DEVELOPMENT OF THE PHYSICAL FOUNDATION OF ECOLOGICALLY CLEAN TECHNOLOGIES FOR THE FORMATION OF THE WEAR RESISTANT COMPOSITE COATINGS COMBINING ELECTROEXPLOSIVE SPRAYING AND HIGH INTENSIVE ELECTRON BEAM IRRADIATION

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During the implementation of the program the following works were done in 2014:

Mathematical modeling of thermal effects was carried out on electroexplosive coatings with a layered and filled structure with the subsequent electron-beam treatment, taking into account the effects of melting and evaporation, as well as structural and phase transformations in the solid state. The method of electroexplosive spraying of composite coatings of TiB_2-Mo and TiB_2-Ni systems in a wide range of spraying parameters, ensuring the formation of a high hardness and wear resistance of coatings was worked out. The method of electron-beam treatment of composite coatings of TiB_2-Mo and TiB_2-Ni systems was developed. It provides a low surface roughness of coatings, their compatibility with the substrate material, and an increased microhardness and wear resistance. By the methods of scanning and transmission electron microscopy, X-ray diffraction analysis and optical interferometry, phase and elemental composition, the state of the defect substructure (type, size and phase morphology, the amplitude of the internal stress fields, the parameters of the dislocation substructure) were studied, a set of roughness parameters of wear-resistant composite coatings of TiB_2-Mo and TiB_2-Ni systems, formed by electroexplosive spraying and the subsequent electron-beam treatment was defined. The values of microhardness and wear resistance of composite coatings of the studied systems after electroexplosive spraying and the subsequent electron-beam treatment were defined.

In 2014 the following results were received:

The method of electroexplosive spraying of wear-resistant nano, submicro- and microcrystalline coatings of TiB_2-Mo and TiB_2-Ni systems using electron-beam treatment was worked out. The morphological features of the coating surface were revealed. Electroexplosive spraying of coatings of TiB_2-Mo and TiB_2-Ni systems with substrate. Formation of coatings in the conditions of technical vacuum at melting of the substrate is followed by their saturation with carbon and oxygen atoms. The formation of the metallurgical bonds of the coatings with the substrate does not lead to alloying of the heat affected layer of substrate with the coating elements. With the increase of distance from the surface of the coating the concentration of iron atoms increases but titanium atoms reduces. The concentration of molybdenum atoms in the coatings of TiB_2-Mo system and nickel in the coatings of TiB_2-Ni system varies insignificantly along the coating thickness. The main coating phases of TiB_2-Mo system are structurally-free molybdenum, titanium boride TiB_2 and Ti_2B_5, iron borides FeB, Fe_3B and Fe_4B_2, molybdenum boride MoB_4, iron carbides Fe_3C and molybdenum MoC, molybdenum karboborid Mo_2BC.

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