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APPLICATION IMPACT OF CUTTING TOOL STRENGTHENED BY GLOW DISCHARGE ON QUALITY OF TREATED SURFACE

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The method of processing materials with a glow discharge makes it possible to obtain coatings and reinforced layers that serve as diffusion barriers, reduce friction, tool wear, cutting and deformation forces. The treatment of hard-metals in a glow discharge leads to an increase of surface hardness by 10...15 %. The greatest impact on the change of surface hardness is exerted by the power characteristics of a glow discharge, such as voltage U, kV (Curve 1, Fig. 1) and current density J, A / m2 (Curve 2, Fig. 1). These characteristics have a complex effect on the change in hardness. Changes are described by curves with extrema:

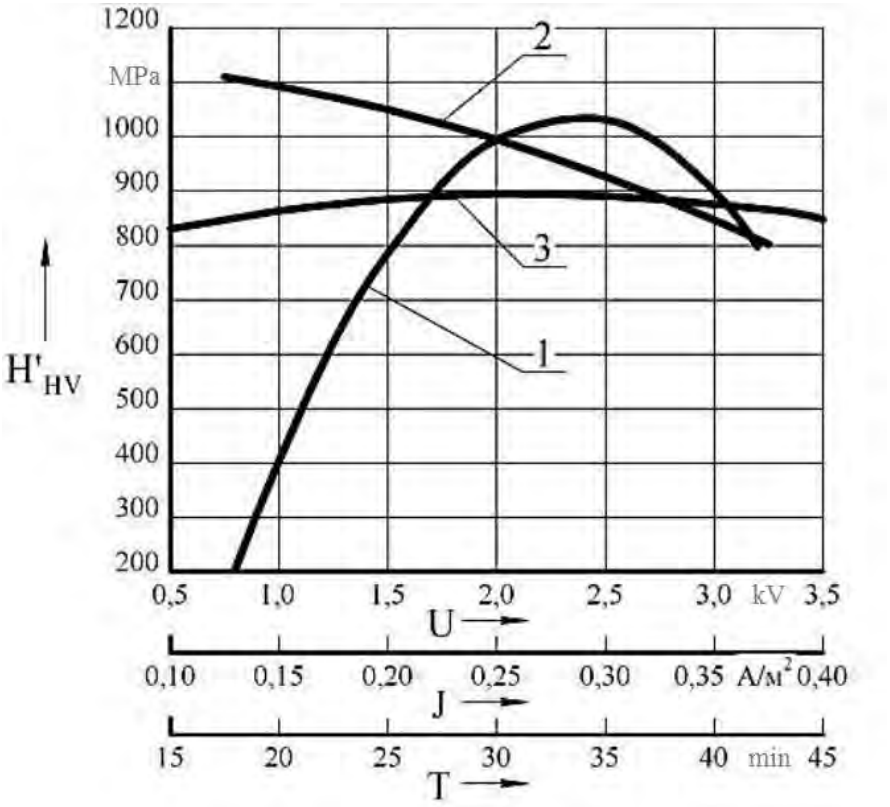

Fig. 1. Power characteristics of a glow discharge

Processing time T, min. (Curve 3, Fig. 1) together with power characteristics of a glow discharge (Fig. 2) have a complex effect on the hardness increase, which can be expressed with the help of a polynomial of the second degree with the requirement of rotatability.

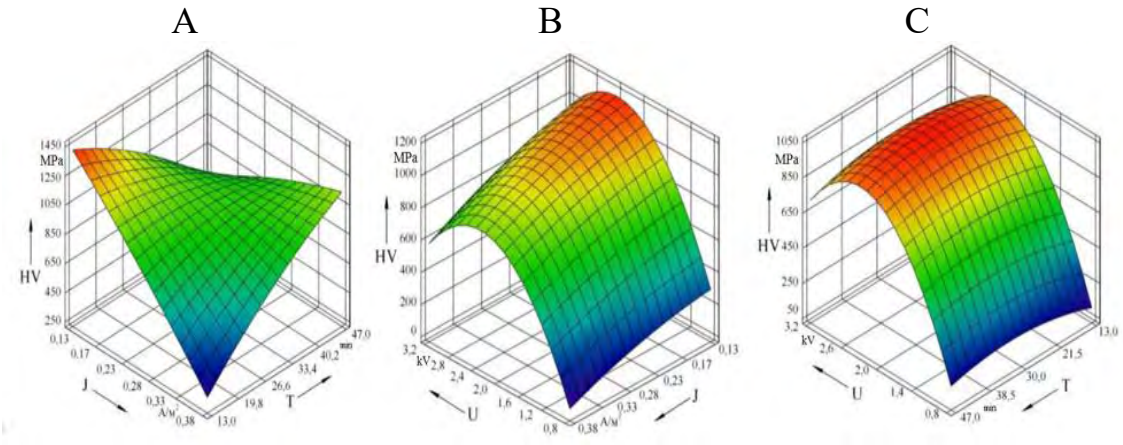

Fig. 2. Influence of current density J, A / m^2, and the treatment time t, min (a); combustion voltage glow discharge U, kV, and current density J, A / m^2 (b); glow discharge voltage U, kV, and time treatment T, min (c) on the increment of the surface hardness of inserts made of hardmetal VK8

After the impact of the glow discharge on the hardmetal, the depth of the modified layer can reach 220 μm for the VK8 hardmetal depending on the processing parameters. The formation of different depths of the modified layer is explained by the long-range effect, and also by the presence of pores in the hardmetal VK8 which reduce the effect of screening of charged particles bumping up against it.

Due to low heat conductivity, these coatings and layers protect the substrate from overheating, reduce the tendency to grasp the material being processed and stick it to the tool. Such method obtained the widest application in order to increase the wear resistance of non-re-sharpened cutting inserts made of hardmetals (Fig. 3).

Fig. 3. Non-resharpened cutting inserts made of hardmetals

The processing of hardmetals by a glow discharge with certain technological characteristics causes an increase in their wear resistance with different types of machining of the entire spectrum of materials from 1,5 to 3 times. Moreover, the modifying treatment results in a relatively uniform wear throughout the cut-

ting length to achieve critical wear. Modification of hardmetals is more effective in the blade processing of materials with the formation of elemental or articulated chips, which reduce the contact area with the front surface and thereby reduce wear on it. The obtained data show that the hardness of surface layer of hardmetal VK8, being in the delivery state with a depth of up to 50 μm, differs from the hardness of the main layer and has lowered values. This feature is explained by the accumulation of cobalt or nickel binder at the surface, connected with the fact that while carbide tools sintering, the formation of the droplet phase of the binder, which under the influence of pressure and capillary effect, is squeezed out to the surface.

This research involves establishing a functional relationship between the parameters of the hardening processing of cutting inserts and the quality parameters of the surface treated with these inserts. For this purpose, a number of experiments imply the establishment of functional dependency of parameters of processing cutting inserts made of high-speed steel P6M5 and hardmetal T15K6 coated with TiN and TiC reinforced by glow discharge and quality parameters of machined surface. Preliminarily, such inserts are processed with a glow discharge. Each next insert is processed with new processing parameters. Later on, they are used to process the material. The processing conditions and the material being processed remain unchanged. Comparing the roughness parameters of the machined surface and the corresponding processing parameters of the cutting insert, a mathematical model will be obtained that establishes an exact relationship between the quality of the machined surface and the processing parameters of the cutting tool.

Taking into account all that has been said above, it is possible to draw a number of conclusions concerning the direct effect of the use of a hardened by a glow discharge instrument on the treated surface:

1) due to the reduced friction between the tool and the workpiece, and also due to the low heat conductivity of such tools, the negative effect of temperature phenomena on the workpiece decreases, which in turn leads to an improvement in the quality of machining by the cutting tool;

2) due to their increased hardness, such tools can be used for machining more solid types of materials;

3) increased wear resistance of the cutting tool makes it possible to increase the service life of such tool. Uniform wear on the front surface of the tool allows to maintain the processing parameters at a more stable level throughout the tool life period, which also results in improved quality of the treated surface;

4) to achieve maximum wear resistance, treatment should be carried out with a glow discharge with a burning voltage U, equal to 2,7 kV. The current density J is equal to 0,325 A/m^2, with a processing time of T=30 min.