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BEHAVIOUR OF HYDROGEN IN BINERY SYSTEM «IRON-COPPER»

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The change of concentration of hydrogen is set in samples of steel brands 30ХГСА after causing of copper coverage by an electrolytic method. Measuring of concentration of hydrogen was produced by the method of high-temperature extraction in the stream of inert gas-carrier. Growth of concentration of hydrogen in samples with copper coverage can testify both to extraction of hydrogen from steel and about the its chemisorptions in coverage at the process of the electrolytic causing.

Keywords: hydrogen, concentration, steel, electrolysis, coverage

Entry. Areas of techniques in which the systems «metal-hydrogen» vast enough are used. Hydrogen, entering into co-operating with different elements, can participate in formation of both heteropolar connection (hydrides) and covalently (germane, silane, methane), and also van-der-waals (hydrogen connections at the association of molecules). Hydrogen can to diffuse through many metals (copper, iron, nickel, platinum, palladium and other), to corbate on the surface of crystalline and amorphous materials, participating in the processes of catalysis, corrosion and other, to dissolve in the volume of crystalline bodies, with preliminary dissociation of molecules on a surface, not form sosoloids (occlusion). It is repeatedly well-proven that hydrogen to diffuse through a metal can only in the atomic state [1,2]. For determination of mechanism of penetration of hydrogen in the grate of metal the «hypothesis of proton gas» is pulled out: hydrogen, being in a hard and liquid metal in the ionized state (the positively charged particles - protons) due to an occlusion gets to the electronic shells of atoms, causing deep change of its physical nature.

All variety of processes of co-operation of hydrogen with matters is conditioned by the features of structure of their atoms, by level of imperfectness of crystalline structure, by size and character of external power influences. At crystallizational processes, flowing with high-rate, hydrogen, being in fusion, is driven back in a liquid phase, where can to enter into chemical reactions with cut-in oxygen with formation of H_2O and more subzero oxides of basic matter [1]. If pressure, rendered by an appearing blub, is added up with internal tensions (structural, thermal, from remaining deformations), in a metal, between the borders of grains can appear round defects the accumulations of molecular hydrogen, pores and snowflakes. The hydrogen contained in a metal results to the irreversible processes of the corrosive spalling, hydrogen fragility, origin of cracks at the constantly operating loading, id est to the sharp worsening of consumer properties and marriage. The special value has a necessity of providing of high operating properties in metals and alloys, used in aircraft building, in particular to high specific durability and

inoxidizability, to ability to work in the conditions of variable gradients of temperatures, dynamic loading and other.

Hydrogen in metals possesses high diffusive mobility, can pass from one equilibrium position in other due to tunnelling or revealing to additional energy the atom from outside (for overcoming of influence of traps, are imperfections of crystalline structure). Interest presents the study of possibility of transport of hydrogen, because of its high mobility, through the border of division in the layer of other matter, which has greater «affinity» to hydrogen, determined, in this case, by ability to link and retain hydrogen, clearing to the same, contacting metal, subject to cleaning from hydrogen.

Raising of task. The purpose of the this work was a study of possibility of transition of hydrogen from a steel sample in film of copper, inflicted by an electrolytic way.

Methods of experiment. There are investigated content of hydrogen in the samples of steel 30ХГСА of cylindrical form with long 10 mm and diameter 5 mm on which inflicted copper coverage in a sulfate electrolyte ($CuSO_4 + H_2SO_4 + H_2O$) at a temperature ~50 °C. Measuring of concentration of hydrogen it was exposed to : initial sample, sample with the inflicted copper coverage, and also sample with coverage, exposed to annealing (temperature - 150 °C, duration - 2 hours). The content of hydrogen was determined by the method of high temperature extraction in the stream of inert gas-transmitter with the use of analyzer of firm «*Leko*». In the process of measuring there was the complete melting of sample.

Discussion of results. The got results showed growth of concentration of hydrogen in a sample with the inflicted copper coverage and in a sample with coverage, exposed to annealing, as compared to the its value in an initial sample steel. In the process of electrolysis the mechanical capture of hydrogen is possible in the electrolytic inflicted metal, because of confluence of a few growing crystals, in the beginning remote from each other, and then combinable and slamming being between them gaseous hydrogen. Hydrogenation of copper coverage can take place because of co-operating of appearing at electrolysis hydrogen with a sell on the surface of steel sample. This process substantially depends on the adsorbtivity of concrete brand of steel, on character of treatment of surface of sample, electrolyte composition, density of current and other. Hydrogen which appears at an electrolysis also will co-operate and with the copper oxide (I), always being in an electrolytic coverage [3]. Thus, reasons of the looked increase of concentration of hydrogen in steel samples with copper coverage can be a few. At the same time, realization of annealing (temperature - 150 °C, duration - 2 hours), that is accompanied by the decline of concentration of hydrogen, can testify to the removal of hydrogen, entering copper coverage because of accompanying an electrolysis processes of hydrogenation. A difference in the measured values of concentrations perceptibly exceeds the error of measuring. However, for argument of efficiency of process of cleaning of metal matrix from hydrogen due to over coated and establishment of mechanism of such process, further experiments are needed.

Conclusions. Hydrogen, easily diffusing in the layer of metal, can to react with admixtures creates additional break efforts, assists to making light of structure,

deepening, expansion and branching of intercrystalline cracks. Watched trend to the decline of concentration of hydrogen in steel samples with film of copper, inflicted by an electrolytic method, can testify to possibility of initiation of cleaning process from hydrogen in transition and withholding of its atoms in film of copper. In connection with appearance of new high-fidelity methods of determination of concentration of hydrogen, both in the volume of sample and in skims, productive will be continuation of study of the described processes, including., estimation of influence of co-operation of atoms of hydrogen with admixtures and defects in steel, charakter of its behavior at the action of gradients of temperature, field deformation and dynamic loading for the concrete modes of exploitation of material, at flowing of thermo-chemical processes.

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