INFLUENCE OF ALANIN ON THE COPPER ANODIC DEPASSIVATION IN ALKALINE SOLUTION

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The processes of complex's formation are very important in electrochemistry of copper [1].Thereby amino acids are of special interest for researchers as complexing agents[2]. However, in spite of the theoretical and practical importance of this question, the last one has not been investigated enough yet, so there is an opportunity for creation and innovation.

In connection with it there is an attempt which has been undertook in present work to carry out the systematic study of an aminoacid's role (for example α- and β-alanin) in anodic processes of copper in an alkaline solution (pH=12) in zone of potentials, where the metal is in a passive state or exposed local activation. Concentration of an additive was changed from $1*10^{-4}$ to $1*10^{-1}$mpl. The experiments were carried out with use physic-chemical methods (voltammetry, chronoamperometry and microscopy), which can help to give a comprehensive kinetic characteristic of an electrochemical process and estimate the state of metal/solution interface.

According to received results character of β-alanin's effect depends on concentration of additive. Copper is in the passive state up to potential of oxygen evolution in the alkaline solution with the concentration of alanin $1*10^{-4} \leq Cala < 1*10^{-2}$ mpl. β-Alanin stabilizes system, what is expressed in decrease of critical passivation currents, currents of complete passivation and widening of passive state. Copper is local depassivated on the contrary at $Cala \geq 1*10^{-2}$ mpl, what is confirmed by chronoamperometric data (E_{LA}=0,170 V [NHE]). The microscopic examination of a surface showed some pits with a regular shape (diameter 42 mkm), which are repassivated later. The influence of alanin ($Cala > 5*10^{-2}$ mpl) is appeared already in the region of the potentials of copper active dissolution and prevents from transition of metal in passive state.

Comparative of the analysis influence of α- and β-alanin on copper anodic processes showed that effects caused by these amino acids are similar. However, copper has already a local activation with $C\alpha\text{-ala} \geq 5*10^{-3}$ mpl instead of β-alanin because of the bigger activity, than β-alanin.

An explanation of these effects must be based on the knowledge of copper local depassivation which is connected with nature of passive state. The additional experiments were carried out with use of the cyclic voltammetry (CVA) for determination of one. The presence of peaks on catodic regions CVA corresponds about reduction of the insoluble products of oxidation under the proper potentials. Identification of ones with use literary data [3,4] showed, that the following compounds: Cu(OH), $Cu(OH)_2$, Cu_2O and CuO are responsible for passive state of copper in the alkaline solution.

The dual role of amino acid, which predominates as an anion in researched solution, can be found already on formation of passive film. So, the small concentration of β-alanin ($1*10^{-4} \leq Cala < 1*10^{-2}$ mpl), as was shown above, have an inhibiting effect on anodic processes of copper, what is expressed in increase stability its passive state. Moreover, the presence of amino acid in the small quantities does not influence on thickness and composition of passive film. This fact can be explained displacement OH^- -ions by anions of alanin from initial layer of passive film, which is completed formation stable complexes on surface. There is another effect at concentration of β-alanin $Cala \geq 1*10^{-2}$ mpl: decrease total thickness of film and lowering CuO in one. It is known [3], that namely CuO is responsible for stability of copper passive state. As a consequence of this protective properties of oxide-hydroxide layers, which are formed on copper in solutions containing amino acid, are decreased. In the same time there is a possibility of formation of volumetric copper complexes with big concentrations of alanin, that lead to local activation of copper. This process is realized in conformity with the mechanism of nucleofil substitution (stimulating role of amino acid)[5].

The stability of copper passive state can be increased and decreased (causing local activation of metal) by regulation of the concentration of alanin. It depends on alignment volumetric copper complexes and complexes on surface with alanin and one's stability.

References.

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