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Mathematical models for describing the turning process as a random non-stationary process

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Abstract: In this paper, we consider the description of the turning process as a non-stationary random process, we use the distribution function of the cutting parameters of the form and, by double logarithm, this model is reduced to the form of a linear model.

Keywords: Coated substrate, wear-resistant coatings, coefficient of friction.

Introduction. To describe the turning process as a non-stationary random process, the distribution function of the cutting parameters of the shape is used.

$$F(R) = 1 - \exp \cdot \left[- \left(R / C \cdot t^{a_1} \cdot s^{a_2} \cdot v^{a_3} \cdot T^{a_4} \right)^{\alpha} \right]$$

Functions that describe this model in general terms:

$$F(h_3) = 1 - \exp \cdot \left[\left(- h_3 / c_1 \cdot t^{a11} \cdot s^{a_{12}} \cdot v^{a_{13}} \cdot T^{a_{14}} \right)^{\alpha_1} \right]$$
$$F(P_z) = 1 - \exp \cdot \left[\left(- P_z / c_2 \cdot t^{a_{21}} \cdot s^{a_{22}} \cdot v^{a_{23}} \cdot T^{a_{24}} \right)^{\alpha_2} \right]$$
$$F(Ra) = 1 - \exp \cdot \left[\left(- Ra / c_3 \cdot t^{a_{31}} \cdot s^{a_{32}} \cdot v^{a_{33}} \cdot T^{a_{34}} \right)^{\alpha_3} \right]$$

By taking the double logarithm, this model is reduced to the form of a linear model:

$$\ln \ln \frac{1}{1 - F(R)} = \alpha \cdot \left(\ln R - \ln R_0 \right)$$
$$\ln R_0 = \ln C + a_1 \cdot \ln t + a_2 \cdot \ln s + a_3 \cdot \ln v + a_4 \cdot \ln T$$

The main superiority of the procedure for applying wear-resistant coatings over other technologies for increasing the working capacity of a driving device is included in the versatility of the seconded regulation of the qualities of the working plane of the device material, which are half or completely preserved. A property that is revealed in the size of a categorical body.[2] The mechanical qualities of wear-resistant coatings, their structural parametric and crystal-chemical qualities in various aspects are determined by the method of their manufacture. In any case, however, coated plugging tools are superior to uncoated plugging tools. Since classic wear coating technologies for cutting tools are thoroughly depicted in the progressive industry literature, we further investigate the mechanism of wear coating qualities acquired by physiological vapor deposition technologies. For example, it depends on the CIB method and the improvement order. The mechanism for finding features of wear-resistant coatings. The CIB recipe allows you to transfer all kinds of coatings with different physical and mechanical properties both on carbide tools, similarly to high-speed tools. The acquired wear-resistant lining can significantly increase the validity of the driving tool, however, in some embodiments, the effectiveness is insufficient. Analysis of services, aware of the study of the mechanism of wear of a coated driver, allows us to certify poor rust and crack stability as the main root causes of destruction of coatings. The sticky credibility of instrumental coatings.[4] Metal-metalloid (Me-X) compositions are established on IV-VI of the Periodic Table and are used as wear-resistant coating materials, blunt alloys act like metals, and carbon, organogen and oxygen act like metals. too. For compounds of the Me-X type, the interstitial phase design is distinctive. The investigation of the introduction of metalloid atoms into the metal

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lattice is the enlightenment of long-term Me-X chemical bonds that change their physical and chemical properties.

Formations of the Me-X type have three types of bonds every minute: heteropolar bonds, metallic bonds and covalent bonds. According to the general image of the chemical bond, it is always possible to separate the materials of wear-resistant coatings into three broad categories, respectively. Nitrides, carbides of transition metals Ti, Zr, Hf, V, Nb, Ta, Mo, Cr are mainly piercing-type bonds, carbides, nitrides Al, Si, Fe, B - materials with covalent bonds, Al oxides; determine the electrovalence of Ti and Zr. The papers present corporate trends in changing the qualities of materials used or coatings.

1.1 Trend in physical-chemical and physical-mechanical properties of hard coatings

Characteristics	Decreasing trend depending on the type of chemical bond
melting temperature stability thermal expansion hardness coefficient weakness propensity to interact Coefficient of adhesion to metal substrates Multi-layer compatibility	covalent bond → metal → ion-ion → metal → covalent ion → metal → covalent bond covalent bond → metal → ionic ion → covalent bond → metallic metal → covalent bond → ionic metal → ion → covalent metal → ion → covalent bond

The factors that determine the quality of coatings are recognized at three levels.

Factors affecting the parameters of the deposition process (for example, the heat of the substrate and the process itself, the interaction of reagents and reaction products, and yes, machine forces and all kinds of particles that are tied up from the deposition near the impact.

The factors combined are materially supported by the deposition of the substrate and the "substrate coating" of the entire system.

Factors associated with structural finish (micro), including seed size and orientational saturation of seed measures (porosity).

Suitable qualities of coatings can be inherited with a certain balance of general qualities of the coating material. Here are the characteristics:

1) bias in the compilation of this or that material.
2) stoichiometry;
3) basic ratio;
4) anisotropy;

The solubility slope of a certain system, establishing the formation of categorical solutions, intermetallic compounds, etc. in the spray material and substrate.

More aspects for the sake of optimizing coatings include consideration of the interaction of the spray with the weld material, the credibility of the coating itself, its fatigue strength, fracture ductility, and ability to respond to automatic stress. Discrepancy between adhesion to the substrate material and its coefficient of thermal expansion.

The hardening of the categorical solution of the spraying material after the second mechanism is noticeably wider. This is where alloying elements can always be divided into two huge categories.

• Elements forming compositions with undivided solubility.
• Elements that form compounds with close solubility, or elements that do not interact.

For doping categorical TiN solutions, elements of the first category are connected with Zr, Mo, Cr, V, Ta, Nb, Hf. They form fcc nitrides like titanium nitride and guarantee noble authority and wear resistance. Its mutually undivided mutual solubility with titanium nitride makes it possible to completely revise the coating staff and, consequently, to select its properties. Between the nitride-forming ingredients of the second category, Al, Fe, Si and B are emphasized. The close bilateral mutual solubility of these nitrides and the existence of three-component formulations means that for the second category in coatings based on elemental doped titanium nitride, the mechanism of action, in addition to the mechanism of solid solution strengthening, is covered in the ability of dispersion hardening.

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Elements of the second category are relatively inexpensive and famous materials. The doping agent Me2 interacts with both metals and metalloids. This is where exposure to multiple curing mechanisms from multiple sides is used to establish the qualities of the coating. Among the many results of alloying ingredients for a non-metal, the modification of the thermodynamic enterprisingness of the X impurity seems to be the most certain. Therefore, the deepening of the sputtering material by alloying after the second mechanism affects the magnitude of the Phaerus mass. This manifests itself in an increase in the internal discordance and hence the yield point of the Me1Me2X type solution, and this change stops more certain with increasing temperature. Oblique curing of these solutions is extreme.

The hardening step of a categorical solution at full plowing of alloying ingredients unanimously of the concept can be formulated by the following equation.

All kinds of coatings applied to driving tools can be classified according to a certain set of qualities and functions that are installed. Development and promotion of installation of multi-layer coatings. Promotion of the coating scheme, development of a new coating composition. It is characterized by a folding transition through the general to the upper solid cover of spraying. Choosing the quality and thickness of any cover is in tune with the functionality. The purpose allows more fruitfully to betray the qualities of only the coating. In addition, the creation of coatings enhances its resistance to fragile destruction under the influence of various thermomechanical loads. The principle of covering doctrine is examined. The overlay consists of the following layers: It should be noted that the top is a fundamental wear-resistant layer that provides physical and chemical passivation and noble thermodynamic stability of the cultivated material. chemical sociability of the base material high adhesion to the surface of the device Medium discharge - has an abundance of properties, guarantees a sticky association between the upper and lower layers, and yes, it performs a barrier function. The works reveal a structural-energy approach to the formation of coatings.

General specification for wear-resistant coatings on cutting tools.

The former is forced to exist fundamentally lower, in bondage through a compromise between the sticky stability of the coating for the base material and the tool being coated. When creating multilayer coatings, the maximum discharge is forced to have more noble thermodynamic stability and energy consumption than the lower layer. The fluff is forced to border well to the tool material and the top layer.

Therefore, the construction of layered and composite multilayer coatings from blunt compositions with high thermodynamic stability and the introduction of a transitional coating of pure metals (Ti, Zr, Mo) to increase sticky adhesion and increase corporate deposition (intergranular space and microscopic for a more pliable coating to fill cracks).

As mentioned in the aforementioned study, the intricate personnel and the qualities of the multiplet deposition exhibit noble thermal stability and more noble micro hardness than the individual elements. These coatings have increased fracture resistance due to changes in their structure and saw properties across the entire cross section. Based on the results of research on the sociable course of various methods of finishing and analysis of the thermal state of the clogging part of the device and experimental and theoretical assessment of the elegant stability of the instrument.

They promote the graceful stability and rigidity of the cutting wedge of the tool through the creation of a wear-resistant composite consisting of a hardening (therm stabilizing) layer, a tacky underlayer and an anti-wear coating. Each subject of a wear-resistant composite performs a strictly regulated function. The reinforcing discharge contributes to an increase in the elegant stability and rigidity of the driving wedge. Wear-resistant wrapping enhances the wear of the communication area by increasing the physico-chemical passivation and the noble thermodynamic stability of the hardened material of the communication area. Adhesive containment improves the chemical bonding of the hardened coating crystals and the wear resistant coating material, thereby improving the strength of the wear resistant composite and adhesive formulation for the tool base. This scheme continues the principles laid down in past studies and guarantees a total approach to the creation of multilayer coatings, in addition to taking into account certain processing methods and features. Analyzing the famous views on the development of multilayer coatings, it is possible to note that all of them are subject to corporate conditions for wear-resistant coatings. Accumulated experience and numerous studies show that the validity of the same coating with different actions of mechanical finishing is not the same.

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