Proceedings of International Scientific and Technical Conference on
"Problems and Prospects of Innovative Technique and Technology in Agri-Food Chain"
Organized by Tashkent State Technical University, Tashkent, Uzbekistan
International Journal of Innovations in Engineering Research and Technology [IJIERT]
ISSN: 2394-3696, Website: www.ijiert.org, Organized on 24-25 April, 2020

INNOVATIVE EQUIPMENT FOR FORMING WEAR-RESISTANT SURFACE ALLOYS ON THE PROCESSING DISK MILLS

Author: ***FYODOROV S.V.,***
Moscow State Technological University "Stankin" (МГТУ Станкин)

Author: ***URINOV N.F.,***
Bukhara Engineering and Technology Institute

Author: ***SHARIPOV J.O.***
Bukhara Engineering and Technology Institute

Author: ***UMIRZOKOV J.U.***
Bukhara Engineering and Technology Institute

Abstract
This paper investigates the major points of the innovative equipment for forming wear-resistant surface alloys on the processing disk mills. In this case, research has been conducted both theoretically and practically. It concludes with outcomes and shortcomings as a whole.

Key words: RITM-SP-M installations, cutting tools, surface alloying, increased wear resistance.

Introduction

Every year in the modern automated machine-building production, the introduction of innovative technologies, which significantly increase the machining productivity, plays an increasingly important role. One of the bottlenecks in technological systems of automated production is a cutting tool. Due to the fact that the failure of the tool usually occurs much earlier than the wear of parts and components of technological equipment (machines, devices, etc.), it is precisely because of the tool that if its preventive replacement is not performed, the technological system as a whole will fail. . Many methods are known to improve the surface properties of a metal cutting tool before applying a wear-resistant coating. In particular, methods of chemical-thermal treatment have gained distribution. An alternative to traditional methods can be the creation of a doped surface layer of micron thickness with increased wear resistance on steel or carbide tools using a low-energy high-current electron beam (NSEC), which is the innovative approach to solving the problem. In some cases, the NSEC, in addition to melting and mixing the surface layers of the target, initiates the reaction of self-propagating high-temperature synthesis (SHS), which is realized through the use of the internal energy of the chemical interaction of the starting reagents. This article describes the capabilities of the recently launched RITM-SP equipment.Electron-beam alloying and equipment for its implementation

It is known that when creating a SHS system, a sufficiently large spectrum of chemically active substances at high temperature can be used as reagents. At the same time, other substances can also be used as fillers or diluents, including those participating in the synthesis as reaction by-products.

Main part

The main thing is that conditions are provided for the effective interaction of reagents, in particular exothermicity. An example is the synthesis reaction with the formation of nitride, carbide or intermetallic phases and the reaction of the decomposition of decomposed compounds with base elements. In our case, as described below, the reaction was initiated by the NSEP. To demonstrate the capabilities of the proposed equipment, we present the results of experiments in which two types of materials were used as the base material: H13A hard alloy plates (Sandvik coromant) and P6M5 high-speed steel plates, previously nitrided in a two-stage vacuum-arc discharge to a depth of about 50 μm. Using a magnetron, a thin Zr film with a thickness of 150-250 nm was applied to the samples in the case of high-speed steel in order to obtain ZrN

ISSN: 2394-3696, Website: www.ijiert.org, Organized on 24-25 April, 2020

crystals and a NbHfTi alloy film in the surface layer in the case of processing a hard alloy to form a layer of wear-resistant non-stoichiometric carbides. Then, excluding contact with the air, in the same process chamber, the samples were subjected to a series of pulses of a wide-aperture NSEP. Heating the surface to high temperatures, he initiated chemical reactions in the liquid and solid phases, between the metal film and nitrogen and carbon, which are in the composition of the base, both in free form and in the composition of the compounds. The processing was carried out on the RITM-SP installation, which can be manufactured both in laboratory and in industrial design. It is a combination of an NSEC source and several magnetron sputtering systems located on a single vacuum chamber. The device allows the deposition of films of different materials on the surface of the desired product and the subsequent liquid-phase mixing of the film materials and the NSEC substrate in a single vacuum cycle. As a result of this treatment, a coating with a given chemical composition deposited on the surface of the sample is fused into it. In this case, the sharp interface between the film and the substrate is eroded and an extended transition layer is formed with a thickness of several micrometers with varying elemental composition, thereby achieving the highest level of coating adhesion to the substrate, which was previously demonstrated on numerous metal film-substrate systems, in particular, on the system stainless steel - copper.

The NSEC is generated by extracting electrons from the near-cathode plasma, which is formed due to explosive electric emission on the metal micropoints of the cathode and their subsequent acceleration in the double electric layer. Next, the beam is transported in a plasma-filled diode to the collector. The use of such a generation and transportation scheme makes it possible to obtain a microsecond beam at the collector with a current density of up to 104 A / cm2 and an electron energy of 15–30 keV. The area of simultaneous processing of the target, equal to the diameter of the beam, can be from 50 to 100 cm2. It should be noted that the processing time of the tool is about 15 minutes without taking into account the evacuation time of the working chamber, which allows full loading of an industrial machine for applying medium-sized wear-resistant coatings with a working cycle of 4-5 hours using a single surface alloying machine. An assessment of the temperature regime of the target irradiated by the NSEC shows that the surface temperature reaches values significantly higher than the melting temperature of the components. The appearance of the melt in the volume of more refractory particles leads to a sharp increase in the interfacial surface and an increase in the rate of the chemical reaction between the components. Illustrating the result of the impact of a series of several NSEC pulses on the surface of a nitrided sample of steel P6M5. Irradiation of a 0.2 μm thick Zr film preliminarily deposited onto the sample by magnetron sputtering initiates a chemical reaction of the formation of refractory ZrN in a surface layer about 2 μm thick. This happens because electron beam processing causes the dissociation of iron nitrides, especially the ε-phase, which is confirmed by the data of x-ray diffraction analysis, which are presented. Along with the phases of α and γ iron, peaks of zirconium nitride are clearly visible in the diffraction pattern.

The effect of NSEC on a plate made of hard alloy H13A is illustrated. At the fracture, two different layers are clearly distinguishable - the surface and the intermediate. The concentration of Nb, Hf, and W in the intermediate layer indicates the mixing of the alloyed alloy carbide as a result of the high-temperature synthesis reaction. The thickness within which it is possible to obtain a modified SHS structure is 3-4 μm. Repeated initiation of the NSEP process practically does not change the initial microstructure. To complete the transformation, as a rule, a series of five to six NESP pulses is sufficient.

The powerful thermal effect of NESP with a pulse duration of about 5 μs on the surface of the hard alloy with a NbHfTi alloy film deposited on it with a thickness of about 200 nm leads to the formation of the fcc carbide phase, identified as (NbHfTi) CX. In this case, it is possible to avoid the accumulation of free carbon and to prevent surface cracking due to residual thermal stresses. The outer layer is enriched with refractory carbide phases of the MS type, which, due to the extremely high cooling rate, remain small and homogeneously distributed in the final product.

Conclusion

The obtained experimental results indicate the possibility of obtaining, with the help of the RITM-SP-M series installations on the market, on the surface of instrumental materials modified by electron-beam alloying of layers. Such layers were obtained due to the initiation of SHS chemical reactions between the base and a thin film deposited on it, in the products of which the formation of new carbide, nitride, or intermetallic phases was possible, by means of an instrument such as NSEC. With this effect, the synthesis of new compounds can occur at high temperatures, both in liquid and in solid phases.

Bibliography.

1. Vereshchaka A. S., Grigoryev S. N., Vereshchaka A. A., Lytkin D. N., Savushkin D. Yu., Sivenkov A. S., Improving the health of blade tools due to directional modification of the properties of their working surfaces when applying nanostructured multilayer composite coatings, Vestnik MGTU "Stankin", No. 4 (31), 2014, 45-51.
2. M. A. Volosova. On the selection of the optimal method for modifying the surface of a cutting tool, based on its official purpose, Strengthening technologies and coatings, 2012, No. 12 (96), p. 12-16.
3. M.A. Volosova, A.A. Tumanov. Systematization of coating methods and modification of the working surfaces of a cutting tool and the algorithm for their selection: Vestnik MGTU "Stankin", No. 3, 2011, 78-83.
4. A.B. Markov, A.V. Mikov, G.E. Ozur, A.G. Padey. RITM-SP installation for the formation of surface alloys // Instruments and experimental equipment, No. 6. 2011, p.122-126.