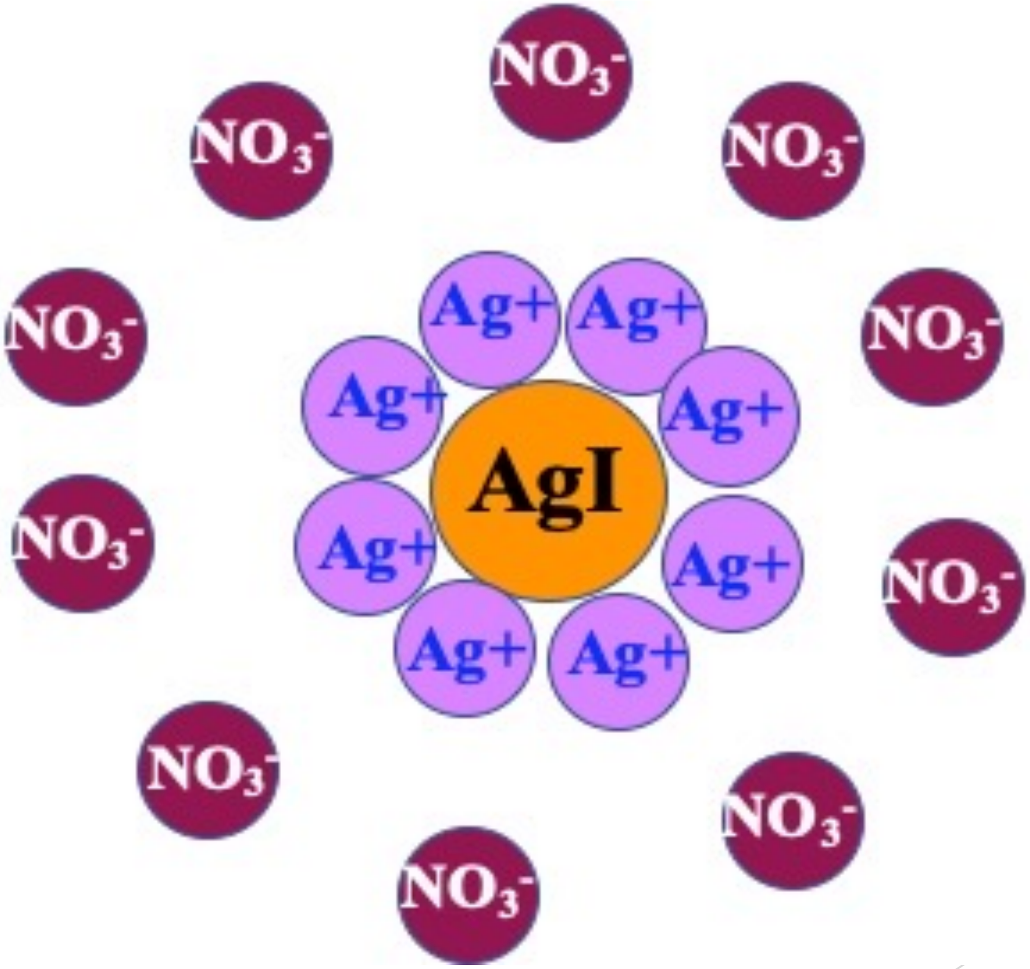


The source of the charge on the colloidal particles: -

Adsorption

Excess of $AgNO_3$

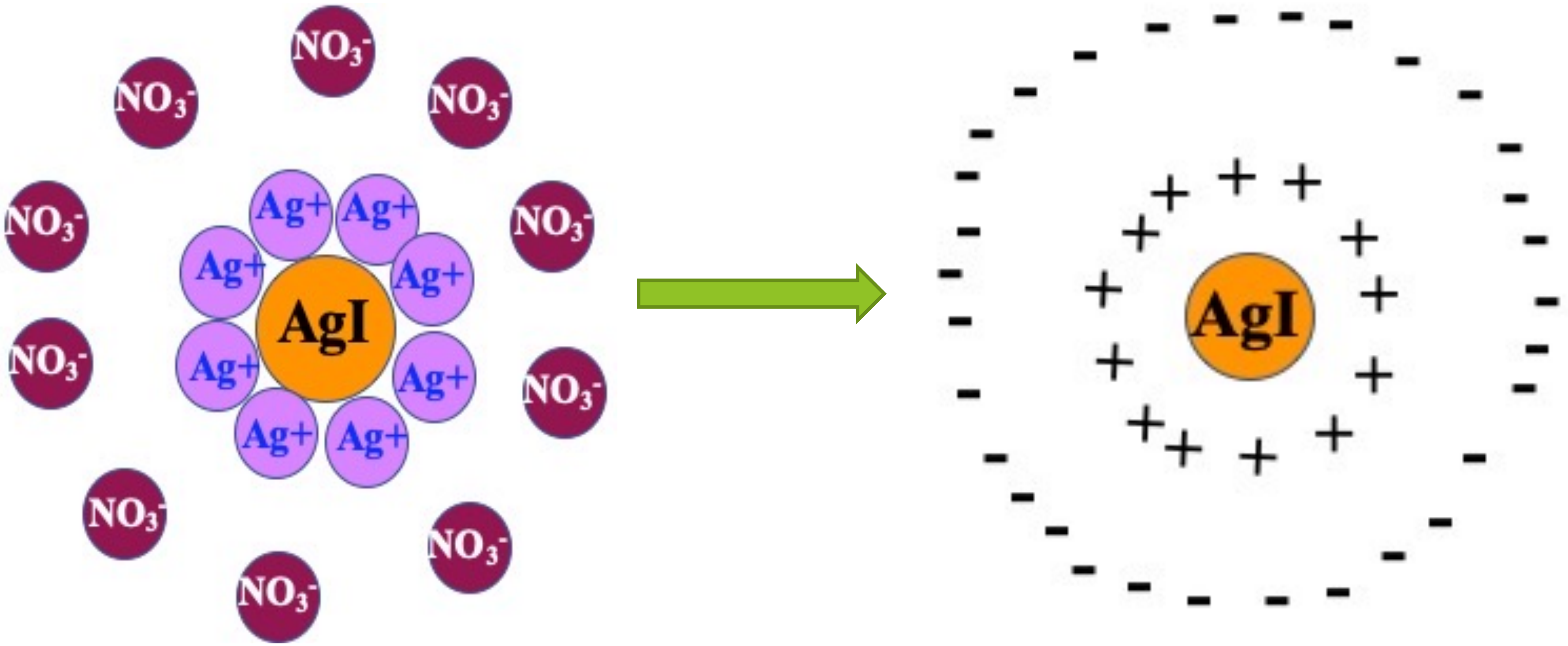
$[\,AgI\,]\,Ag^{+}\,\vdots\,NO_3^{-}$



The source of the charge on the colloidal particles: -

$[AgI]\,Ag^{+}\ \vdots\ NO_3^{-}$

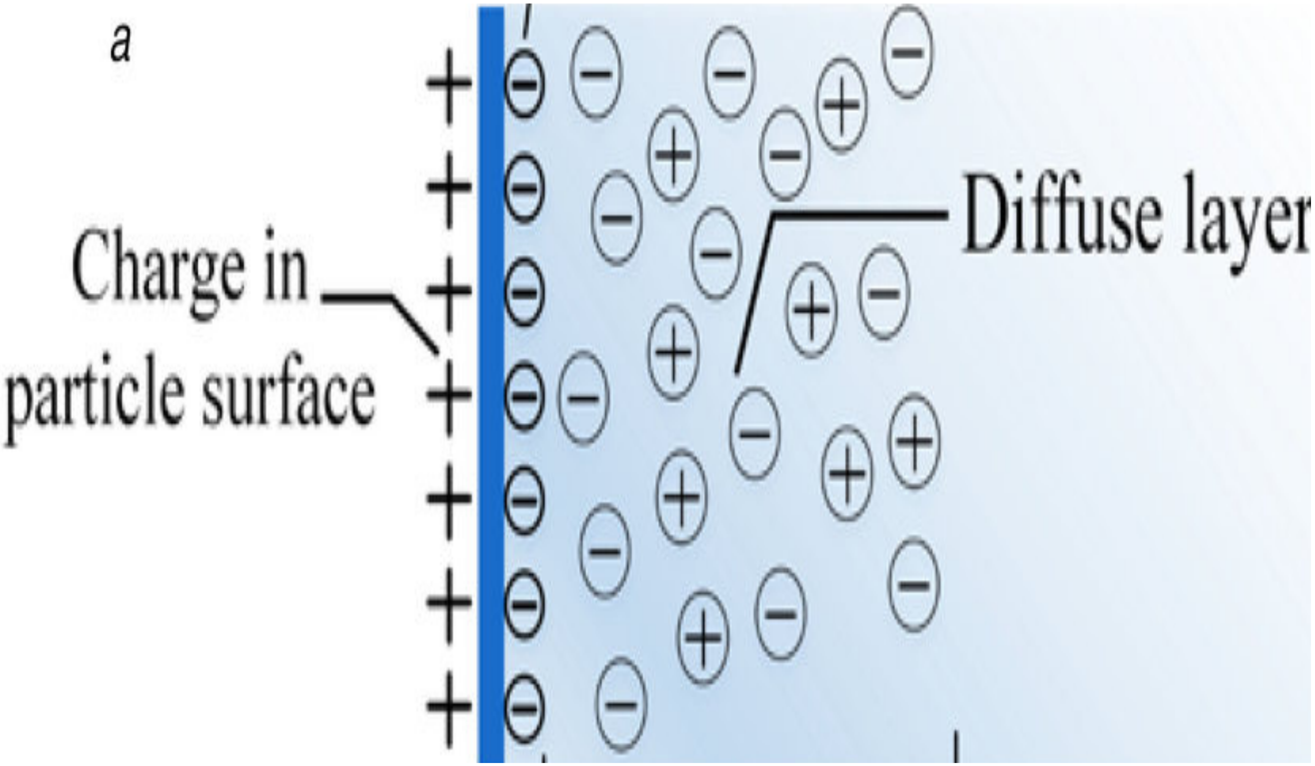
Adsorption



The source of the charge on the colloidal particles: -

Adsorption

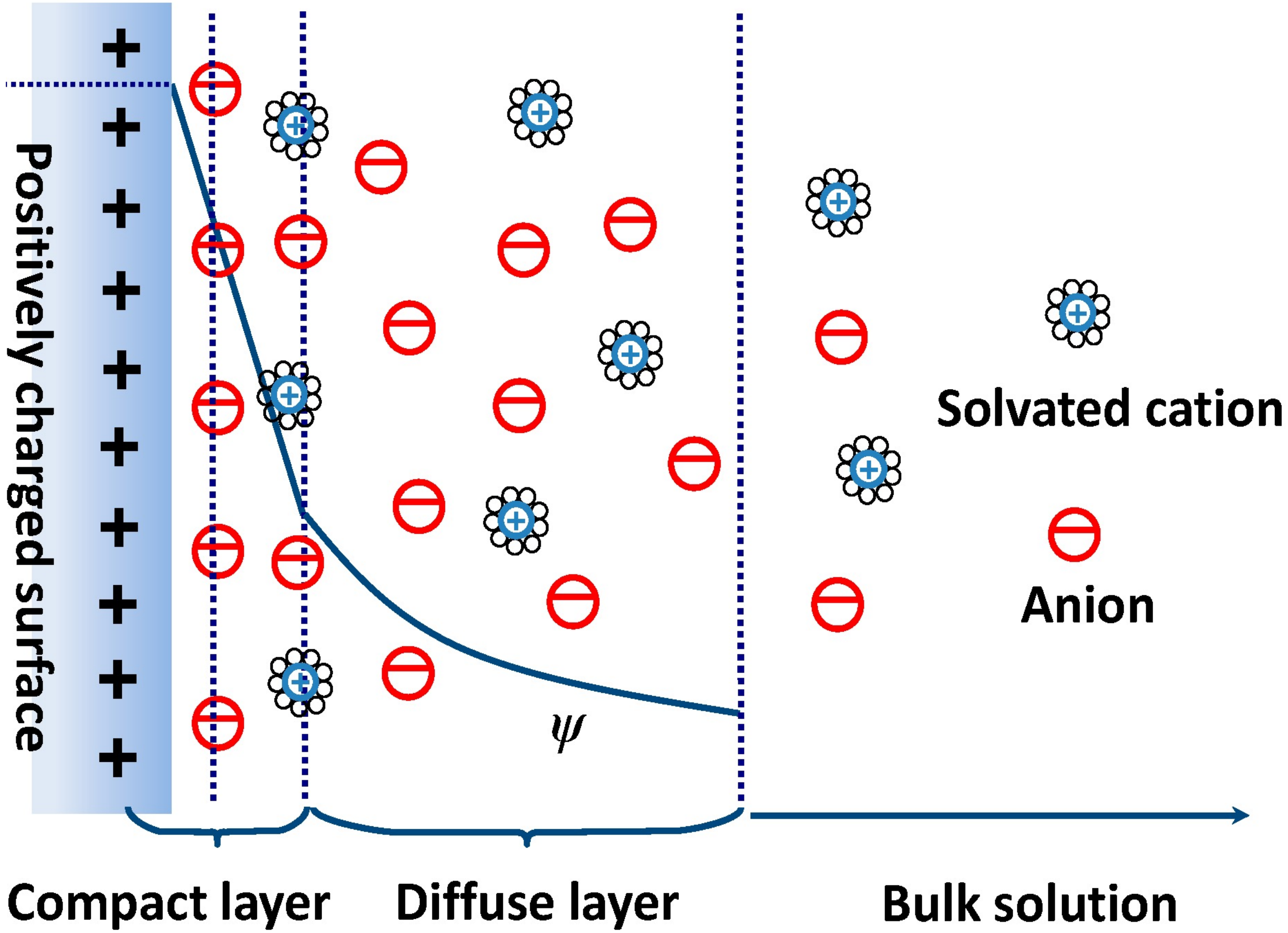
"Helmholtz Double Layer"



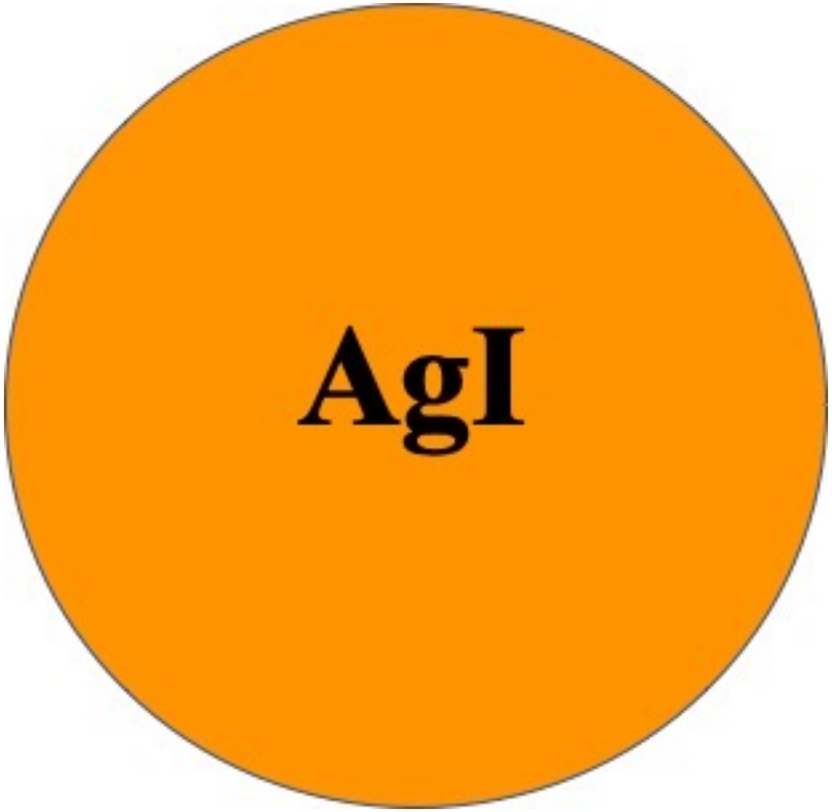
The source of the charge on the colloidal particles: -

Adsorption

"Helmholtz Double Layer"



- When adding equal quantities of both KI and $AgNO_3$, AgI precipitates, no colloid formed?



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Lect. 6

Solutions

Solutions

True Solution

- It is a homogeneous mixture of two or more components.
- The particle diameter is < 1 nm.
- Examples: solutions of sugar, lactose, minerals, and vitamins.

- Solutions consists of two main components:

1. Solvent = dissolving medium and present in the larger amount.

Solutions

Solvent can be:

- ❑often liquid; frequently water
- ❑gas in air and other gas solutions
- ❑rarely a solid

2. **Solute(s) =** dissolved material(s) and present in the smaller amount(s).

- ○solids, liquids, and/or gases
- ○often more than one solute

Solubility: It is the amount of solute required to prepare a saturated solution with a specific volume of solvent at a specific temperature.

According to the solubility, there are three types of solutions:

1. A saturated solution contains the maximum amount of a solute that will dissolve in a given solvent at a specific temperature.

2. **An unsaturated solution contains less solute than the solvent has the capacity to dissolve at a specific temperature.**

3. **A supersaturated solution contains more solute than is present in a saturated solution at a specific temperature.**

- **A supersaturated solution is clear before a seed crystal is added.**

- Crystals begin to form in the solution immediately after the addition of a seed crystal.

❖**Excess solute crystallizes rapidly.**

Solution Formation

The compositions of the solvent and the solute determine whether a substance will dissolve.

The factors that determine how fast a substance dissolves are:-

- **Nature of Solute / Solvent.**
- **Stirring (agitation).**
- **Temperature.**
- **The surface area of the dissolving particles.**

Factors Affecting Solubility

1. Nature of Solute / Solvent.

❑ **Like dissolves like.**

Organic solvents dissolve organic solute, and inorganic solvents dissolve inorganic solute.

Factors Affecting Solubility

1. Nature of Solute / Solvent.

2. Temperature :-

- Solids/Liquids Solubility increases with temperature.

Increasing Kinetic Energy (K.E.) increases motion and collision between solute / solvent, which leads to increasing the solubility.

Miscible vs. Immiscible

Miscible :- two liquids that dissolve in each other in all proportions.

Immiscible :- two liquids that are insoluble in one another.

The Chemical methods of expressing concentration

1. **Percent (%w/v)** - (Percentage weight in volume):

It expresses the number of grams of solute in 100 ml of solution.

2. **g/L:** Which means the number of grams of solute dissolved in one Liter of the solution.

3. **Molarity (M):**

Which is the number of moles (gram-molecular weights) of solute contained in1000 ml (1 Litre) of solution.

The Chemical methods of expressing concentration

4. Molality (m):

Is the number of moles of a solute contained in 1000 gm of a solvent.

5. Normality (N):

Is the number of equivalents (gram- equivalent weight) of the solute in one litre of solution.

Any Questions

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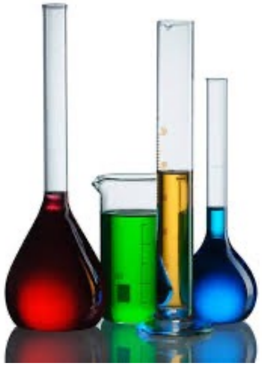


Lect. 7

Preparing of Solutions

The Chemical methods of expressing concentration

1. Percent (%w/v) - (Percentage weight in volume):

It expresses the number of grams of solute in 100 ml of solution.

2. g/L: Which means the number of grams of solute dissolved in one Liter of the solution.

3. Molarity (M):

Which is the number of moles (gram-molecular weights) of solute contained in1000 ml (1 Litre) of solution.

The Chemical methods of expressing concentration

4. Molality (m):

Is the number of moles of a solute contained in 1000 gm of a solvent.

5. Normality (N):

Is the number of equivalents (gram- equivalent weight) of the solute in one litre of solution.

The Chemical methods of expressing concentration

A. Equivalent weight of an acid

= Molecular weight of the acid / No. of replaceable hydrogen atoms.

= Molecular weight of the acid / Basicity of the acid

The Chemical methods of expressing concentration

A. Equivalent weight of an acid:-

For example, the basicity of Sulphuric acid is 2.

Equivalent weight of H_2SO_4 = Molecular weight of $H_2SO_4/2$ = 98/2 = 49 gm.

Equivalent weight of CH_3COOH = molecular weight of $CH_3COOH /1$ = 60/1 = 60 gm

The Chemical methods of expressing concentration

B. **Equivalent weight of a base** = **Molecular weight of the base/Number of replaceable hydroxide groups.**

= **Molecular weight of the base/acidity of the base.**

Equivalent weight of KOH = 56 /1 = 56

Equivalent weight of $Ca(OH)_2$ = 74 /2 = 37

The Chemical methods of expressing concentration

C. Equivalent weight of a Salt = Molecular weight of the Salt / Oxidation number of one of its halves multiplied in number of its ions.

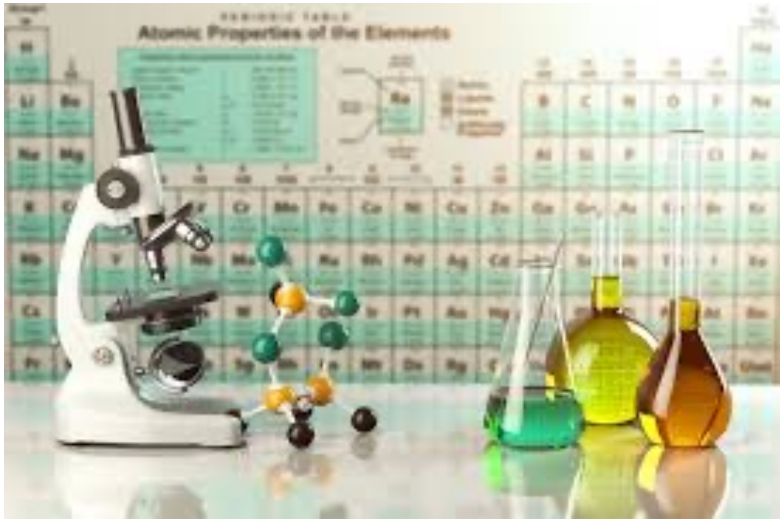
Examples:

Equivalent weight of $Na^{+}Cl^{-}$ = 58.5 /1 = 58.5

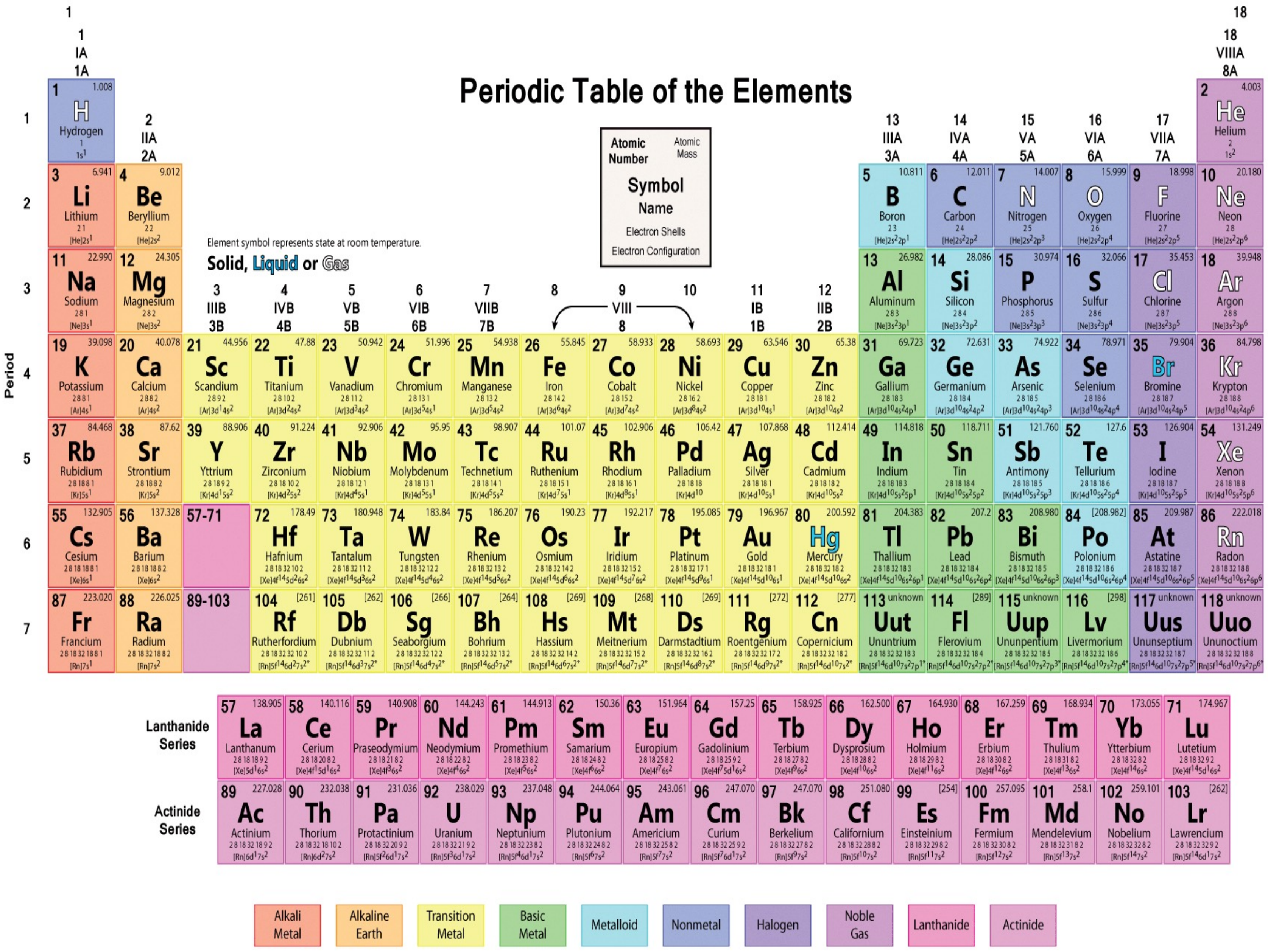
Equivalent weight of $Ca^{+2}Cl_{2}^{-1}$ = 74 /2 = 37

By Using the periodic table, in the next slide, calculate the molecular and equivalent weights for the following substances?

1. $Al(OH)_3$
2. $SrBr_2$
3. Mn_2O_3
4. H_3PO_4
5. $Fe_2(SO_4)_3$



N.B. Each student should answer this question and send me the answer within this week.



Periodic Table of the Elements

Atomic Number	Symbol Name Electron Shells Electron Configuration	Atomic Mass

Element symbol represents state at room temperature.

Solid, Liquid or Gas

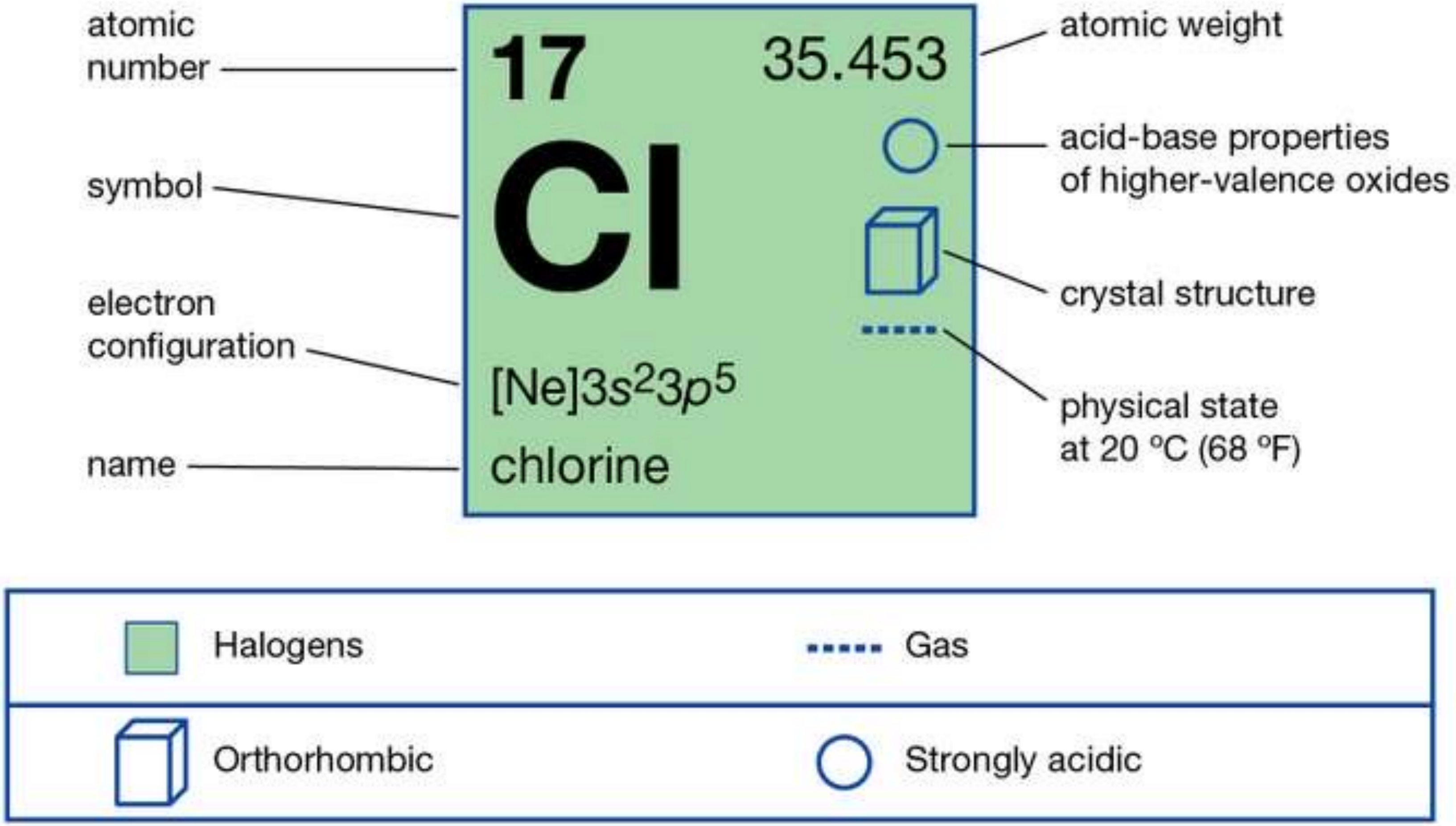
Period	1 IA 1A	2 IIA 2A	3 IIIB 3B	4 IVB 4B	5 VB 5B	6 VIB 6B	7 VIIB 7B	8 VIII 8	9 VIII 8	10 VIII 8	11 IB 1B	12 IIB 2B	13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	18 VIIIA 8A
1	1 **H** Hydrogen 1.008																	2 **He** Helium 4.003
2	3 **Li** Lithium 6.941	4 **Be** Beryllium 9.012											5 **B** Boron 10.811	6 **C** Carbon 12.011	7 **N** Nitrogen 14.007	8 **O** Oxygen 15.999	9 **F** Fluorine 18.998	10 **Ne** Neon 20.180
3	11 **Na** Sodium 22.990	12 **Mg** Magnesium 24.305											13 **Al** Aluminum 26.982	14 **Si** Silicon 28.086	15 **P** Phosphorus 30.974	16 **S** Sulfur 32.066	17 **Cl** Chlorine 35.453	18 **Ar** Argon 39.948
4	19 **K** Potassium 39.098	20 **Ca** Calcium 40.078	21 **Sc** Scandium 44.956	22 **Ti** Titanium 47.88	23 **V** Vanadium 50.942	24 **Cr** Chromium 51.996	25 **Mn** Manganese 54.938	26 **Fe** Iron 55.845	27 **Co** Cobalt 58.933	28 **Ni** Nickel 58.693	29 **Cu** Copper 63.546	30 **Zn** Zinc 65.38	31 **Ga** Gallium 69.723	32 **Ge** Germanium 72.631	33 **As** Arsenic 74.922	34 **Se** Selenium 78.971	35 **Br** Bromine 79.904	36 **Kr** Krypton 84.798
5	37 **Rb** Rubidium 84.468	38 **Sr** Strontium 87.62	39 **Y** Yttrium 88.906	40 **Zr** Zirconium 91.224	41 **Nb** Niobium 92.906	42 **Mo** Molybdenum 95.95	43 **Tc** Technetium 98.907	44 **Ru** Ruthenium 101.07	45 **Rh** Rhodium 102.906	46 **Pd** Palladium 106.42	47 **Ag** Silver 107.868	48 **Cd** Cadmium 112.414	49 **In** Indium 114.818	50 **Sn** Tin 118.711	51 **Sb** Antimony 121.760	52 **Te** Tellurium 127.6	53 **I** Iodine 126.904	54 **Xe** Xenon 131.249
6	55 **Cs** Cesium 132.905	56 **Ba** Barium 137.328	57-71	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.948	74 **W** Tungsten 183.84	75 **Re** Rhenium 186.207	76 **Os** Osmium 190.23	77 **Ir** Iridium 192.217	78 **Pt** Platinum 195.085	79 **Au** Gold 196.967	80 **Hg** Mercury 200.592	81 **Tl** Thallium 204.383	82 **Pb** Lead 207.2	83 **Bi** Bismuth 208.980	84 **Po** Polonium [208.982]	85 **At** Astatine 209.987	86 **Rn** Radon 222.018
7	87 **Fr** Francium 223.020	88 **Ra** Radium 226.025	89-103	104 **Rf** Rutherfordium [261]	105 **Db** Dubnium [262]	106 **Sg** Seaborgium [266]	107 **Bh** Bohrium [264]	108 **Hs** Hassium [269]	109 **Mt** Meitnerium [268]	110 **Ds** Darmstadtium [269]	111 **Rg** Roentgenium [272]	112 **Cn** Copernicium [277]	113 **Uut** Ununtrium unknown	114 **Fl** Flerovium [289]	115 **Uup** Ununpentium unknown	116 **Lv** Livermorium [298]	117 **Uus** Ununseptium unknown	118 **Uuo** Ununoctium unknown

Lanthanide Series	Actinide Series
57 **La** Lanthanum 138.905	89 **Ac** Actinium 227.028
58 **Ce** Cerium 140.116	90 **Th** Thorium 232.038
59 **Pr** Praseodymium 140.908	91 **Pa** Protactinium 231.036
60 **Nd** Neodymium 144.243	92 **U** Uranium 238.029
61 **Pm** Promethium 144.913	93 **Np** Neptunium 237.048
62 **Sm** Samarium 150.36	94 **Pu** Plutonium 244.064
63 **Eu** Europium 151.964	95 **Am** Americium 243.061
64 **Gd** Gadolinium 157.25	96 **Cm** Curium 247.070
65 **Tb** Terbium 158.925	97 **Bk** Berkelium 247.070
66 **Dy** Dysprosium 162.500	98 **Cf** Californium 251.080
67 **Ho** Holmium 164.930	99 **Es** Einsteinium [254]
68 **Er** Erbium 167.259	100 **Fm** Fermium 257.095
69 **Tm** Thulium 168.934	101 **Md** Mendelevium 258.1
70 **Yb** Ytterbium 173.055	102 **No** Nobelium 259.101
71 **Lu** Lutetium 174.967	103 **Lr** Lawrencium [262]

Alkali Metal · Alkaline Earth · Transition Metal · Basic Metal · Metalloid · Nonmetal · Halogen · Noble Gas · Lanthanide · Actinide


8
$2s^2\ 2p^4$
O
Oxygen
15.999
VectorStock

Chlorine


atomic number
17
atomic weight
35.453
symbol
Cl
acid-base properties of higher-valence oxides
crystal structure
electron configuration
[Ne]3s²3p⁵
physical state at 20 °C (68 °F)
name
chlorine
Halogens
Gas
Orthorhombic
Strongly acidic

Types of Solutions according to the types of solvent and solute.

A. **Gases in Gases: such as O_2 and N_2 in Air.**

Gases mixed quickly in each other due to their quick distribution and the large interstitial distances among the gas particles.

Types of Solutions according to the types of solvent and solute.

B. Gases in Liquids solutions: such as ammonia and carbon dioxide in water.

$$NH_{3\,(g)} + H_2O_{\,(l)} = NH_4OH_{\,(aq)}$$

$$CO_{2\,(g)} + H_2O_{\,(l)} = H_2CO_{3\,(aq)}$$

Solubility of gas in liquid is defined as the gas volume which is required to prepare a saturated solution of 1 cm^3 of the solvent.

Factors affecting the suitability of gases in liquids.

1. The gas type.

- ✓ The much easy liquefying gases the much easy for them to soluble in liquids.

for example solubility of carbon dioxide and water is much higher than the solubility of oxygen in water.

- ✓ The solubility of gases increases if the gas tends to react with the liquid.

For example ammonia soluble in water forming NH_4OH.

Factors affecting the suitability of gases in liquids.

2. Liquid type:

- **The solubility of gas is different from liquid to liquid.**

For example the solubility of carbon dioxide in benzene much more than it's solubility in water.

3. Effect of temperature.

The solubility of gases in liquids is exothermic process, so these solubility decreases by increasing the temperature.

Any Questions

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General Chemistry (II)

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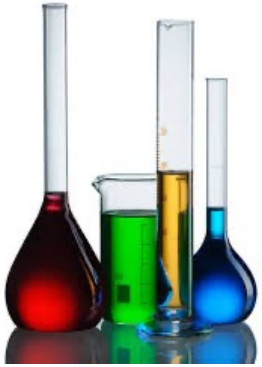
Faculty of Education (Hurghada)



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Lect. 8

Types of Solutions

Gases in liquids Solutions.

- ✓ Solutions having solute in gaseous state and solvent in liquid state, are called Gas - Liquid Solutions.

For example - Solution of oxygen in water, mixture of carbon dioxide in water.

Coca cola, is an example of gas - liquid solution, as it has carbon dioxide dissolved in water.

Factors affecting the solubility of gases in liquids.

1. The gas type.

- ✓ **As much easy liquefying gases as much easy for them to dissolve in liquids.**

for example solubility of carbon dioxide in water is much higher than the solubility of oxygen in water.

- ✓ **The solubility of gases increases if the gas tends to react with the liquid.**

For example ammonia soluble in water forming NH_4OH.

2. Liquid type:

- **The solubility of gas is different from liquid to liquid.**

For example the solubility of carbon dioxide in benzene much more than it's solubility in water.

3. Effect of temperature.

The solubility of gases in liquids is exothermic process, so these solubility decreases by increasing the temperature.

Factors affecting the solubility of gases in liquids.

3. Effect of temperature.

Decreasing of solubility by increasing the temperature can be due to increasing of the kinetic energy of the gas so it can escape from the solution. Meanwhile, decreasing the temperature can lead to condensation of the gas and decreasing the kinetic energy, consequently increasing the solubility of the gas in the liquid.

Factors affecting the solubility of gases in liquids.

Gases in liquids Solutions.

✓ 4. The effect of pressure (Henry’s law)

According to Henry’s law; at a specific temperature, the dissolved weight of a gas, in a specific volume of the liquid, is proportional to the gas pressure. So if the applied pressure was doubled, that can lead to doubling the amount of the dissolved gas at the same volume of the liquid.

If m is the gas mass which is soluble at a specific volume of the liquid and P it’s pressure so:

$$m \ \alpha \ P \qquad\qquad m = KP$$

Types of solutions according to the types of solute and solvent

C. Gases in solids solutions: such as hydrogen in Iron or Nickel or Playdium.

Gases are absorbed on the surface of the solids which can be done in three different forms:

- **Chemical absorption:** which can be done between the gas and the solid through a chemical reaction such as the absorption of CO_2 on the surface of lime (hydrated lime) to form calcium carbonate.

$$CaO + H_2O \rightleftharpoons Ca(OH)_2$$

$$Ca(OH)_2 + CO_2 \rightleftharpoons Ca\,CO_3 + H_2O$$

Types of solutions according to the types of solute and solvent

C. Gas is in solids solutions

- **Distribution:** which means the gas can distribute into the pores of the solid to form a homogeneous mixture as in the case of hot palladium with hydrogen.

Types of solutions according to the types of solute and solvent

C.Gas is in solids solutions

Adsorption: **in which the gas particles can be adsorbed on the surface of the solid, which is followed by a slow distribution process of the gas into the solid.**

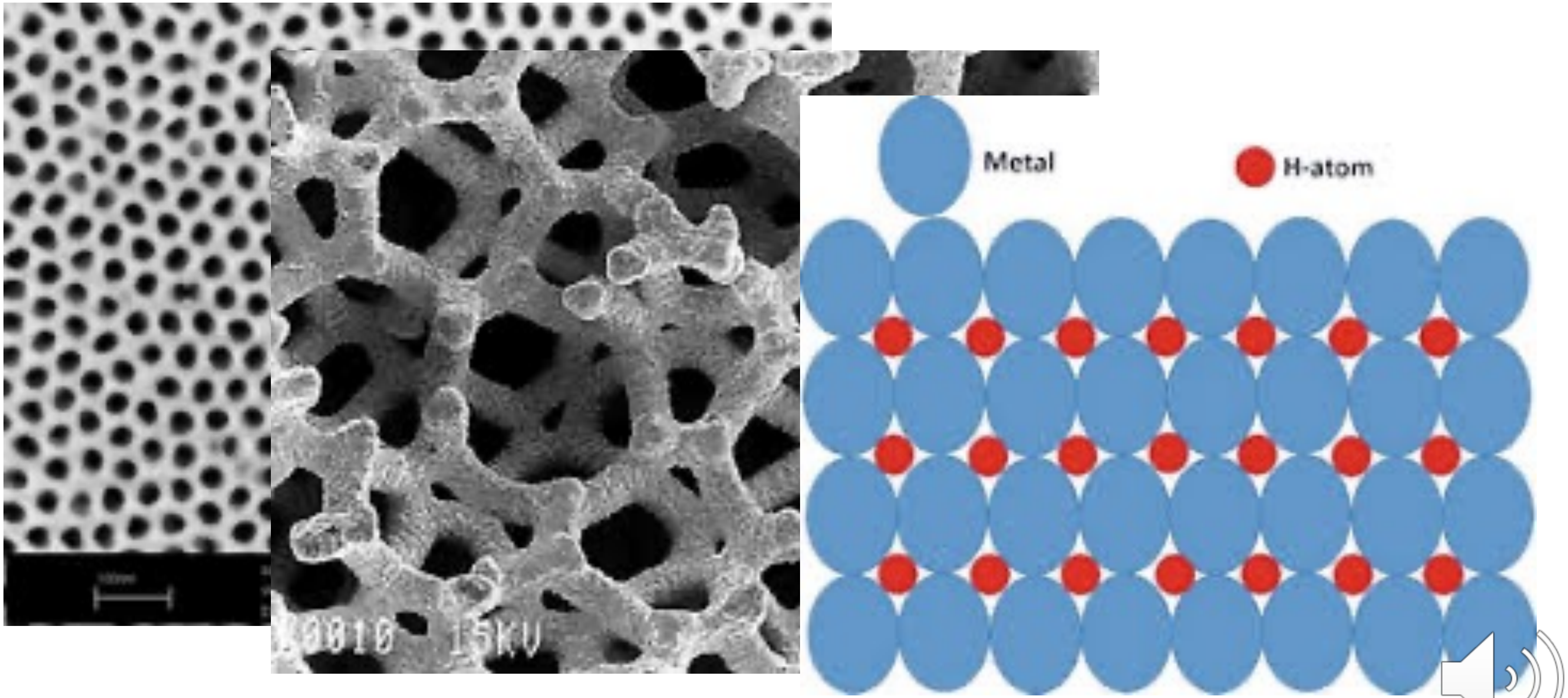
For example, the adsorption of hydrogen on the surface of Carbon.

Types of solutions according to the types of solute and solvent

C. Gas is in solids solutions

Hydrogen adsorbed on Iron, Nickel, Playdium or Carbon.

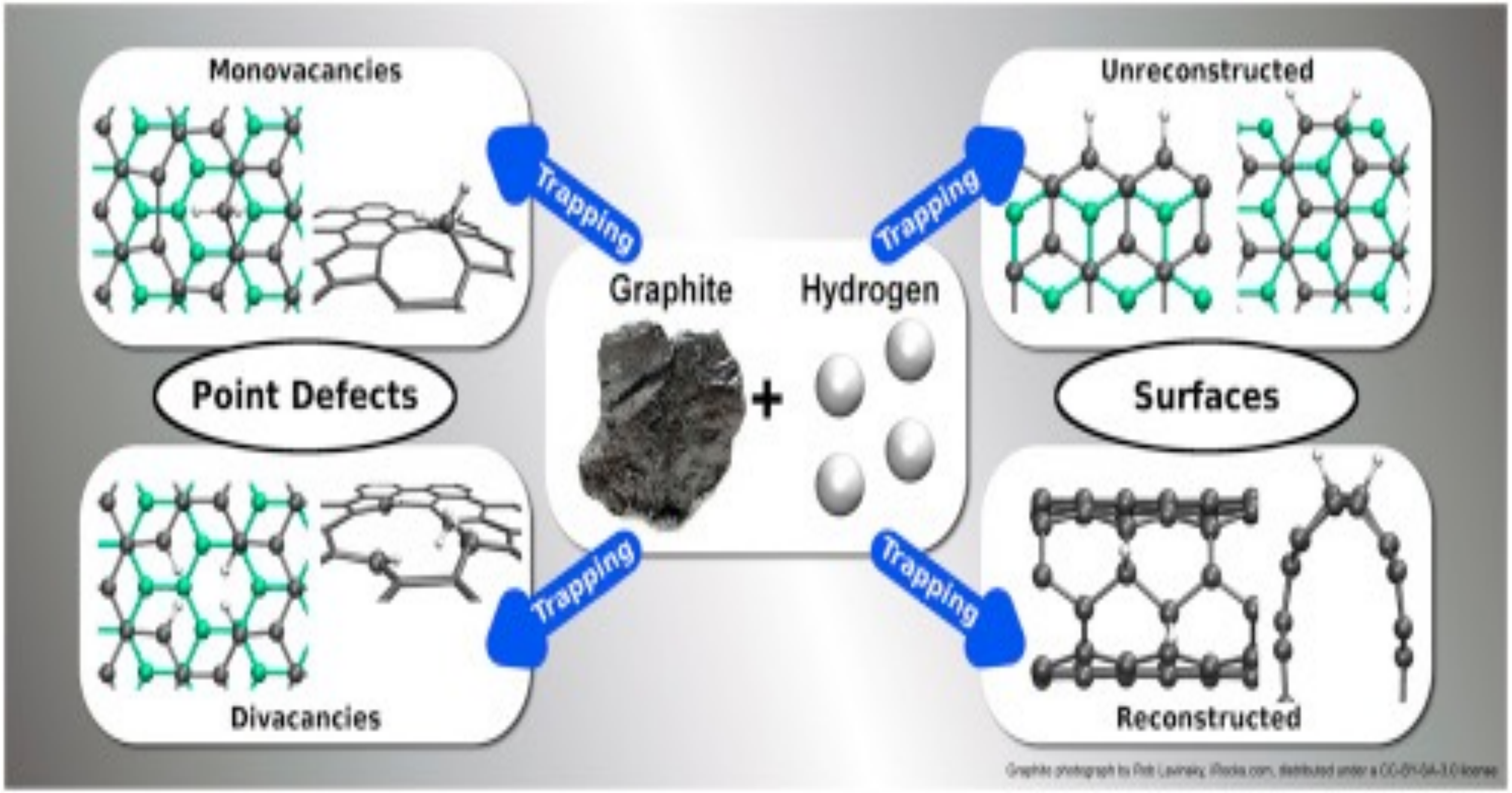
Metal Hydride (MH)



Types of solutions according to the types of solute and solvent

C.Gas is in solids solutions

The adsorption of hydrogen on the surface of carbon (Nano-Graphene).



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https://www.sciencedirect.com/science/article/abs/pii/S0008622317309788

Types of solutions according to the types of solute and solvent

C.Gas is in solids solutions

- The adsorption process is much faster than the distribution process.
- The adsorption process depends on :

1. **Gas type:** as easy the gas can be liquified as much faster it’s ability to be absorbed on the surface of solids

Types of solutions according to the types of solute and solvent

C.Gas is in solids solutions

Absorption depends also on:

2. **The solid type:** **as the adsorption is different from a solid to a solid.**

For example the adsorption of hydrogen on the surface of Nickel is much higher than the adsorption of hydrogen on the surface of Copper on the same conditions of the pressure and temperature.

Types of solutions according to the types of solute and solvent

C.Gas is in solids solutions

Adsorption depends also on:

3. **The solid surface area: as much surface area of the solid as much gas amount can be absorbed.**

For example; the powdered Platinum has ability to adsorb much bigger amount of gases than the polished Platinum does, that due to the bigger surface area of the divided Pt.

- **For that, when we use a catalyst in a chemical reaction, we use the divided material**

Types of solutions according to the types of solute and solvent

C.Gas is in solids solutions

Adsorption depends also on:

4. **Temperature:** **adsorption is an exothermic process, for that and according to Le Chatelier's Principle; the adsorption process decreases by increasing the temperature.**

- **Morover increasing the temperature leads to increasing the kinetic energy of the gas, so it can overcome the attractive force which connected it to the solid surface, consequently the amount of absorbed gas will decrease.**

Types of solutions according to the types of solute and solvent

C.Gas is in solids solutions

Adsorption depends also on:

4. **Pressure:** adsorption increases by increasing the pressure at a specific temperature until it reach a saturation, in which the solid surface can't except any further gas molecules.

Any Questions

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