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SELECTION OF THE SUBSTRATE MATERIAL FOR THE HOLDERS OF DIAMOND SINGLE CRYSTALS AT THE MEASUREMENTS OF HIGH-TEMPERATURE HARDNESS

The study of the mechanical properties is important because it allows establishing the effect of growth features: the composition of growth system, the temperature, the amount and the type of impurities.

To test mechanical properties, diamond samples of 2–4 mm in size and 0.1–0.16 ct in weight were used, being obtained by the method of temperature gradient. The tests were performed at the temperature of 900°C in UIMB-1 plant [1]. The problem was fixing of the samples by a holder of 5 mm in height and 15 mm in diameter. The samples were decided to be fixed in ceramic disks.

Thermally stable materials (aluminum nitride, manganese oxide, zirconia) were selected for producing the substrate. The powders of these materials were mixed with the silicate-based binder and pressed under the pressure of 0.2–0.3 GPa in a cylindrical mould. After the pressing, the plates were allowed at the room temperature and sintered at 900°C.

The plates made of manganese oxide were destroyed and eliminated from the succeeding tests. Compressive strength of the AlN and ZrO_2 plates was measured. The breaking load of the ZrO_2 samples did not exceed 1kN. The quality of the samples did not allow evaluation of R_{compr} The loading of the AlN samples was 27.05 kN and the compressive strength reached R_{compr} = 160 MPa. Naturally, a conclusion was made that the aluminum nitride substrate is the proper material for diamonds to be pressed in.

So, the material of the substrates was selected where the crystals of synthetic diamonds should be pressed in. This fact provided successful measurements of the hardness at high temperatures [2].

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Fig. 1. Diamond single crystals: *а* – type II*b*, weight 0.1 ct; *б* – type I*b*, weight 0.16 ct; *в* – type II*a*, weight 0.14 ct

Fig. 2. The cell design for YIMB-1 [3]: *1* – disk with synthetic diamond samples, *2* – holder of the disk with the samples, *3* – Berkovich diamond indentor, *4* – rod, which connects weights with the indentor, *5* – sinkers of 50–1000 g in weight

Fig. 3. Diamond samples pressed into the aluminum nitride substrate-holder