
Learning the Mechanism of Anodic Oxidation of Sodium Hypophosphite and the Effect of Additives on Chemical Solutions of Nickel Plating

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Abstract: This article discusses to learn the mechanism of anodic oxidation of sodium hypophosphite and the effect of additives on chemical solutions of nickel plating. Thus, the difference of anodic and cathodic oxidation has been learnt. Anodes and cathodes are electrodes with opposite poles. Anode - positive terminal, cathode - negative terminal. In addition, a study of the effect of additives on chemical solutions of nickel plating is reported, as well as current efficiency measurements. So, the effects of sodium hypophosphite were studied.

Keywords: chemistry, mechanism, anodic oxidation, sodium hypophosphite, chemical solutions, nickel plating, action.

INTRODUCTION

In modern society, every science, discipline has its own uniqueness. Each subject has its own field of teaching, tasks, content, methods and techniques of teaching. Thus, Chemistry, like other sciences, came into being as a product of human activity, with the aim of satisfying natural needs, producing the necessary products, synthesizing one another, and finally discovering the secrets of various phenomena.

Researchers have linked the formation of chemistry as a science to Egypt. Science, philosophy, industry, and agriculture flourished in this country, where trade, handicrafts, and cultural ties were highly developed. In the first century, treatises written in Alexandria on the Nile provide much chemical information, including the appearance of chemical equipment, roasting, cooking, curing, dry driving, melting, crystallization, separation, and other methods.

Nowadays, chemistry has several directions. In theoretical basis of chemistry, we learn the concept of oxidation mechanism. And also, we analyze it deeply. Anodic oxidation is an electrochemical method for the production of an oxide film on a metallic substrate. It removes electrons from a substance and oxidizes the anode. Anodic oxidation increases corrosion resistance and wear resistance, and provides better adhesion for paint primers and glues than does bare metal. For example, aluminum is anodized.

Thus, if we analyze the mechanism of anodic oxidation of sodium hypophosphite, scientists have found that using sodium hypophosphite as the reducing agent instead of formaldehyde is especially attractive because of its low pH, low cost, and relative safety.

So, new issues have appeared by using hypophosphite, and the main difficulty outcomes from the fact that the oxidation of hypophosphite is not catalyzed by copper. Because of this little or no plating on a pure copper surface can be obtained. This meant that additive(s) to overcome this problem were actively researched. For example, adding nickel ions (or other

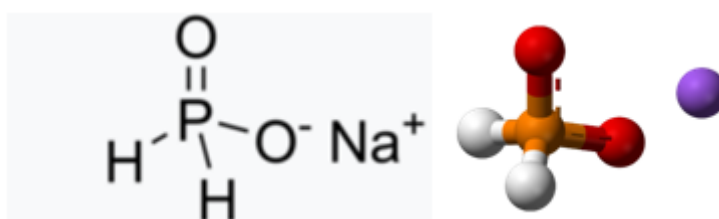
metal ions) to the bath, resulting in a very small amount of code posited nickel in the copper deposit can catalyze the oxidation of the reducing agent. The nickel then serves to catalyze the oxidation of hypophosphite enabling continuous copper deposition.

Sodium hypophosphite (NaPO_2H_2 , also known as sodium phosphinate) is the sodium salt of hypo phosphorous acid and is often encountered as the monohydrate, $\text{NaPO}_2\text{H}_2 \cdot \text{H}_2\text{O}$. It is a solid at room temperature, appearing as odorless white crystals. It is soluble in water, and easily absorbs moisture from the air.

Sodium hypophosphite should be kept in a cool, dry place, isolated from oxidizing materials. It decomposes into phosphine which is irritating to the respiratory tract and disodium phosphate.



These chemical formula and picture indicate Sodium hypophosphite's chemical view.



MATERIAL AND METHODS

Sodium hypophosphite transfers the electrons through the hydride ion when it is *oxidized* by water to phosphite or phosphoric acid.

In 2000, Russian chemistry scientist Sherban Marina Grigorevna has learnt “Anodic oxidation of sodium hypophosphite and mechanism of action of stabilizing additives in chemical nickel-plating solutions” in his dissertation.

In 2003, Candidate of Chemical Sciences Ryabinina Elena Ivanovna has learnt following theme in his research work: “Kinetics of Anodic Oxidation of Hypophosphite Ion and Deposition of Ni-P System Alloys in the Presence of Organic Additives”.

Thus, scientific representatives of D.V. Sokolsky Institute of Organic Catalysis and Electrochemistry, G.S. Polimbetova, M.M. Aleshkova, G.O. Bugubaeva, Zh.U. Ibraimova and A.K. Borangazieva have been discussed “Oxidation of Sodium Hypophosphite by Oxygen in Alcoholic Solutions of Ferrum (III)”.

RESULTS AND DISCUSSION

The data show that, Electro synthesis is a method of electrolysis of various chemical compounds. Both the anode reaction in electrochemical oxidation and the cathode reaction in electrochemical reduction are used to synthesize inorganic and organic compounds. Depending on the chemical nature of the substance undergoing electrochemical oxidation and reduction, the nature of the electrolysis products and the electrode material, and a number of other factors, the electro synthesis reaction takes place in two different processes.

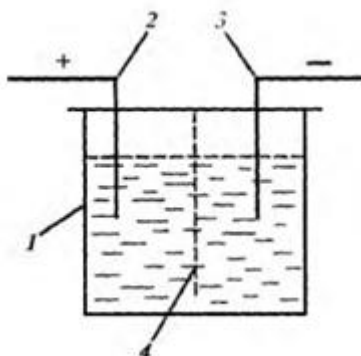
Process 1 the initial compound is oxidized or reversed by direct transfer or bonding of electrons.

In process 2, oxidation or reduction occurs by electrochemical reactions due to the agents initially formed on the electrode surface.

Following 1st picture shows a schematic of the electrolyze. At the positive electrodes, the ions at the anode transfer electrons, that is, an electrochemical oxidation reaction takes place. At

the negative electrodes, the electrons at the cathode combine to form a feedback reaction.

These processes are used to remove impurities from the effluent. These include cyanides, rhodanides, amines, alcohols, aldehydes, nitro compounds, azo dyes, sulfides, mercaptans, and the like. In electrochemical oxidation processes, substances in wastewater are completely broken down into CO, NH₃, water, and simple and non-toxic substances, which can be separated by other methods.



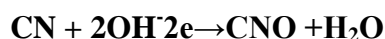
Picture 1. Electrolyze circuit: 1-case; 2-anode; 3-cathode; 4-diaphragm.

Various electrolytic insoluble materials are used as anodes: titanium-based graphite, magnetite, lead, manganese, and ruthenium dioxide.

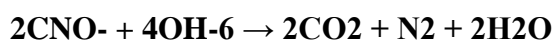
The cathode is an alloy of molybdenum, tungsten and iron or nickel, and stainless steel and other metals coated with molybdenum, tungsten or alloying alloys. The process is used in an electrolyze with or without a diaphragm. In addition to the main processes of electro oxidation and reversal, simultaneous processes of electro flotation, electrophoresis, electro coagulation can also take place.

Cyanide-containing wastewater is generated in machinery, instrumentation, ferrous and nonferrous metallurgy, chemicals, and other industries. In addition to ordinary cyanides (KCN, NaCN), copper, iron and zinc cyanides are also found in wastewater. Their concentrations range from 10 to 600 mg / l. The pH of such waters is usually around 8-12.

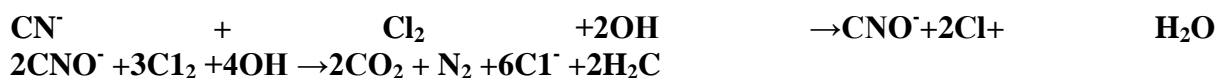
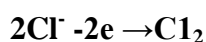
Oxidation of cyanide at the anode is based on the following reaction:



Nitrogen can also be formed during oxidation:

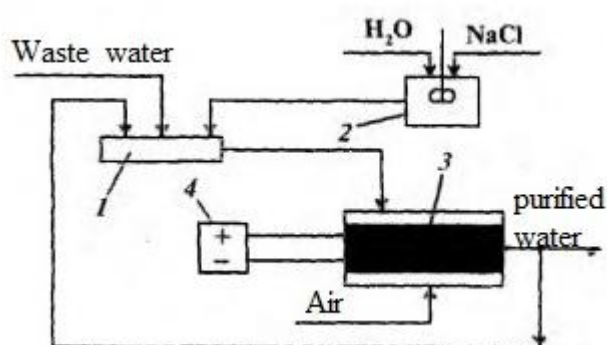
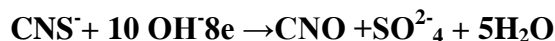


NaCl salt is added to the water to increase the electrical conductivity of the wastewater. When the concentration of CN in the wastewater is 1 g / l, 20-30 g / l NaCl salt is added to the water. Graphite anodes and cathode electrodes are used in this process. Optimal conditions of oxidation: current anode density 3-4 A / dm², distance between electrodes 3 cm, water velocity 30 dm³ / h, ambient pH 8-9. Under these conditions, the water purification rate is close to 100%. The following reactions occur:



The scheme of the device for electrochemical treatment of wastewater cyanides is shown in

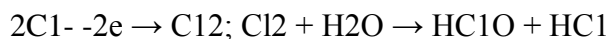
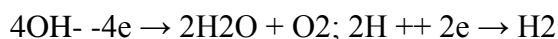
Picture 2. The device is simple and easy to use. The amount of active chlorine in wastewater should be up to 200 mg / l. The decomposed metal is disposed of at the cathode. Rhodanides are decomposed according to the following scheme:



Picture 2. Drawing of the device for electrochemical treatment of wastewater from cyanide compounds: 1-Standardizer; 2-Cistern to prepare NaCl solution;

3-electrolyzer; 4- DC current source.

Sulfide ions are oxidized at pH = 7 to sulfate. When the pH of the medium is less than 7, elemental sulfur is formed. Oxidation of phenolic chloride in wastewater follows the following scheme:



Anodic oxidation is used to treat wastewater from iron ore, various dyes, pulp and paper, and oil refineries.

Types of electrodes located in anode and cathode electrochemical cells. These are devices capable of generating electricity through a chemical reaction. The most commonly used electrochemical cells are batteries.

There are two types of electrochemical cells, electrolytic cells and galvanic or voltaic cells. In electrolytic cells, the chemical reaction that produces energy does not occur spontaneously, but electricity is converted into a chemical oxidation-reduction reaction.

The galvanic cell consists of two half-cells. They are connected by two elements, a metal conductor and a salt bridge.

An electric conductor, as its name implies, conducts electricity because it has very little resistance to the motion of an electric charge. The best conductors are usually metal.

A salt bridge is a tube that connects two hemispheres to each other, maintains their electrical connection, and prevents the components of each cell from coming together. Each half-cell of the galvanic cell contains an electrode and an electrolyte.

When a chemical reaction occurs, one of the half-cells loses electrons to its electrode through an oxidation process; the latter is achieved in the process of returning electrons to the electrode.

The oxidation process takes place at the anode, and the reduction process takes place at the cathode. The name of the anode comes from the Greek aná (aná): up, and o (odós): path. The term was coined by Faraday in the 19th century. The best definition of an anode is an electrode that loses electrons in an oxidation reaction. Usually this depends on the positive

pole of the electric current transit, but this is not always the case.

In batteries, the anode is a positive pole, but in LED lamps it is the opposite, and the anode is a negative pole. The direction of an electric current is usually determined by the direction of the free charges, but if the conductors are not metallic, the resulting positive charges are transferred to an external conductor.

This motion means that we have positive and negative charges moving in opposite directions, so the direction of current is called the direction of the positive charges of the captions at the anode to the negative charge of the anodes. found at the cathode.

In galvanic cells with a metal conductor, the current generated by the reaction travels from the positive to the negative pole.

However, in electrolytic cells, which do not have a metal conductor and instead have an electrolyte, positive and negatively charged ions can be found moving in opposite directions.

Thermonic anodes take most of the electrons from the cathode, heat the anode, and find a way to distribute it. This heat is generated by the voltage between the electrons.

Nickel and its alloys also catalyze anodic oxidation of the hypophosphite ion, which reaction is the limiting stage of the so-called electro less deposition of many metals, including nickel itself.

The simplest way to differ the content of the nonmetallic component in nickel–phosphorus alloys is to differ the sodium hypophosphite concentration in the nickel plating electrolyte. The Ni–P alloys obtained in electrolyte¹ may contain 0–31.5% of phosphorus. The rate of anodic oxidation of the hypophosphite ion on the obtained Ni–P_x and Ni–P_x–S_y alloys also depends on the heteroatom nature.

CONCLUSION

Learning the mechanism of anodic oxidation of sodium hypophosphite and the effect of additives on chemical solutions of nickel plating was studied as a function of their composition. The effect of the electronic and structural factors on the catalytic activity of nickel alloys was analyzed.

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