Modification of the surface of parts

To cite this article: L A Simonova et al 2016 IOP Conf. Ser.: Mater. Sci. Eng. 134 012046

View the article online for updates and enhancements.

You may also like

- Neural network model of mathematical knowledge and development of information and educational environment for mathematical training of engineers
  Yu I Dimitrienko and E A Gubareva

- Machineology as a conceptual basis for the formation of a mining engineering scientific platform
  V V Glushchenko

- Considerations on the mechanisms for optimizing the relationship between the science and engineering of metallic materials from the perspective of the professional development at university level
  V F Soporan, T R Lehene, S Pdureu et al.
Modification of the surface of parts

L A Simonova, M A Chernova and V V Zvezdin

Department of Energy and Information, Kazan Federal University, Naberezhnye Chelny, Russian Federation

smilby@mail.ru

Abstract. The increasing wear resistance of parts is one of the main tasks of engineering. The achievement of stable parameters is a difficult task. It depends on capabilities of equipment, type of evaporator, interaction evaporator with the evaporating substance and deposition process. The control system must foresee and identify emerging cracks or damage of the system components. At every stage software of control process system must automatically make the optimal decisions based on information about the process. It also improves the efficiency of the operator. This article focuses on the results of using intelligent control system technological process.

Key words: intelligent control system, modification the surface of the parts, wear resistance.

Introduction:

Management of technological complexes coating caused by the need to obtain the desired quality parameters of the process and provide the required physical and chemical properties. Modification of the surface layer of parts and tools is widespread in engineering [1]. This allows giving the surface the necessary quality by specified performance requirements [2]. Introduction of automated control systems of technological complexes of surface modification leads to high rates of quality and stability of the parameters of the surface layer parts. This is justified by the high performance and efficiency of the coating process.

Using previous experience on the analysis of deviations from the nominal values of process parameters is possible using elements of artificial intelligence [3].

Materials and methods:

The effectiveness of control systems of technological complexes of surface modification to a large extent determined by the scientific validity of the decisions and timely control actions on the actuators. The solution to this problem allows the use of the mechanisms of artificial intelligence [4]. At every stage software of control process system must allow automatically make the optimal decisions based on information about the process.

The wear resistance is the result of a complex set of processes that occur not only in the physical wear of the tool edges, it may be accompanied by plastic deformation, fatigue, and even the diffusion processes. The wear resistance depends not only on the structure and properties of the tool steel, but also on the properties of the processed material (its hardness), and the coefficient of friction and the external environment in which the processing occurs. Increasing the hardness tends to reduce...
viscosity. If dynamic load is dominated in the tool, for the increase of wear resistance for a given hardness and content of carbides the large supply of viscosity is required. In many cases, increasing the viscosity should seek to reduce the hardness, increased surface hardness improves the wear resistance.

To achieve the required quality of the technological process (the depth of the modified zone tool wear, surface roughness, micro-hardness, chemical composition of the deposited layer zone, etc.), depending on the parameters of the technological complex, it is necessary to use control system.

Results:
The results of experimental studies of laser hardening, welding carbide cutting edge of the tooth powders hob are shown. The Al2O3 sprayed onto substrates of different materials for experimental research. The installation UVN-4M and Eifeler alpha 400 p are used as a technological complex. Proposed intelligent control system and methods for its implementation have been applied in vacuum sputtering equipment UVN-4M. It is intended to magnetron metals sputtering on the surface of products of various geometric shapes, open to a direct hit on it evaporated metal vapor. The principle of the device is based on the sputtering material by ions of the working gas. Is formed in an abnormal glow discharge plasma in crossed electric and magnetic fields in working chamber.

Figure 1 (a, b, c,) are photographs of sputtered layers on glass.

Figure. 1 - before the application of the system: the sample of a - layer thickness is less than specified, the sample b - thickness of the layer is greater than a given;

Figure. 2 after application of the control system: the sample a - thickness of the sprayed layer is within the required limits.

The level of adhesion on test specimens by direct separation on the device Elcometer 108 according to ISO 14923: 2003 and ISO 2063: 2005 was measured. On polished and degreased surface of the coating with an adhesive M2000 were glued samples, then the hydraulics system of device
apply a force whose value was fixed at the time of separation. The best adhesion was observed in the sample where used the control system.

Experimental studies on the surface modification carried out on the laser technological complex pulse-periodic action LRS-150 A. Pulse duration: $t = 3$ ms. Energy pulse: $E_1 = 11$ J.

Microhardness the structure of parts was measured by GOST R ISO 6507-1-2007 on Hardness MicroMet 5104 under a load of 1 H. For the material of parts is used tool steel R18K5F2.

Modifying the surface of a layer of steel - an alloy powder PG - CP4 - OM. It is mainly used to cover the parts of machines, which are subjected to abrasion with a relatively low impact load.

The microstructure of the base metal plate is a ferrite and structural - free cementite 0V points GOST 5640-68 with microhardness up to 390 HV0.1. The microstructure of the hardened surface layer with carbides. High hardness layer has a positive effect on the wear resistance of the tool. Hard metals with high hardness, exhibit low ductility and are fragile, therefore have poor impact resistance. Friability hardmetals stored at high temperatures, so that they are prone to cracking during surfacing . Figure 3 shows a fragment hob with laser welding.

![Figure 3. - Fragment hob with laser welding.](image1)

Figure 4 is a sample of the powder-coated alloy PG - CP4 - OM.x 5.

![Figure 4](image2)

**Conclusion:**

From a comparison of different methods of changing the microstructure of the metal, the use of laser deposition welding and using alloy powders optimally to create a modified surface of the part.

The main influence on the process of laser welding and plasma spraying of coatings with high resistance to wear have enhanced physicochemical properties of both the materials and the environment in which the process occurs. This difference is due to the distribution of thermal field in a variety of materials characterized by different chemical activity and thermal properties.

Analysis of the relationship of parameters of technological systems and quality of deposition and deposition showed that a great influence on the quality of their stability and optimal values and all parameters are temperature dependent and physico-chemical properties of the medium.

As a result of implementing the system was to improve the quality of decisions on the management of the process and reducing the time for troubleshooting. This greatly improves the efficiency of the
coating process by reducing the time for diagnosing faults using control system with elements of artificial intelligence.

Designed technological complex control method using fuzzy logic to maintain a predetermined process parameters coating enhanced the abrasion resistance components to 20%.

REFERENCES:
[1] R M Khisamutdinov, M R Khisamutdinov 2014 Automation system goals for the creation and operation of the tool IOP Conference Series: Materials Science and Engineering 69 012021
[2] S M Portnov, R R Saubanov, R A Kish, I N Kuznetsov, I H Israfilov, V V Zvezdin, A I Nugumanova 2011 The process control system of heat treatment with concentrated flows of energy surfaces of parts Global scientific potential - scientific journal 8 pp 95-100
[3] L A Simonova, E I Egorova 2015 Development of structural element precedent of technological process in computer-aided design IOP Conference Series: Materials Science and Engineering 86 012017
[4] K V Klochkova, S V Petrovich, L A Simonova, L R Yusupov 2015 Development of methodology for controlling the parameters of TP IOP Conference Series: Materials Science and Engineering 86 012015
[5] Chernova M A, Simonova L A, Israfilov D I, Nugumanova A I 2012 Developing the knowledge base for the management of the technological complex vacuum sputtering installation UVN-4M European applied sciences. ORT Publishing vol 1 pp 331-334
[6] Fedorov Y N 2008 Engineer directory for process control: design and development Moscow: Infra-Engineering pp 928
[7] Tarasov V B 2002. From multi-agent systems to intelligent organizations M: Editorial URSS pp 352
[8] Makarov I M, V M Lokhin, S V Manko and M P Romanov 2006 Intelligence and Intelligent Control Systems Publisher: Nauka pp 333
[9] Saaty T L 2008 Decision-making at the accuracy, improves raw material stocks. dependencies and feedbacks. Analytic Network. M
[10] Kashapov L N, Kashapov N F and Kashapov R N 2013 Investigation of the influence of plasma-electrolytic processing on the surface of austenitic chromium-nickel steels. IOP Conference Series: Materials Science and Engineering J. Phys.: Conf. Ser. 479 012003