ANNOTATION
of dissertation for the PhD degree
in specialty 6D071200 «Mechanical Engineering»

**Elena Sergeevna Platonova**

# Increasing of operational properties of mechanisms details and mining machines and power equipment

**Actuality.** Currently, with limited material resources in the industrial complex technologies that increase the durability (resource) of parts and units of machines are particularly important. Ninety percent of the parts and machines become out of order due to surface wear. This is especially appropriate for mining, oil field and energy sector equipment, where the majority of mechanisms operate in extreme conditions, and in particular, in a high abrasion and high temperatures.

The most relevant and promising to produce nanostructured hardening, wear-resistant, corrosion-resistant and heat-resistant coatings are vacuum ion-plasma methods: magnetron sputtering, ion and vacuum arc deposition. This is due to the fact that in addition there are thermal factors and other - the high degree of ionization, the flux density and particle energy. The quality of the coating can be adjusted by changing the substrate temperature, the pressure of the working gas, the potential of the substrate and other process parameters.

Kazakhstan does not produce special steels for the manufacture of most mechanical parts and machines for thermal power stations, mining, engineering and metallurgical enterprises, chemical industry and agriculture.

Offered innovative technology of ion-beam treatment gives the product of simple steels, which are produced in Kazakhstan, performance that rivals products from special steels, which determines the need for the development of new formulations and solutions for corrosion-resistant nanostructured coatings.

Relevance of the work is confirmed by the fact that the work is done within the framework of the MES of the RK: «Design and Technology and instrumental quality assurance for parts of mining and ore-processing equipment in order to increase their service durability (2011-2014)»; «Development of nanotechnology surface modification tribocoupling based on C and N providing good wear resistance (2012-2014)»; «Creating a production site and introduction of magnetron technology of coating parts for thermal power stations (2013-2015)».

**Objective** – increasing of operational properties of mechanisms details and mining machines and power equipment.

**The idea of work** is to use the methods of vacuum ion-plasma coatings to increase wear resistance and thermal stability of parts of machines and mechanisms of energy and mining complexes**.**

To achieve the goals and ideas it is necessary to solve the following **actual problems:**

- to develop a model of corrosion and the corrosion resistance of metals, alloys and coatings;

- to develop a model of thermo-mechanical destruction and heat resistance of metals, alloys and coatings;

- to develop the technology of application of corrosion-resistant, heat-resistant and strengthening of multi-element and multi-phase coatings on parts of mining equipment and thermal power plants;

- to research physical and mechanical properties of ion-plasma coatings of different compositions

- to develop practical recommendations on the organization of coating area of mining enterprises and thermal power stations.

**Scientific novelty:**

- for the first time based on statistical data we obtained formulas predicting the rate of destruction of metals and coatings from corrosion, deformation and thermal influences;

- for the first time dependence of the corrosion resistance and heat resistance of metals, alloys and coatings was developed, which allowed to establish a connection between the rate of corrosion and thermal degradation of coatings and their surface energy;

- on the basis of experimental and theoretical studies composition of multi-functional and multi-layer nanocrystalline coatings with desired properties was developed.

**The practical significance of the work**:

- The compositions of multielement and multiphase cathodes for application of anticorrosive and strengthening coatings were developed. Determination of the concentration of elements and calculating the stoichiometry of components included in the cathodes compositions was performed using the program PHI-RHO-Z;

- technological processes of the sputter of protective corrosion-resistant and heat-resistant coatings of a wide range of parts were developed (coupling, nipple, rod mill beater, smoke exhaust spatula) ensure high durability.

- multilayer composite coatings used for hardening of working surfaces of bilov coal mills used in the Karaganda CHP - 3.

- practical recommendations on the organization of the coating site for mining enterprises and CHP. The work was performed under the theme of MES of the RK "Creating a production site and the introduction of magnetron coating technology of parts for thermal power stations (2013-2015)."

**Publications:** On materials of dissertation 9 articles and 4 abstracts were published. 5 out of them are KKSON RK articles, 1 article is a part of the SCOPUS base.

**Testing results:** fundamentals and results of the thesis were reported:

1. Influence of technological parameters on the fracture energy coatings Materials of XI International scientific-practical conference «Bdeschite izsledvaniya - 2015», 17-25 February, 2015 Volume 16, 37-40

2. The surface energy of the ion-plasma coatings ZN-CU-AL Materials of XI International scientific-practical conference «Veda a technologie: krok do budoucnosti - 2015», 17-25 February, 2015 Volume 17, 26-28

3. Effect of ion irradiation on tribological properties of composite coatings IOP Conf. Series: Materials Science and Engineering 81 (2015) 012089 RTEP2014

4. Multiphase composite coatings: structure and properties IOP Conf. Series: Materials Science and Engineering 81 (2015) 012089 RTEP2014

5. Increasing wear resistance and corrosion resistance of parts of mechanical engineering, energy and mining equipment WORKS «The role and place of young scientists in the implementation of the new economic policy of Kazakhstan» of International Satpayev Readings, Almaty 2015 Volume 2, p.263-269

**Volume and structure of the dissertation:** work consists of introduction, five chapters, conclusion and list of references. It is stated on 127 pages, including 71 images, 40 tables and 131 literary references.