# Redox reactions

# The concept of redox reactions

Redox reactions - chemical reactions that occur with a change in the oxidation state of the elements included in the reactants

# **Oxidation** - the process of recoil electrons an atom, molecule or ion.

- Atoms are converted into positively charged ion: $Zn^0 - 2e \rightarrow Zn^{2+}$
- negatively charged ion becomes neutral atom: $2Cl^- - 2e \rightarrow Cl_2^0$

  $S^{2-} - 2e \rightarrow S^0$
- The value of the positively charged ion (an atom) is increased accordingly the number of electron donating:

  $Fe^{2+} - 1e \rightarrow Fe^{3+}$

  $Mn^{+2} - 2e \rightarrow Mn^{+4}$

# **Recovery** - the process of accession of electrons an atom, molecule or ion.

- Atom converted to a negatively charged ion

$$S^0 + 2e \rightarrow S^{2-}$$

$$Br^0 + e \rightarrow Br^-$$

- The value of the positively charged ions (atoms) reduced by the number of electrons attached:

$$Mn^{+7} + 5e \rightarrow Mn^{+2}$$

$$S^{+6} + 2e \rightarrow S^{+4}$$

  - or it can go into a neutral atom:

$$H^+ + e \rightarrow H^0$$

$$Cu^{2+} + 2e \rightarrow Cu^0$$

# Recovery - atoms, molecules, or ions donate electrons. They are in the process redox reaction oxidized

*Typical reductants:*

- metal atoms with high atomic radii (I-A, II-A group), as well as Fe, Al, Zn
- simple substances, non-metals: hydrogen, carbon, boron;
- negative ions: $Cl^-$, $Br^-$, $I^-$, $S^{2-}$, $N^{-3}$. We are reducing the fluoride ion $F^-$.
- metal ions in lower oxidation states: $Fe^{2+}$,$Cu^+$,$Mn^{2+}$,$Cr^{3+}$;
- complex ions and molecules containing atoms with intermediate oxidation state: $SO_3^{2-}$, $NO_2^-$; CO, $MnO_2$ and others.

Oxidants - atoms, molecules or ions, electrons join. They are in the process of oxidation-reduction reactions are restored

*Typical oxidizers:*

- nonmetal atoms VII-A, VI-A, VA group consisting of simple substances
- metal ions in the higher oxidation state: $Cu^{2+}$, $Fe^{3+}$,$Ag^{+}$ …
- Complex ions and molecules containing atoms with the highest and lowest oxidation state:c.o.: $SO_4^{2-}$, $NO_3^{-}$, $MnO_4^{-}$, $ClO_3^{-}$, $Cr_2O_7^{2-}$, $SO_3$, $MnO_2$ and others

- On the display of the redox properties of the effect of such factors as the stability of the molecule or ion. The stronger the particle, the less it shows the redox properties

# The degree of oxidation of sulfur: -2,0,+4,+6

- $H_2S^{-2}$ - reductant
- $2H_2S+3O_2=2H_2O+2SO_2$
- $S^0, S^{+4}O_2$ – oxidant and reductant
- $S+O_2=SO_2$ (reductant) $2SO_2+O_2=2SO_3$
- $S+2Na=Na_2S$ (oxidant) $SO_2+2H_2S=3S+2H_2O$
- $H_2S^{+6}O_4$ - oxidant
- $Cu+2H_2SO_4=CuSO_4+SO_2+2H_2O$

# Определение степеней окисления атомов химических элементов

- The oxidation state of atoms of chemical elements in the simple substance = 0
- The algebraic sum of oxidation states of all elements in the ion is the ion charge
- The algebraic sum of oxidation states of all elements in the composite material is 0.

$$K^{+1}\ Mn^{+7}\ O_4^{-2}$$

$$1+x+4(-2)=0$$

# Classification of redox reactions

- Intermolecular oxidation reactions
  - $2Al^{0} + 3Cl_2^{0} \rightarrow 2Al^{+3}Cl_3^{-1}$
- Intramolecular oxidation

$$2KCl^{+5}O_3^{-2} \rightarrow 2KCl^{-1} + 3O_2^{0}$$

- Disproportionation, dismutation (repair itself, autoxidation):

$$3Cl_2^{0} + 6KOH_{(\text{гор.})} \rightarrow KCl^{+5}O_3 + 5KCl^{-1} + 3H_2O$$

$$2N^{+4}O_2 + H_2O \rightarrow HN^{+3}O_2 + HN^{+5}O_3$$

# The value of redox reactions

- Redox reactions are very common. They linked the metabolic processes in living organisms, respiration, rotting, fermentation, photosynthesis.
- Redox reactions provide the cycling of matter in nature. They can be seen from the combustion and smelting of metal corrosion. With their help prepared alkalis, acids and other valuable chemicals.
- Redox reactions underlie energy conversion interacting chemicals in eclectic energy in the battery cell.

# Corrosion of metals

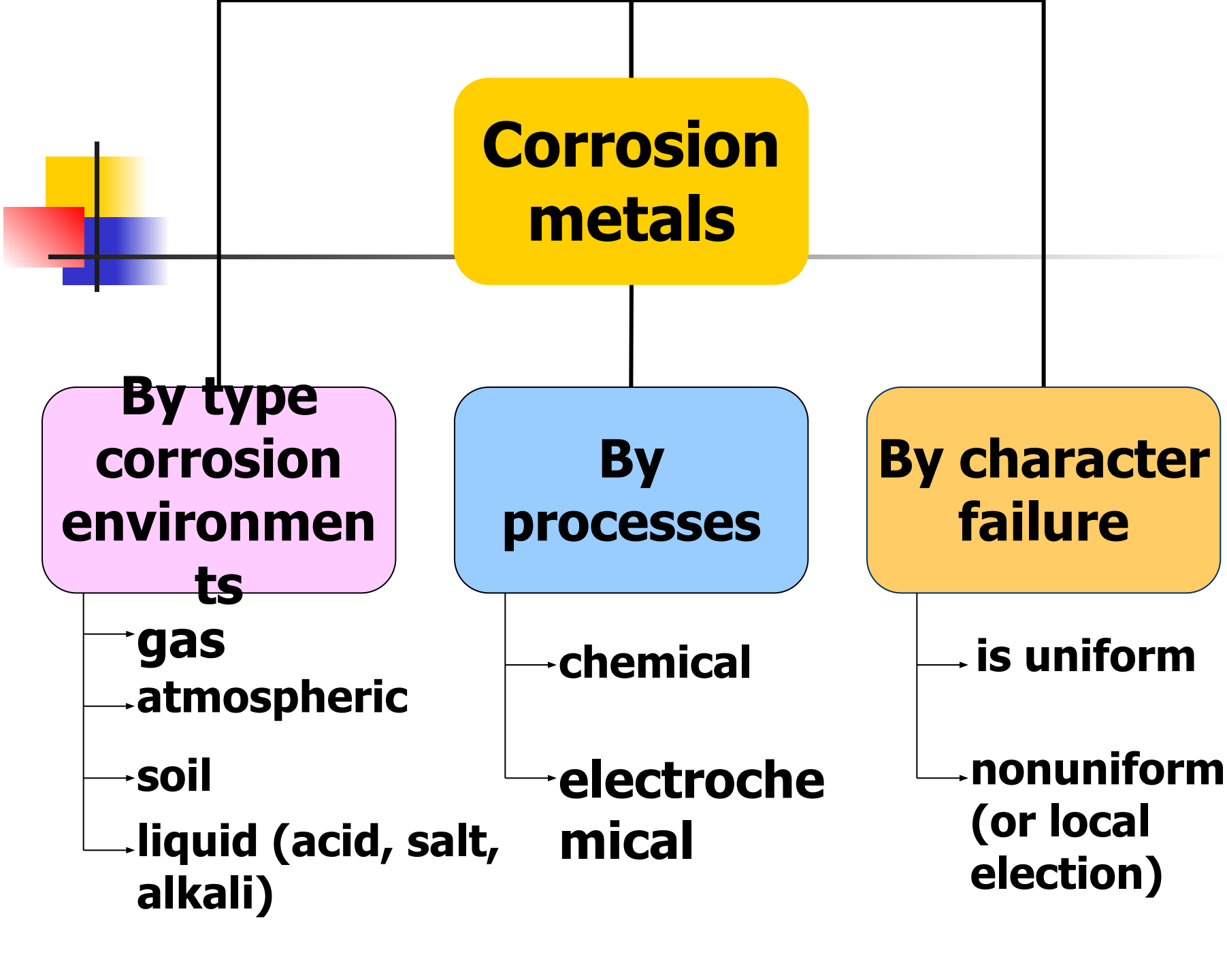
**Methods corrosion protection**

**CORROSION -** spontaneous destruction of metals and alloys as a result of chemical and electrochemical interactions with their environment.

- This redox reaction in which the metal atoms become ions. The more active the metal, so it is more susceptible to corrosion.
- In the role of an oxidant act atmospheric oxygen and hydrogen cations.

# Factors that may cause corrosion

1. **Oxygen and atmospheric moisture**
2. **Carbon and sulfur gases contained in the atmosphere**
3. **Sea water**
4. **Groundwater**


Corrosion metals
By type corrosion environments
gas
atmospheric
soil
liquid (acid, salt, alkali)
By processes
chemical
electrochemical
By character failure
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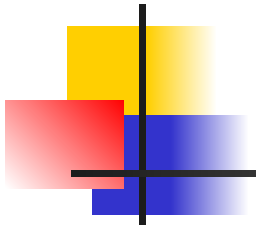
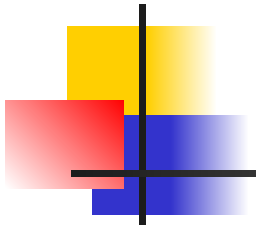


- **CHEMICAL** - a failure of metals and alloys as a result of their chemical interactions with the substances of the environment.
- The protective oxide film on the aluminum surface
- Loose film on the iron surface, leading to destruction of metal



- **Electrochemical -** a failure of metals, which is accompanied by the appearance of an electric current in water or another electrolyte medium.
- Chemical processes - this oxidation metal recoil electrons.
- Electrical processes - transfer of electrons from one site to another product.

# CONDITIONS of electrochemical corrosion

1. **The position of the metal in a series of activity of metal: the farther they are from each other, the faster corrosion.**
2. **The purity of the metal: the impurity accelerate corrosion. Irregularities in the metal surface cracks.**
3. **Ground water, sea water, the environment of the electrolyte.**
4. **Temperature increase.**
5. **The action of microorganisms (fungi, bacteria, lichens to metals with high corrosion resistance).**

# METHODS corrosion protection

1. **The application of protective coatings (paints, varnishes, enamels);**
2. **Covering other metals (gold-plated, silver, chrome, zinc plating);**
3. **Creation and use of corrosion-resistant alloys Introduction to the inhibitors reduce aggressive environment;**
4. **Sacrificial protection**