Study of nitrided steel R6M5 abrasive wear-resistance

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1. Introduction

It is known [1], providing maximum wear-resistance of cutting tools - one of the most important problems of modern engineering. Among the various ways to increase the endurance one effective way is to nitriding.

Therefore, the objective of this work is to study the abrasive wear-resistance of high-speed steel R6M5 nitrided layers [2].

2. Material and methods of research

In accordance with the objective fast-cutting tungsten-molybdenum steel R6M5 (0.80 - 0.88 C, 3.8 - 4.4 Cr; 5,5 - 6,5 W; 1,7 - 2,1 V; 5,0 - 5,5 Mo), was selected as an object of study.

Nitriding was carried out by heating and holding at saturating environment electrolytic plasma effect due to electrical potential changes in the plasma layer, that created between the electrolyte and the sample surface (cathode) [3]. The processing was carried out in an electrolyte of urea-sodium water solution containing 20% urea and 10% sodium carbonate solution to the active cathode in the following mode: voltage when heated to a temperature of 550 °C - 320 V, the current density - 3 A/cm^2, the ageing treatment voltage at 550 °C - 160 V, the current density - 2 A/cm^2, the processing time - 7 minutes.

Microhardness and microstructure were studying by using optical microscope “NEOPHOT-21” and scanning electron microscope JSM-6390LV. Microhardness evaluation conducted on the PMT-3M device under 0.5 N loads by State standard 9450-76. The abrasion wear of the samples was determined using the abrasive wear-resistance testing machine with the friction on not rigidly fixed abrasive particles [4].

3. Results and their discussion

In this work was determined that the microstructure of the steel R6M5 modified surface layer after treatment consists of a nitride layer and the diffusion zone, between which there is no clear boundary. Found that the electrolytic-plasma nitriding increases the microhardness of up to 1.7 times. Figure 4 shows the results of abrasion wear tests on steel R6M5 samples. Samples were weighed every minute and tested for three minutes, the wear length of 28.825 m. Results showed that wear-resistance of the nitrided sample better than the initial. Mass loss of the nitrided sample increases with depth in the first and second minute, at third minutes is equal to the mass loss of the initial sample, it means that after the second minute of modified layer wears away. This shows that abrasive wear-resistance in the surface layer more than at the base. Increase in wear-resistance after nitriding is mainly due with formation of alloying elements nitride phase’s fine particles [4].

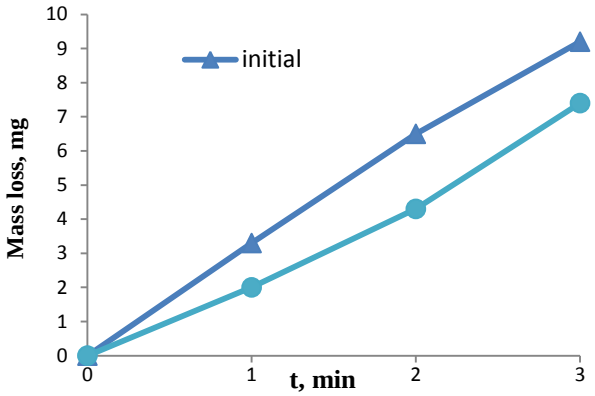

Figure 1 - The results of tests on abrasion

4. Conclusions

Thus, the experimentally determined that after nitriding electrolytic plasma heating at the surface high-speed steel R6M5 formed modified layer, which has high wear-resistance and microhardness. Method of electrolytic-plasma nitriding can be recommended for protection cutting tool surface from abrasive wear.

5. References

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