MICROSTRUCTURE AND WEAR RESISTANCE CHANGES OF 30CrMnSiA STEEL MODIFIED SURFACE LAYERS BY ELECTROLYTE-PLASMA PROCESSING

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1. Introduction

It is known [1] that the low durability of machine parts causes unwanted overruns of metal and a very low coefficient of its useful life, which is associated with high costs of energy resources and material means. In this regard, we apply a scientific energy - and resource-efficient type of treatment, which leads to the formation of stable ferritic-pearlitic structures, allowing for higher mechanical and tribologycal properties. Electron microscopic studies and X-Ray analysis showed that the main component in the structure of 30CrMnSiA steel after treatment is mainly α-Fe phase, and as there are nitride and carbide phase [2].

In connection with the above, the purpose of this work is to study the changes of morphology of microstructure and mechanical and tribological properties of modified surface layers of 30CrMnSiA steel at electrolyte-plasma nitriding.

2. Material and Methods

The study of the morphology of the samples of 30CrMnSiA steel conducted in the Institute of Nanotechnology and new materials D.Serikbayev EKSTU using optical microscopy on «Altami-MET». Study of the phase composition and structural parameters of the samples was conducted on the diffractometer Shimadzu XRD-6000 on CuKα-radiation. Analysis of the phase composition, the size of coherent scattering regions, internal elastic stresses (h/d) is performed using the database PCPDFWIN and PDF4+, as well as programs full profile analysis POWDER CELL 2.4 (TPU Material Testing Center for Collective Use, Tomsk, Russia, April 2013). Microhardness of the surface layers of samples of 30CrMnSiA steel before and after nitriding was measured by the method of pressing-diamond pyramid on the device PMT-3M with a load 1N state standard. Study of wear resistance conducted on high-temperature tibometre TNT CSM Instruments, featured conditions for tribological testing ASTM G99 “Standard Test Method for wear Testing with a Pin-on-Disk Apparatus”. The coefficient of friction for samples of 30CrMnIA steel, calculated from the amount of material removed during the test due to friction and wear and wear rate of the surface is calculated and posted the results in the form of the output.

As for research material we used 30CrMnSiA steel samples size $(30x30x8)mm^3$ in as-received condition (quenching at 880^oC and tempering at 540^oC in oil, state standard 4543-71) and processed states at different modes of electrolytic-plasma cementation. Chemical composition of steel: (0.28-0.35)% C; (0.8-1.1)% Cr; (0.8-1.1) % Mn; (0.9-1) % Si; 0.025 % P, 0.025 % S, the residual of Fe on state standard.

As a result of the analysis of the fragments of the microstructure obtained by optical microscopy, found that after nitriding of samples of 30CrMnSiA steel plasma electrolyte changes the morphology of the surface layer of 30CrMnSiA steel. The nitriding of samples in plasma electrolyte is observed enrichment ferrite atomic nitrogen, promotes the growth of nitride particles in the near-surface modified layer. The microstructure of the surface layer of samples of 30CrMnSiA steel consists of ferritic structure, with dispersed inclusions of particles of nitrides.

In result of studies of the obtained data the following conclusions:

- it is established that the microstructure of the samples of steel 30CrMnSiA, in various modes of processing, consists of α and iron nitride (FeN) phase;
- the values of microhardness of modified surface layers of 30CrMnSi steel in the state of delivery Hμ=3,8 GPA and after electrolyte-plasma nitriding is Hμ=(7,6-8,2)GPa;
- obtained values of the coefficient of friction and wear rate of samples of 30CrMnSiA steel in the state of delivery. Found that the rate of wear after electrolyte-plasma nitriding decreases 4.3.

3. Acknowledgments

The present research work was in accordance with the contract # 475/189-209-11of Joint-Stock Company “Science Fund of the Republic Kazakhstan”.

4. References

[1] Meletis E.I., Nie X., Wang F.L., Jiang J.C.. Electrolytic plasma processing for cleaning and metal-coating of steel surface. Surface and Coatings Technology 150, 2002, p.p.246-256.

[2] Skakov M., Zhurerova L., Scheffler M. Influence of Regimes Electrolyte-Plasma Processing on Phase Structure, Mechanical Properties and Wear Resistance of Steel 30CrMnSi, Tribology 2012, Teoria I praktika, “SIMPRESS”, ISSN 0208-7774, ROK XLIII NR 5/2012(245), Wroclaw, Poland, 2012, p.p.175-182.

[3] Skakov M., Zhurerova L., Scheffler M. Influence of Regimes Electrolyte-Plasma Processing on Phase Structure and Hardening of Steel 30CrMnSi, Advanced Materials Research Vol. 601 (2013), Beijing, China, 2012, p.p.79-83.