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ANODIC DEPOSITIONS OF COMPOSITS ELECTRODE PbO_2/CoO_X ON SUPSTRAT OF TITANIUM

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ABSTRACT

In order to obtain a new anodic materials having catalytic properties for reaction of oxygen releasing, but also for another electrochemical oxidation processes, in this work composite deposition has been investigated comprising of lead and cobalt oxides. In this composite, PbO_2 has role of a good conductor of electricity, and CoO_X has role of electrocatalysator, which results in stable anode with good properties.

Thorough experimental investigations have been made with aim of studying the electrolyte composition as well as substrate influence of electrochemical deposition of lead and cobalt oxides. PbO_2/CoO_x anodes with good properties have been obtained from sulphamate solution as well as from acid and alkali suspension with Co_3O_4 particles.

For electrochemical deposition of the composite, nickel as substrate exhibited good results, and alkali suspension was proved as good electrolyte.

The composite electrode was tried for reaction of oxygen release from NaOH solution with aim of studying electro-catalytic properties, stability, and economic aspects.

Key words: Anode, compozits electrode, PbO_2/CoO_x, electrochemical depozition, titan.

1. INTRODUCTION

During exploatacion, in electrolytic process, the electrodes are using and on that way, disturbing working condition. Also, this process increasing distance between electrodes and electrical resistance wich influence to change voltage in cell. This change of working condition significantly effects on electrical balance of cell, temperature and optimal condition of process.

Products of corozion of electrodes causing the unclearnes of electrolyt and products of electrolytic process, so that the separate tretman is indispensable.

There are no completely undissolving anode. Anode can be stable in once conditions work, while in secound conditions are less stable or they are completely unstable.

For each kind of anodic materials existing the conditions in wich disturbance of their stability appeared, and, in wich start their intensive destructions. This conditions called „critical“conditions for this process and this anodic material. Changing the composition, pH of electrolytes, density of current, temperature, anodic potential, in relation to proper conditions the unwanted effects could appeared and came the rapid destroy of anode. Therefore, if we wanted to keep stability of anode, their working conditions mustn't be nearly critical conditions.

The complexity problem of anodic materials lay in the facts that during anodic polarization anodic surface are significantly change in medium wich contain oxigen. In presence of oxigen, all metals, except gold, are termodinamicly unstable. Stability of anode is directly dependents of nature and state of surface of oxide membrane .

Excludy, alkali, alkali – earth and metals of III – group periodic system, all other metals to present potential anodic materials .

The main aim of this study is getting the composits of anode with electrocatalytic properties for the reactions of oxigen separation and possibly some other electrochemical process. In this work we also examine the anodic deposition the composits wich consits of PbO_2/CoO_x [1].

2. EXPERIMENTAL

Examination of the influence of electrolytic composition, pH, as well as of the nature of metalic matrix - substrate were done by linear voltametric chronopotenciometric and chronamperometric methods.

For examination electrochemical depositions of composites plate, potenciostat / galvanostat M263 are used, with electrochemical microcell M K0264 (EG & GPARC).

In cells for voltametric examination as reference electrode Ag/AgCl electrode type K0265 is used. Additional electrode is platinium.

For depositions composits plate PbO_2/CoO_X, with current control, as working electrodes is used tile from titanium, bigger surface.

Electrode is first polished with abrasion paper after that the grease is removed from electrode in ethanol. Finaly, electrodes are threating with solutions for microdamage.

In paper are used four different electrolytes wich differs by the nature and pH:

- 0,12 $moldm^{-3}$ $Pb(CH_3COO)_2$ + 0,8 $moldm^{-3}$ $Pb(NO_3)_2$ + 0,1 $moldm^{-3}$ $Co(NO_3)_2$
- sulfamatic solution Pb(II) and Co(II) ions. In prepared solution Pb (II) sulfamat is added 0,1 $moldm^{-3}$ solution of Co(II) nitrats.
- acid suspension :0,12 $moldm^{-3}$ $Pb(CH_3COO)_2$ + 0,8 mol/dm^3 $Pb(NO_3)_2$ + particles Co_3O_4, wich are wide < 1μm. Volume percent of particles was: φ=0,03; φ=0,1;φ=1,0
- alkali suspension : 0,1mol/dm^3 $Pb(CH_3COO)_2$ + 3mol/dm^3 NaOH + particles Co_3O_4, wich are wide < 1 μm. Volume percent of particles Co_3O_4 in suspenzion was : φ=0,03; φ=0,1;φ=1,0.

3. RESULTS AND DISSCUSIONS

Influence of the electrolytic composites on anodic reaction of simultaneouns rising composits of PbO_2/CoO_x is showed on figure 3.1.

Based on eksperimental research and literature data, the most appropriate current density for simultaneous deposition PbO_2 and CoO_X is determinated . For composits deposits of that oxid from sulfamatic electrolyt, as well as for the suspension, we used current density from 3,0 mA/cm^2. Changing the concetration ratio Pb^{2+} and Co^{2+} ions, hronopotenciometric depositions on substract of titanium were done (figure 3.2.).

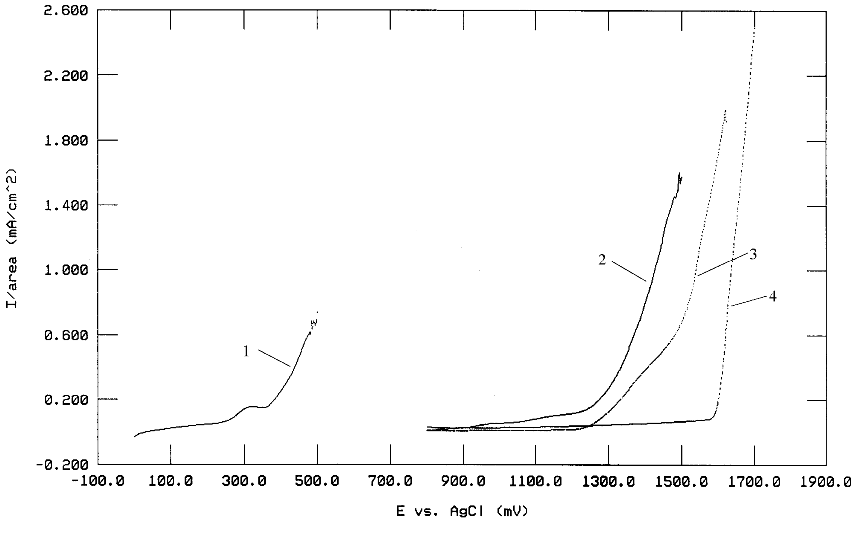

Figure 3.1. I -E voltamogram of reaction rise PbO_2/CoO_x on substrat of titanium, electrolyt: 1-0,1 $moldm^{-3}$ $Pb(CH_3COO)_2$+ 0,02 volume Co_3O_4+3,0 $moldm^{-3}$NaOH; 2-0,13 $moldm^{-3}$ $Pb(CH_3COO)_2$+0,9 $moldm^{-3}$ $Pb(NO_3)_2$ + 0,03 volume Co_3O_4; 3-0,13$moldm^{-3}$ $Pb(CH_3COO)_2$ + 0,9$moldm^{-3}$$Pb(NO_3)_2$ + 0,1$moldm^{-3}$$Co(NO_3)_2$; 4-0,1$moldm^{-3}$ $Pb(SO_3NH_2)_2$ + 0,1 $moldm^{-3}$$Co(NO_3)_2$.

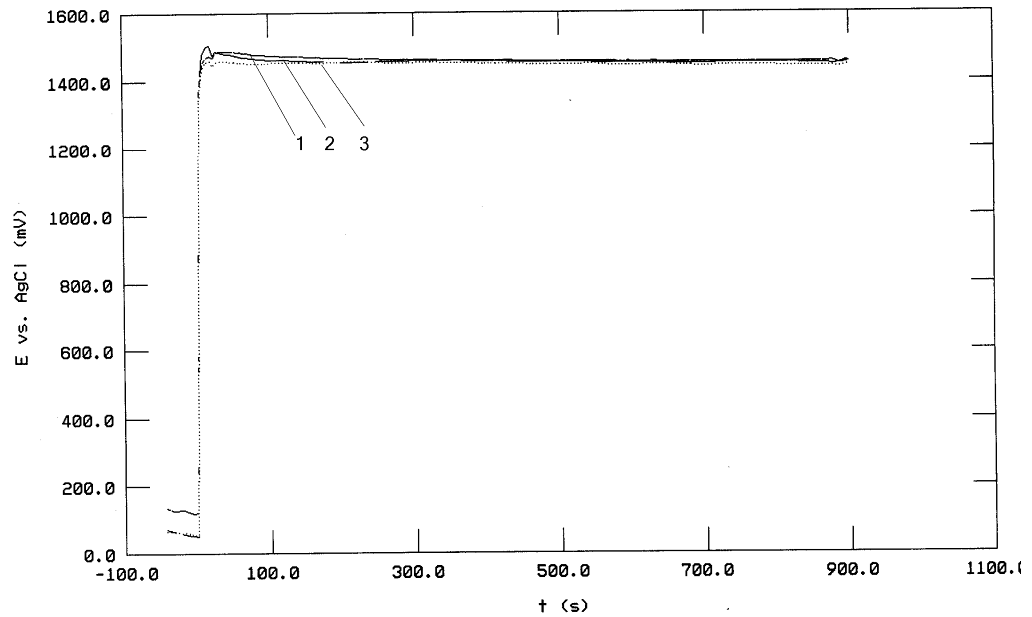

Figure 3.2. Hronopotenciometric diagram; substrat titan. (1)-0,5 moldm^{-3}Pb(SO_3NH_2)$_2$ + 0,5moldm^{-3}Co(NO_3)$_2$; (2)-0,3moldm^{-3}Pb(SO_3NH_2)$_2$ + 0,7moldm^{-3}Co(NO_3)$_2$; (3)- 0,1moldm^{-3}Pb(SO_3NH_2)$_2$ + 0,9 moldm^{-3}Co(NO_3)$_2$.

We supposed that composites obtained by hronoampermetryc methods from solution of Pb(II) and Co(II) ions and Co particles gives the plate wich in own composition except, PbO_2 has CoO_X.

This hypothesis we confirmed by testing anode on reaction of oxigen separating from solution of 1M NaOH.

The obtained composits electrodes PbO_2 / CoO_X, were applyed as anode for reaction of oxigen separating , in purpose of examine their caracteristic.

At figure 3.3 is showed voltamogram of reaction separate oxigen :

- at anode from substrate of titanium
- at anode from same substrate with plate from PbO_2 obtained from solution lead –sulfamat.
- at anode from same substrate with composits PbO_2/CoO_X obtained from acid suspension, with different volume percent Co_3O_4.

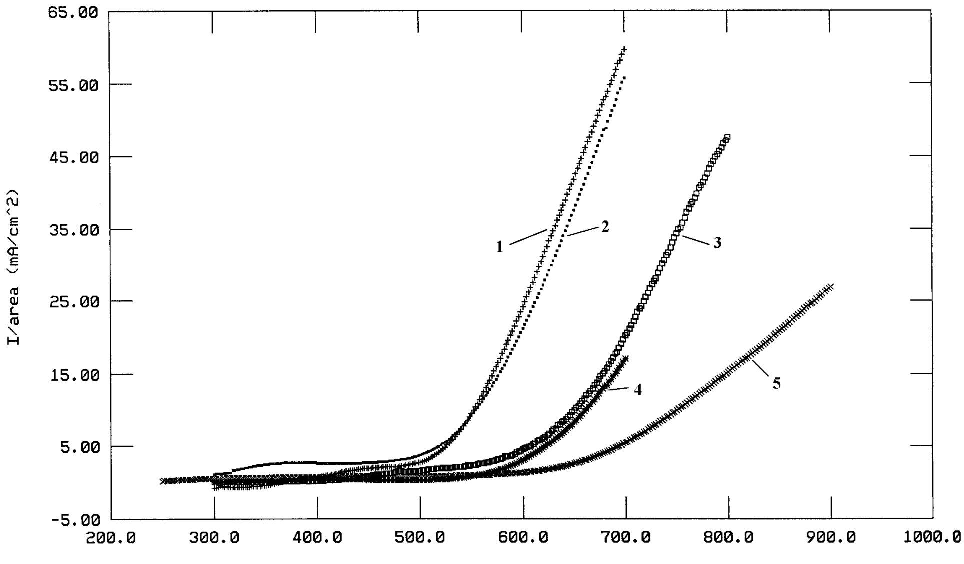

Figure 3.3. Comparasion i-E for reaction izdvajanja oxigen from 1,0 moldm^{-3}NaOH; composits PbO_2/Co_3O_4, on substratat of titanium, (acid suspension):(1)-φ=0,1 Co_3O_4; (2)-φ=1,0 Co_3O_4; (3)-φ=0,03 Co_3O_4; (4) - PbO_2 on substrat of titanium

4. CONCLUSION

Experimentaly obtained voltamograms of elektrochemic reactions to rise of composits lead dioxyde and oxydes of cobalt, are showed dependences of potentials of reactions from pH of electrolytes. Lowest valuables the potential of reaction to rise of composits, were done for the alkali suspension of composition: *$0{,}1 mol/dm^3$ $Pb(CH_3COO)_2$ $+3{,}0 mol/dm^3 NaOH$ + particles Co_3O_4, with volume part, $\varphi = 0{,}02$;*. Potentials for the sulfamatic electrolyte of composition: *$0{,}1 mol/dm^3$ $Pb(CO_3NH_2)_2$ + $0{,}1 mol/dm^3$ $Co(NO_3)_2$,* were done more positively.

Comparison i-E (fig.3.3.), to discern of significant changes of potential for the reaction of separatings of oxygen all tested composits anodes obtained on the substrat of titanium (line 1,2,3) in the comparison with the lead dioxide anode and alone substrats (line 4and 5). Obtained composits electrode has catalytic effects. Biggest the moving potential towards smaller positive values, reactions separatings of oxygens, to descerned for the composits PbO_2/Co_3O_4, wich obtained from suspension with volume part of Co_3O_4 particles, $\varphi = 0{,}1$ (line 1), [2,3].

5. REFERENCES

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