# FEATURES OF INTERACTION OF HYDROGEN WITH COVERINGS ON THE BASIS OF NICKEL

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**Introduction**

Interaction of the metals received by a method of electrocrystallization, with hydrogen has specific character. The structure of the electrobesieged metal coverings differs high concentration of defects of the crystal structure, exceeding termodinamik the equilibrium. The given systems are characterised by the raised free energy and aspiration spontaneously to pass in steadier condition. Interaction of hydrogen with metals is carried out on defects of structure, and the quantity of absorbed hydrogen is defined by density of defects on unit of a surface (volume) of the store [1].

It is known, that nickel coverings possess propensity to hydrogen absorption, and the quantity of the adsorbed and absorbed hydrogen depends both on a chemical compound of electrolit and from electrosedimentation modes. Definition of quantity of the absorbed hydrogen by metals represents the big interest for two reasons: first, included in structure of metals and alloys hydrogen changes their physical and chemical and physicomechanical properties; secondly, allows to estimate their possibility on use as stores.

From the point of view of physicomechanical properties of metals and alloys, hydrogen absorption causes their fragility that can lead to the negative phenomena (loss solid characteristics, acceleration of corrosion processes). For elimination of these phenomena use bake when low temperatyre coverings or there is a necessity to transition to pulse modes of electrocrystallization. However these methods can appear also ineffective at formation of coverings of a considerable thickness. It is connected by that hydrogen extracted only from the top layers of metal, and being in covering deep layers in "traps" and collectors remains. In this connection studying of interrelation of structure, hydrogen saturation galvanic coverings depending on a thickness of a formed film is of interest.

**Results and discussion**

As object of research are chosen Ni and Ni-B the films received by electrocrystallization from sulphatic ($NiSO_4 \cdot 7H_2O$ – 220 g/l; NaCl – 10 g/l; $H_3BO_3$ – 30 g/l) and sulpamate electrolits (Ni $(NH_2SO_3)_2 \cdot 4H_2O$ – 400 g/l); $NiCl_2 \cdot 6H_2O$ – 18 g/l; $H_3BO_3$ – 30 g/l) [2].

The analysis of experimental data has allowed to establish, that with increase in a thickness of galvanic films the general tendency – decrease hydrogen saturation is marked. For example, for Ni – the films received from sulphatic electrolit at $i_k$ = 2 A/dm$^2$, the hydrogen maintenance decreases in 2,6 times thus a thickness of coverings increases from 3,0 to 5,2 microns [3].

In tab. 1 the parametres showing decrease of quantity of absorbed hydrogen with increase in a thickness for nickel-pine forest of a covering, received of sulphamate electrolits are shown.

Table 1. The maintenance of hydrogen in covering Ni-B depending on technological parametres electrolysis (concentration boron-containing additives 0,05 d/l; pH = 4,0; $t_{el-t}$= 40 °C).

| $i_k$, A/dm$^2$ | $T_{el-s}$, min | d, μm | $V_{H2}$, cm$^3$/100 g |
|---|---|---|---|
| 0,5 | 10 | 1 | 300,0 |
| | 40 | 4 | 158,0 |
| 2 | 10 | 4 | 80,0 |
| | 40 | 16 | 60,6 |
| 4 | 5 | 4 | 65,0 |
| | 10 | 8 | 52,3 |
| | 40 | 32 | 30,1 |

For coverings Ni–B received, for example, at $i_k$ = 2 A/dm$^2$, the hydrogen maintenance decreases in 80,0 to 60,6 cm$^3$/100 g. Thus a thickness of coverings increases from 4 to 16 microne. For coverings more than 15 micron hydrogen saturation are stabilised by thickness and practically does not change.

By results of the experiment, received by a method vacuum extraction, it has been established, that quantity absorbed hydrogen in thin layers of nickel and nickel-pine forest (a thickness of an order to 4 microns) its maintenance in 3-5 times in coverings in the thickness more surpasses than 4 microns. On the basis of experimental data, it is possible to make a following conclusion, amount (weight) of the besieged threw (Ni and Ni-B) it is proportional to time electrolysis , that is the

increase in weight of metal from time electrolysis at $i_k$ = const submits to the linear law. Comparing dependences of a thickness of coverings Ni and Ni-B and volume of the hydrogen absorbed in process electrolysis, it is established, that relative the maintenance hydrogen in unit of volume with increase in a thickness decreases. In tab. 2 dependences of quantity of the electricity spent for reception of covering Ni-B of various thickness and volume of hydrogen included in the given deposit are resulted.

Table 2. Dependence of quantity of the electricity passed through electrolytic a cell (Q, c.) and hydrogen maintenances ($V_{H2}$, $cm^3/100$ from a thickness of alloy Ni-B. A mode electrolysis: concentration boron-containing additives – 0,05 g/l, $i_k$ = 4 $A/dm^2$; pH = 4,0; $t_{el-t}$ = 40 wasps.

| d, μm | 4 | 8 | 32 |
|---|---|---|---|
| Q, c. | 144 | 288 | 1152 |
| $V_{H2}$, $cm^3/100$ g | 30,1 | 52,3 | 65,0 |

From given tab. 2 follows, that the quantity of included hydrogen should increase to proportionally quantity of the passed electricity through electrolytic a cell. However the analysis of results of experiment shows, that the quantity of the hydrogen dissolved in the sample decreases irrespective of a chemical compound of electrolit and applied modes electrolysis. It is possible to explain quantitative discrepancy of real dependence incomplete extraction hydrogen from metal volume at thermodiffusion because of presence of "hydrogen traps" [4]. The given phenomenon is caused by that at heating of the sample by an external source of thermal radiation under the influence of a gradient of temperature thermodiffusion is carried out deep into the sample and thereof the moved atoms can form union hydrogen molecules in the closed collectors of structure of the metal which their exit, as a rule, is blocked, therefore measured volumes of hydrogen do not reflect the valid picture of occurring processes. The quantity of the blocked hydrogen can exceed several times volum esextracted. Hydrogen definition in such form cannot be carried out known methods. In electrolytic metals and alloys at increase in a thickness of a covering the probability of formation of traps increases, as the probability overlapping separate formed layers of metal increases with time growth electrolysis localisation of free hydrogen in this case can be found out only at metal fusion. Even use of a structurally-sensitive method of an internal friction cannot give the information on interaction of molecular hydrogen with structure of metal [5]. To find out such structural changes it is possible, using additional methods, for example, measuring a gradient of temperature of a thermal field at pulse excitation in infra-red area of radiation.

**Conclusions**

The quantity absorbed hydrogen in thin layers of nickel and a nickel-pine forest defined by a method vacuum extraction is established, that, surpasses its maintenance in 3-5 times in coverings in the thickness more than 4 microns. Discrepancy between the quantity of the electricity passed through electrolytic a cell and volume of included hydrogen, coverings on the basis of nickel with increase in a thickness of a layer that is connected with incomplete extraction hydrogen from metal volume at thermodiffusion because of presence of "hydrogen traps" is revealed.

**References**

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