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# DEFORMATION AND DESTROYING FEATURES OF ELECTROLYTIC GALVANIC IRON COATING

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***Abstract:*** *Are given the results of the studies, which make it possible to explain some special features of deformations and destruction of electrolytic iron plantings, at different depths of depression, with tests.*

***Key words:*** *deformation, destroying, electrolytic, galvanic, iron, coating.*

## 1. INTRODUCTION

Electrolytic wear-resistant coatings are widely applied to the reinforcement and restoration of machine components in industry to increase their durability. It is well known, that plating conditions render essential influence on physical and mechanical characteristics of electrolytic galvanic precipitations [1].

Knowledge of physical and mechanical characteristics of electrolytic galvanic coatings is necessary for a reasonable choice of the technological precipitation conditions dependent on operating work conditions of restored details, as well as for accomplishing important strengthening calculations [1].

## 2. INFORMATION

Important parameter in the study of physical and mechanical characteristics of wear-resistant galvanic coatings is their brittleness. This property of coatings is undesirable as the augmentation of brittleness influences such important performance characteristics of precipitations, as wear resistance [1].

Current problems of physical and mechanical characteristics research of materials in the surface and near-surface beds is stipulated by the fact, that all modern processing methods, reinforcement and connections of metals, are connected to contact deformations.

Testing for kinetic Knoop hardness and hardness reveals new possibilities for determining physical and mechanical properties and crack toughness, electrolytic galvanic coatings [1–3].

The possibility of determining elastoplastic characteristics, work of deformation $A_y$, $A_n$, $A_p$, $A$, ratio $H/H_h$; $H/H_d$; $H_h/E$; $H_d/E$, unrestored and dynamic knoop hardnesses $H_h$, $H_d$ of electrolytic wear-resistant galvanic iron, iron-nickel and chromium coatings are also mentioned [4–6]. Some features of deformation and destroying of the electrolytic galvanic coatings obtained from electrolyte 2. may be found on page 59 [1]. Testing was conducted to establish physical tests in branch ВНИИМАШ, Волжск [1].

As a sample, 30 mm rollers, coating of 0.5 mm width and 100 mm length were used, which were handled at optimum grinding conditions.

The depth of resilient $h_y$, plastic and general indentation $h_n$, $h$ were determined by the indentation diagram.

Distorted volumes calculus $V_y$, $V_n$, $V$ and work used for resilient $A_y$, plastic $A_n$ and general $A$ deforming of coatings for determining depths of indentation (0.5 μm ÷ 4 μm) was done by the known method [2, 3]. Dynamic Knoop hardness was determined as the ratio of work $A$ to the distorted volume $V$ of iron coatings.

Investigation results (Table 4) have shown, that the factor $a$ describing material hardness, unrestored Knoop hardness $H_h$, dynamic Knoop hardness $H_d$, work for plastic $A_n$ and general deforming $A$ of coatings and the load $P$ necessary for indentation of Vikkers pyramid on depth $h$ into the investigated coating for iron galvanic coatings are extreme.

In all the interval of current density augmentation (from 5 to 30 A/dm$^2$) the depth of restored imprint $h_y$ increased from 0.172 to 0.400 μm, and work used for resilient deforming $A_y$ of iron galvanic coatings increased from $2.88\cdot10^{-6}$ to $37.30\cdot10^{-6}$ (H·mm).

These data agree well with earlier researches [1] and have shown that with augmentation of current density $J$ from 5 to 30 A/dm$^2$ the depth of restored imprint increased at microindentation of iron galvanic coatings.

With augmentation of current density $J$ from 5 to 30 A/dm$^2$ the depth of plastic indentation $h_n$ has decreased from 1.828 to 1.600 μm. However, work used for plastic deforming $A_n$ of iron coatings with current density changed in the entire interval is extreme. With augmentation of current density from 5 to 15 A/dm$^2$, $A_n$ increased from $346\cdot10^{-6}$ to $369\cdot10^{-6}$ H·mm. With further augmentation of current density $J$ from 15 to 30 A/dm$^2$ $A_n$ decreased from $369\cdot10^{-6}$ to $239\cdot10^{-6}$ H·mm.

With augmentation of current density $J$ from 5 to 30 A/dm$^2$ at receiving iron galvanic coatings, the general depth of indentation ($h = 2$ μm) and general amount of elastoplastic deformations ($V = 65.3\cdot10^{-9}$ mm$^3$) are constant.

However, work used for elastoplastic deforming $A$ of iron galvanic coatings is extreme when current density changed $J$. With further augmentation of current density, $J$ at receiving iron galvanic coatings, from 5 to 15 A/dm$^2$,

*Table 1*

**Physicomechanical characteristics of iron electrolytic platings**

| **Conditions of the electrolyte** | | **Elastic properties** | **Plastic properties** | **General properties** | $a$ | $H_h$ | $P\cdot10^{-2}$ |
|---|---|---|---|---|---|---|---|
| $D_k$ [A/dm$^2$] | $T$ [°C] | $h_y$ [μm] | $h_n$ [μm] | $h$ [μm] | [H/mm$^2$] | [H/mm$^2$] | [H] |
| | | $A_y\cdot10^{-6}$ [H·mm] | $A_n\cdot10^{-6}$ [H·mm] | $A\cdot10^{-6}$ [H·mm] | $A_p\cdot10^{-6}$ [H/mm$^2$] | $H_d$ [H/mm$^2$] | |
| 5 | 40 | 0.043 | 0.457 | 0.5 | 10204 | 18900 | 12.5 |
| | | 0.013 | 15.9 | 20.8 | 4.887 | 20408 | |
| 10 | 40 | 0.062 | 0.438 | 0.5 | 11510 | 21270 | 14.1 |
| | | 0.45 | 15.95 | 23.5 | 7.100 | 23017 | |
| 15 | 40 | 0.065 | 0.435 | 0.5 | 13306 | 24740 | 16.3 |
| | | 0.60 | 17.9 | 27.2 | 8.700 | 26641 | |
| 20 | 40 | 0.095 | 0.405 | 0.5 | 9795 | 18140 | 12.0 |
| | | 1.37 | 10.6 | 20.0 | 8.030 | 19560 | |
| 30 | 40 | 0.100 | 0.400 | 0.5 | 9763 | 18100 | 11.9 |
| | | 1.60 | 10.2 | 19.9 | 8.100 | 19900 | |

*Table 2*

**Physicomechanical characteristics of iron electrolytic platings**

| **Conditions of the electrolyte** | | **Elastic properties** | **Plastic properties** | **General properties** | $a$ | $H_h$ | $P\cdot10^{-2}$ |
|---|---|---|---|---|---|---|---|
| $D_k$ [A/dm$^2$] | $T$ [°C] | $h_y$ [μm] | $h_n$ [μm] | $h$ [μm] | [H/mm$^2$] | [H/mm$^2$] | [H] |
| | | $A_y\cdot10^{-6}$ [H·mm] | $A_n\cdot10^{-6}$ [H·mm] | $A\cdot10^{-6}$ [H·mm] | $A_p\cdot10^{-6}$ [H/mm$^2$] | $H_d$ [H/mm$^2$] | |
| 5 | 40 | 0.086 | 0.914 | 1.0 | 5918 | 10960 | 29.0 |
| | | 0.61 | 73.8 | 96.6 | 22.19 | 11836 | |
| 10 | 40 | 0.123 | 0.877 | 1.0 | 6938 | 12850 | 34.0 |
| | | 2.10 | 76.4 | 113.3 | 34.60 | 13876 | |
| 15 | 40 | 0.130 | 0.870 | 1.0 | 7142 | 13250 | 35.0 |
| | | 2.56 | 76.8 | 116.6 | 37.24 | 14284 | |
| 20 | 40 | 0.189 | 0.811 | 1.0 | 5918 | 10960 | 29.0 |
| | | 6.52 | 51.5 | 96.6 | 38.58 | 11836 | |
| 30 | 40 | 0.200 | 0.800 | 1.0 | 5816 | 10770 | 28.5 |
| | | 7.60 | 48.6 | 95.0 | 38.80 | 11632 | |
| 10 | 20 | 0.212 | 0.788 | 1.0 | 4899 | 9070 | 24.0 |
| | | 7.61 | 39.1 | 80.0 | 33.29 | 9798 | |
| 10 | 60 | 0.069 | 0.931 | 1.0 | 5102 | 9450 | 25.0 |
| | | 2.74 | 67.2 | 83.3 | 13.36 | 10204 | |

*Table 3*

**Physicomechanical characteristics of iron electrolytic platings**

| **Conditions of the electrolyte** | | **Elastic properties** | **Plastic properties** | **General properties** | $a$ | $H_h$ | $P\cdot10^{-2}$ |
|---|---|---|---|---|---|---|---|
| $D_k$ [A/dm$^2$] | $T$ [°C] | $h_y$ [μm] | $h_n$ [μm] | $h$ [μm] | [H/mm$^2$] | [H/mm$^2$] | [H] |
| | | $A_y\cdot10^{-6}$ [H·mm] | $A_n\cdot10^{-6}$ [H·mm] | $A\cdot10^{-6}$ [H·mm] | $A_p\cdot10^{-6}$ [H/mm$^2$] | $H_d$ [H/mm$^2$] | |
| 5 | 40 | 0.172 | 1.828 | 1.5 | 4399 | 8150 | 48.5 |
| | | 2.88 | 346 | 453.3 | 55.76 | 8798 | |
| 10 | 40 | 0.246 | 1.754 | 1.5 | 5306 | 9830 | 58.5 |
| | | 10.20 | 368 | 546.1 | 89.9 | 10612 | |
| 15 | 40 | 0.260 | 1.470 | 1.5 | 5360 | 9940 | 59.1 |
| | | 12.30 | 369 | 560.1 | 91.0 | 10721 | |
| 20 | 40 | 0.378 | 1.622 | 1.5 | 4490 | 8320 | 49.5 |
| | | 32.40 | 256 | 479.1 | 98.9 | 8980 | |
| 30 | 40 | 0.400 | 1.600 | 1.5 | 4399 | 8150 | 48.5 |
| | | 37.30 | 239 | 466.4 | 99.0 | 8798 | |
| 10 | 20 | 0.424 | 1.576 | 1.5 | 3891 | 7220 | 42.9 |
| | | 40.60 | 208 | 455.9 | 89.2 | 7782 | |
| 10 | 60 | 0.138 | 1.862 | 1.5 | 3891 | 7220 | 42.9 |
| | | 40.60 | 339 | 419.4 | 68.19 | 7782 | |

*Table 4*

**Physicomechanical characteristics of iron electrolytic platings**

| **Conditions of the electrolyte** | | **Elastic properties** | **Plastic properties** | **General properties** | $a$ | $H_h$ | $P\cdot10^{-2}$ |
|---|---|---|---|---|---|---|---|
| $D_k$ [A/dm$^2$] | $T$ [°C] | $h_y$ [μm] | $h_n$ [μm] | $h$ [μm] | [H/mm$^2$] | [H/mm$^2$] | [H] |
| | | $A_y\cdot10^{-6}$ [H·mm] | $A_n\cdot10^{-6}$ [H·mm] | $A\cdot10^{-6}$ [H·mm] | $A_p\cdot10^{-6}$ [H/mm$^2$] | $H_d$ [H/mm$^2$] | |
| 5 | 40 | 0.172 | 1.828 | 2.0 | 3469 | 6420 | 68.0 |
| | | 2.88 | 346 | 453.3 | 104.4 | 6940 | |
| 10 | 40 | 0.246 | 1.754 | 2.0 | 4180 | 7750 | 81.9 |
| | | 10.20 | 368 | 546.1 | 167.9 | 8360 | |
| 15 | 40 | 0.260 | 1.740 | 2.0 | 4290 | 7940 | 84.1 |
| | | 12.30 | 369 | 560.1 | 178.8 | 8580 | |
| 20 | 40 | 0.378 | 1.622 | 2.0 | 3670 | 6800 | 71.9 |
| | | 32.40 | 256 | 479.1 | 190.7 | 7340 | |
| 30 | 40 | 0.400 | 1.600 | 2.0 | 3570 | 6620 | 70.9 |
| | | 37.30 | 239 | 466.4 | 190.1 | 7140 | |
| 10 | 20 | 0.424 | 1.576 | 2.0 | 3490 | 6050 | 68.4 |
| | | 40.60 | 208 | 455.9 | 207.3 | 6980 | |
| 10 | 60 | 0.138 | 1.862 | 2.0 | 3210 | 6150 | 62.9 |
| | | 40.60 | 339 | 419.4 | 79.0 | 6420 | |

$A$ increased from $453.3\cdot10^{-6}$ to $560\cdot10^{-6}$ H·mm. With further augmentation of current density $J$ from 15 to 30 A/dm$^2$, $A$ decreased from $560\cdot10^{-6}$ to $466\cdot10^{-6}$ H·mm.

Dependences $a$, $H_h$, $H_d$ and $P$ with current density changed $J$, at receiving iron galvanic coatings, are also extreme. With augmentation of current density $J$ from 5 to 15 A/dm$^2$, factor describing hardness of a material $a$ increase from 3469 to 4290 (H/mm$^2$), unreduced Knoop hardness $H_h$ increased from 6420 to 7940 (H/mm$^2$), dynamic Knoop hardness $H_d$ increased from 6940 to 8590 (H/mm$^2$) and the load $P$ necessary for introduction of Vickers pyramid on at 2 micron into the investigated coating, increased from $68.2\cdot10^{-2}$ till $84.1\cdot10^{-2}$ H.

With further augmentation of current density $J$ from 15 to 30 A/dm$^2$ $a$ decreases from 4290 to 3570 H/mm$^2$, $H_h$ decreased from 8580 to 7140 H/mm$^2$, $P$ decreased from $84.1\cdot10^{-2}$ to $70.0\cdot10^{-2}$ H.

With fluctuation of electrolysis temperature $T$ from 20ºC to 60ºC ($J = 10$ A/dm$^2$), at receiving the desired galvanic coatings, the depth of the restored imprint $h_y$ decreased from 0.424 to 0.138 μm, and the work used for resilient deforming $A_y$ decreased also from $40.6\cdot10^{-6}$ to $1.40\cdot10^{-6}$ H·mm, and the depth of plastic deforming $h_n$ increased from 1.576 to 1.862 μm.

Despite of it, work used for plastic deforming $A_n$ is extreme. With augmentation of electrolysis temperature $T$ from 20ºC to 40ºC, $A_n$ has increased from $208\cdot10^{-6}$ to $368\cdot10^{-6}$ H·mm.

With further augmentation of electrolysis temperature from 40ºC to 60ºC, $A_n$ has decreased from $368\cdot10^{-6}$ to $339\cdot10^{-6}$ H·mm.

With augmentation of electrolysis temperature from 20ºC to 60ºC ($J = 10$ A/dm$^2$), for iron coatings, the indentation depth ($h = 2$ μm) and the full amount of elastoplastic deformations ($V = 65.3\cdot10^{-9}$ mm$^3$) are constant values; however work used for elastoplastic deforming $A$ is extreme.

With augmentation of electrolysis temperature from 20ºC to 40ºC $A$ increased from $455.9 \cdot 10^{-6}$ to $546.1 \cdot 10^{-6}$ H·mm.

With the further augmentation of electrolysis temperature from 40ºC to 60ºC $A$ increased from $546.1 \cdot 10^{-6}$ to $419.4 \cdot 10^{-6}$ H·mm.

Dependences $a$, $H_h$, $H_d$, $P$ with fluctuation of electrolysis temperature, for iron coating, are also extreme. With fluctuation of electrolysis temperature from 20ºC to 40ºC (Table 4, $J = 10$ A/dm$^2$), the factor describing hardness of a material $a$ increases from 3490 to 4180 H/mm$^2$, unrestored Knoop hardness $H_h$ increased from 6050 to 7750 H/mm$^2$, dynamic Knoop hardness $H_d$ increased from 698 to 8360 H/mm$^2$ and the load $P$ necessary for introduction of Vickers pyramid by 2 μm into the investigated coating, increased from $68.4 \cdot 10^{-2}$ to $81.9 \cdot 10^{-2}$ H.

With further augmentation of electrolysis temperature from 40ºC to 60ºC, $a$ decreases from 418 to 3210 H/mm$^2$, $H_d$ decreased from 8360 to 6420 H/mm$^2$ and $P$ decreased from $81.9 \cdot 10^{-2}$ to $62.9 \cdot 10^{-2}$H.

Experimental significances of the values obtained $A_n$, $A$, $a$, $H_h$, $H_d$, $P$ coincide with our earlier obtained recommendations for the iron galvanic coatings from the point of view of their optimal wear resistance [1]. Low values of work used for plastic $A_n$ and general deforming $A$ of the strength factor $a$ unrestored $H_h$ and dynamic $H_d$ Knoop hardnesses for iron galvanic coatings are obtained at current density 15 A/dm$^2$ and electrolysis temperature 40ºC.

The possibility to estimate brittleness of coatings by indentation of an indenter is of great importance [1–3] as at determining by other methods there are difficulties connected to the separation of coatings from the basis and their testing because of low hardness [1].

Destroying of coatings can take place only after some preliminary deformation. Intensity of this accumulating depends on the type of interatomic connections, material structure and conditions of deforming. With fluctuation of precipitation mode of electrolytic coatings the structure of sediment and conditions of deforming [1] are changed. Interstice and cracks are stress raisers which reduce the plastic properties of coatings, increasing their tendency to brittle failure. General porosity of material is determined by an elastic modulus $E$ and by both ratios $(H/H_h)$ and $(H/H_d)$ [2, 4]. On a plastic deformation, connected to preparation of destroying, work is used [2, 4]. Earlier was mentioned [4–6], that work used for energy costs of elastoplastic deforming is always more than the sum of works.

connected to resilient and plastic deforming, electrolytic coatings. The difference of this work, was supposed to be the work used for friable coating destroying.

Table 4 shows the results of investigations, namely that electrolysis conditions $J$, $T$ render the strong influence on work necessary for brittle failure of iron coatings. With augmentation of current density $J$ from 5 to 15 A/dm$^2$, the work necessary for brittle failure $A_p$ of iron coatings increased from $104.42 \cdot 10^{-6}$ to $190.7 \cdot 10^{-6}$ H·mm. With further augmentation of current densities $A_p$ remains constant. With augmentation of electrolysis temperature from 20ºC to 60ºC ($J = 10$ A/dm$^2$), for iron coatings, $A_p$ decreased from $207.3 \cdot 10^{-6}$ to $79.0 \cdot 10^{-6}$ H·mm (Table 4).

Investigations of deformation features and destroying of electrolytic galvanic coatings on various indentation depths of Vickers pyramid are reflected in Tables 1–6. These investigations have shown, that irrespective of indentation depth, an indenter in all augmentations intervals of current density (from 5 to 30 A/dm$^2$) $h_y$, $A_y$ increased, and with augmentation of electrolysis temperature (from 20ºC to 60ºC) $h_y$, $A_y$ decreased (Tables 1–6).

*Table 5*

**Physicomechanical characteristics of iron electrolytic platings**

| **Conditions of the electrolyte** | | **Elastic properties** | **Plastic properties** | **General properties** | | | |
|---|---|---|---|---|---|---|---|
| $D_k$ [A/dm$^2$] | $T$ [°C] | $h_y$ [μm] | $h_n$ [μm] | $h$ [μm] | $a$ [H/mm$^2$] | $H_h$ [H/mm$^2$] | $P \cdot 10^{-2}$ [H] |
| | | $A_y \cdot 10^{-6}$ [H·mm] | $A_n \cdot 10^{-6}$ [H·mm] | $A \cdot 10^{-6}$ [H·mm] | $A_p \cdot 10^{-6}$ [H/mm$^2$] | $H_d$ [H/mm$^2$] | |
| 5 | 40 | 0.258 | 2.742 | 3.0 | 2605 | 4830 | 114.9 |
| | | 7.3 | 877 | 1148 | 263.7 | 5210 | |
| 10 | 40 | 0.369 | 2.631 | 3.0 | 3172 | 5880 | 139.9 |
| | | 26.0 | 943 | 1398 | 429 | 6344 | |
| 15 | 40 | 0.390 | 2.610 | 3.0 | 3743 | 6940 | 165.1 |
| | | 36.3 | 1087 | 1650 | 526.7 | 7486 | |
| 20 | 40 | 0.567 | 2.433 | 3.0 | 2719 | 5040 | 119.9 |
| | | 80.9 | 639 | 1198 | 478.1 | 5438 | |
| 30 | 40 | 0.600 | 2.400 | 3.0 | 2696 | 5000 | 118.9 |
| | | 95.1 | 609 | 1188 | 483.9 | 5392 | |
| 10 | 20 | 0.636 | 2.364 | 3.0 | 2945 | 5460 | 129.9 |
| | | 123.7 | 635 | 1298 | 539.3 | 5890 | |
| 10 | 60 | 0.207 | 2.793 | 3.0 | 2492 | 4620 | 109.9 |
| | | 3.6 | 887 | 1098 | 217.4 | 4984 | |

*Table 6*

**Physicomechanical characteristics of iron electrolytic platings**

| **Conditions of the electrolyte** | | **Elastic properties** | **Plastic properties** | **General properties** | | | |
|---|---|---|---|---|---|---|---|
| $D_k$ [A/dm$^2$] | $T$ [°C] | $h_y$ [μm] | $h_n$ [μm] | $h$ [μm] | $a$ [H/mm$^2$] | $H_h$ [H/mm$^2$] | $P \cdot 10^{-2}$ [H] |
| | | $A_y \cdot 10^{-6}$ [H·mm] | $A_n \cdot 10^{-6}$ [H·mm] | $A \cdot 10^{-6}$ [H·mm] | $A_p \cdot 10^{-6}$ [H/mm$^2$] | $H_d$ [H/mm$^2$] | |
| 5 | 40 | 0.344 | 3.626 | 4.0 | 2065 | 3830 | 161.9 |
| | | 13.7 | 1648 | 2158 | 496.3 | 4130 | |
| 10 | 40 | 0.492 | 3.208 | 4.0 | 2551 | 4730 | 200.0 |
| | | 49.6 | 1798 | 2666 | 818.4 | 5102 | |
| 15 | 40 | 0.520 | 3.480 | 4.0 | 2984 | 5540 | 234.2 |
| | | 68.5 | 2054 | 3118 | 995.5 | 5968 | |
| 20 | 40 | 0.756 | 3.244 | 4.0 | 2292 | 4250 | 179.7 |
| | | 161.7 | 1288 | 2395 | 945.3 | 4584 | |
| 30 | 40 | 0.800 | 3.200 | 4.0 | 2227 | 4130 | 174.6 |
| | | 189.0 | 1192 | 2375 | 994.3 | 4454 | |
| 10 | 20 | 0.848 | 3.152 | 4.0 | 2292 | 4250 | 176.7 |
| | | 228.0 | 1172 | 2375 | 995.0 | 4554 | |
| 10 | 60 | 0.276 | 3.724 | 4.0 | 2038 | 3780 | 159.8 |
| | | 7.0 | 1719 | 2130 | 404.0 | 4076 | |

In all fluctuation interval of changing indentation depth $h$ from 0.5 to 4 microns of investigated galvanic iron coatings (Tables 1–6) the studied parameters $A_n$, $A$, $a$, $H_h$, $H_d$ and $P$ are extreme with fluctuation of electrolysis conditions $J$, $T$. Investigated dependences $A_y$, $A_n$, $A$, $a$, $H_h$, $H_d$, $A_p$, and $P$ essentially differ by the value for various indentation depths (Table 1–6).

With augmentation of indentation depths of Vickers pyramid $h$ from 0.5 to 4 µm (Tables 1–6), for electrolytic iron coating, $A_y$ has increased from $(0.013\div1.6)\cdot10^{-6}$ H·mm to $(7\div228)\cdot10^{-6}$ H·mm, $A_n$ increased from $(10.2\div17.9)\cdot10^{-6}$ H·mm to $(1162\div2054)\cdot10^{-6}$ H·mm, $A$ increased from $(19.9\div27.2)\cdot10^{-6}$ H·mm to $(2130\div3118)\cdot10^{-6}$ H·mm, and $P$ increased from $(19.96\div16.3)\cdot10^{-2}$ to $(159.8\div234)\cdot10^{2}$ H. The significance of parameters $a$, $H_h$ and $H_d$ has considerably decreased with augmentation of indentation depths $h$ from 0.5 to 4.0 µm. Parameter decreased from $9763\div13306$ H/mm$^{2\cdot}$ to (2038-2984) H/mm$^2$; $H_h$ decreased from $(18100\div24740)$ H/mm$^2$ to $(3780\div5540)$ H/mm$^2$ and $H_d$ decreased from $(19560\div26641)$ H/mm$^2$ to $(4076\div5968)$ H/mm$^2$.

Investigations of deformation peculiarities and destroying of electrolytic iron coatings on various indentation depths (Tables 1–6) have shown that the investigated parameters $A_y$, $A_n$, $A$, $a$, $H_h$, $H_d$, $A_p$, and $P$ differ a lot by the value for various indentation depths $(0.5\div4$ µm) depending on electrolysis conditions.

Analysis of obtained data confirms that the conditions of receiving electrolytic iron coatings $J$, $T$, at various indentation depths influence strongly the elastoplastic deforming and destroying of precipitations at indentation.

## 10. CONCLUSION

It is established that the factor describing hardness $a$ unreduced $H_h$, dynamic Knoop hardnesses $H_d$, load $P$, work used for plastic $A_n$ and general work $A$ of deforming electrolytic iron coatings is extreme with density current $J$ and electrolysis temperature $T$ changed.

Extremes of parameters $a$, $H_h$, $H_d$, $A_n$, and $A$ coincide with earlier recommendations obtained by us for iron coatings from the point of view of their optimal wear resistance. The obtained information will allow us to explain the mechanism of elastoplastic deforming and destroying of electrolytic iron coatings at testing in various conditions of abrasion and wear.

Physical and mechanical characteristics of composition electrolytic coatings are necessary for representing equal indentation depths of an indenter.

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