The Way of Hardening High Pressure Apparatus Matrices

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This paper presents the solution of the problem of the lifetime prolongation for the high pressure apparatus matrixes used for artificial diamonds synthesis by means of a catalytic method at working mixture squeezed up to the pressure of 4 GPa and heated up to the temperature 1700 K. Our investigation has shown that a considerable lifetime prolongation for the high pressure apparatus matrices can be achieved by increasing the mechanical hardness of their effective area and by their structure improvement. The matrices were being handled in high vacuum conditions in the Ar+ plasma of a low energy ionic source. Simultaneously a graphite target in the ionic source was being sprayed with laser radiation. This processing led to the formation of the solid replacement solution and to the creation of the strengthened surface layer containing carbide. It also led to the elimination of the microcracks with the i-carbon.

Recently the range of materials used in industry has been constantly extending. It is necessary to emphasize that on the one hand the increase of strength, wear hardness and hardness of used materials causes the difficulties at their handling, and on the other hand there is constant rise of requirements to labour productivity and to lowering energy consumption. Such state of production determines the wide application of instruments made of supersolid materials and, in particular, the use of diamonds.

The industrial application of natural diamonds is restricted by their rarity and high cost. That`s why the production of synthetic diamonds is extremely important. It allows to get crystals with the necessary heat and electro-physical properties, hardness, wear hardness and strength. The electrodischarge snitering is one of the main methods of producing synthetic diamonds. Its essence is in squeesing the working mixture with the pressure up to dozens of MPs and with its subsequent heating by means of electric current. The operation of the equipment for the synthesis which takes place in extreme conditions leads to the rapid wear of costly parts made of hard alloys. Thus, for the economic efficiency and lowering energy and resources consumption it is topical to prolong the durability of the parto of the equipment and to increase the productivity of synthetic diamonds synthesis.

Since the expenses for the high pressure apparatus matrices make up to 40% of all the expenses of synthetic diamonds production, the raise of high pressure matrices durability is one of the possible ways of lowering general cost of the process. The analysis of the reasons for the failure of the matrices made of the WK6 alloy which are used at the "Kristall" enterprise (sited in Gomel) has shown that the main reason for this is the fragile destruction of the matrices especially in the regions of the edges restricting a dimple in them (see Sig.1).