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REMOVAL OF DEFECTIVE SURFACE LAYERS FROM CUTTING CERAMIC INSERTS BY FAST ARGON ATOMS BEFORE DEPOSITION OF WEAR-RESISTANT COATINGS*

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Deposition of wear-resistant coatings on hard alloy tools ensures high operational stability and increase wear resistance by three times, even when machining hard-to-machine titanium and nickel alloys. Ceramic cutting inserts can be operated at high cutting speed unattainable for tools made of hard alloy. However, it is impossible to fully realize the potential of wear-resistant coatings on ceramic inserts. Because they undergo diamond sharpening and after that the insert surface is replete with shallow scratches, deep grooves profiled with single diamond grains and caverns with a depth up to 5 μm. The coatings effectiveness can be ensured only after removal from the insert surface of the defective layer with a thickness exceeding 5 μm.

To deposit wear-resistant TiAlN coatings on round cutting inserts with a diameter of 19.05 mm and a height of 7.9 mm made of dielectric AS500 ceramic an experimental system was used, which comprises a source of fast neutral atoms [1-3], two planar magnetrons and a rotation system for eight inserts. The inserts are fastened thereon in a vertical line. Each insert is placed on its individual holder fastened to one of the eight parallel axes. The angle of the axes relative to trajectories of fast atoms is 45 degrees (Fig. 1).

The beam of fast atoms is produced using a grid composed of twenty parallel 150-mm-long, 300-mm-wide and 0.5-mm-thick titanium plates. The power supply allows regulation of the negative bias voltage on the grid from zero to 5 kV. Ions accelerated from the plasma emitter enter the gaps between the grid plates. They touch the plates and turn into fast atoms. As sections of the grid plates facing towards the plasma emitter are shaped as segments of a 50-cm-radius circle, trajectories of the fast atoms are directed to the center of this circle. Therefore, the width of the fast atom beam is decreasing from 30 cm near the plasma emitter to 2.5 cm near the rotating cutting inserts. The flux density of fast argon atoms and the rate of cutting plates etching increase in this case by a factor of 30/2.5 = 12.

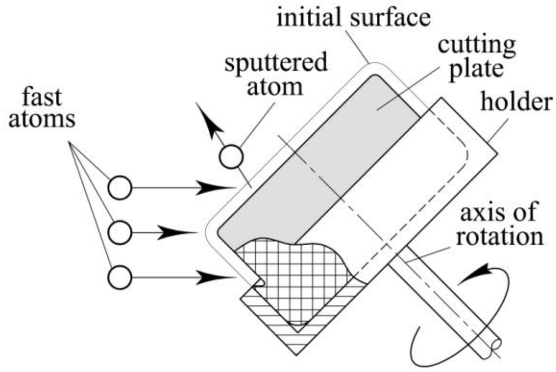

Fig.1. Schematic of etching a ceramic cutting plate with fast argon atoms.

At the equal angles of incidence to the front and back surfaces of the cutting wedge amounting to 45 degrees, two-hour-long etching of cutting inserts provides removal of a 10-μm-thick surface layer of the hard-to-sputter ceramic. As a result the cutting edge radius of the insert diminished from R ~ 20 μm to R ~ 10 μm. Wear-resistant TiAlN coatings deposited after the etching increase wear resistance of the cutting inserts by not less than 1.7 times and significantly increase the processing stability.

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