INVESTIGATION OF THE COMPOSITION, STRUCTURE AND HARDNESS OF TOOL STEEL AFTER INDUCTION NITRIDING

Pavel A. Palkanov, Aleksandr A. Fomin
Yuri Gagarin State Technical University of Saratov, Russia

Nitriding is used to increase the surface hardness, wear resistance and fatigue strength of various metals. In particular, high-speed steels (which have high resistance to plastic deformation and wear resistance) are usually nitrided, since they have low mechanical properties and heat resistance without processing. These properties can be improved by conventional methods of gas or plasma nitriding. However, these methods require several hours to form nitride layers, which leads to poor performance of these methods. In order to increase the rate of nitriding of steel, new nitriding methods have been developed, such as laser nitriding, nitriding of the surface using the powder application method and gas nitriding using solar energy, etc. In this paper, the possibility of using induction heating to obtain wear-resistant nitride layers on the surface of P6M5 steel will be described.

Methodology
The studies used cylindrical samples with a diameter of 10 mm and a thickness of 5 mm made of high-speed steel P6M5, without preliminary thermal treatment.

Nitriding of the samples was carried out in a specially designed sealed chamber in a reaction gas medium at a temperature of 800...1000 °C (Fig. 1). The duration of the process is 10 minutes. As a result of the modification, a nitride wear-resistant layer of a matte-gray color was formed on the sample (Fig. 2).

Results
The analysis of the surface microhardness carried out using the Vickers method at a load of 200 gf showed that the surface microhardness of the sample is 1950±70 HV.

As a result of high-temperature nitriding of tool steel, a uniformly hardened microstructure is formed. The study of the composition of the samples by sections showed that there is a uniform introduction of nitrogen into the metal with a gradient distribution from the surface to the center of the sample.

XRD data proved that the untreated tool steel is characterized by the presence of the α-Fe phase. After nitriding at a temperature of about 900 °C, about 25% of the martensitic phase of γ-Fe appeared. No more than 2.4% of chromium nitride Cr2N and about 1.5% of tungsten nitride W2C were formed in the near-surface layer of the samples (Fig. 3).

Fig. 1. Scheme showing the chamber for induction nitriding: 1 – outlet pressure reducing valve; 2 – "VCh-15A" setup; 3 – water-cooled inductor; 4 – lower base of the chamber for puffing of a working gaseous medium; 5 – sample

Fig. 2. Sample of the resulting nitride surface structure

Fig. 3. Results of XRD analysis of the steel surface

Palkanov Pavel Alekseevich
Email: maikmozovskii@mail.ru
Phone: 8(937)253-82-41