SOME REGULARITIES OF DESTRUCTION OF TUNGSTEN-CONTAINING HARD ALLOYS WITH HETEROGENEOUS PROTECTIVE COATINGS AT THERMAL CHEMICAL OXIDATION IN AIR

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The objective of the present study was to improve the operation parameters of high-hardness tungsten-containing materials.

The comparative experimental data related to operation parameters of tungsten-containing hard alloys (THA) with or without protective coatings formed on their surfaces by means of the method of electro-spark alloying (ESA) were estimated. Some relationships determining the THA behavior during tribological loads in an oxidative medium and characterizing their wear, heat, and corrosion resistance are presented. Depending on the coating composition and structure, the above parameters depend significantly on both substrate and coating structures, their compositions, operation conditions (temperature, load increase rate), environmental impact and other factors.

It has been demonstrated that physical-chemical processes constitute the main factor affecting the THA operation parameters.

An ideal solution concerning the suppression of a destructive tribo-oxidation process consists in the formation of protective phases and elements on the THA surface and in its bulk in the process of changing of the tribological system state in an oxidative medium. In this case the oxygen feed through structural defects to carbide phases and binding elements must be blocked, which would result in the decrease of rates of formation of the structures deteriorating the material operation parameters.

Thermodynamic calculations of stability and free energy of chemical reactions with predetermined element and chemical compositions of electrode materials and coatings in the temperature range approximately correlated to the conditions of their formation and operation in a gaseous medium (air) have been performed. It was revealed that the tendency of the carbide system stability correlated to the oxygen affinity parameter of the coatings hampering the tungsten carbide decomposition. In tribological processes, the mechanism of alloys oxidation is also substantially affected by the temperature factor depending on deformation processes occurring upon loading of the systems under study.

The surface topology, element, phase, and structural compositions of anode materials, THA and protective coatings on THA, both initial and after operation as cutting tools, have been investigated. The main factors reducing the effect of gaseous medium and temperature on the cutting tools destruction have been determined.

The alloyed layers of the electrode surface consist of island-like coatings with a stochastic distribution of alloying elements.

On the basis of the obtained data, predictions were made on the formation of anode materials and protective coatings with optimal element, phase, and structural compositions.

During the ESA process, the following groups of THA were applied: WC systems (WC-Co); TC systems ((WC-TiC)-Co); TT systems ((WC-TiC-TaC)-Co). The anode materials comprised the samples made of transition refractory metals of IV-VI groups of the Periodic Table as well as Al, Co, Ni and their alloys.