Nanostructured surfaces

Wear resistance of the steels with the surface nanocrystalline structure

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Nowadays great interest of scientists is attracted to the nanocrystalline structures (NCS) with high service properties and the technologies of its formating. The technology of mechanical-pulse treatment (MPT) for production of surface NCS was developed in Karpenko Physico-Mechanical Institute. It is based on using the energy of high-speed friction which generates severe plastic deformation necessary to form the gradient surface NKS.

The important characteristic of the bearing capacity of the machine elements is their wearing resistance and especially those that work in heavy service condition at the action of high loads and different working media. A special oil-based technological media with additives of low-molecular polyethylene was elaborated with this purpose for saturation of the surface layers with carbon during the MPT. The friction machine MI-1M was used for ring-insert wear resistance tests of the specimens from 20 (0.2 C), 35 (0.35 C), 45 (0.45 C), 40Kh (0,4 C, 1 Cr) and U8 (0.8 C) steels in the oil-abrasive friction conditions under a specific load of 2–4 MPa. The increment of wear resistance was shown for both hardened rings and unhardened inserts for all friction conditions mainly due to decrease of the friction coefficient in the pair. The wear resistance of the surface NCS fabricated on steels by MPT was higher in comparison with quenched and low-tempered steels. The reduced friction coefficient of NCS is bound up with changing the electron configuration of atoms at the high stresses in the nanograins. Wear resistance of the steels with surface NCS increased simultaneously with surface microhardness and rising carbon content in them. The wear resistance of 45 steel with surface NCS was higher in comparison with quenched and low-tempered ShKh15 (1 C, 1.5 Cr) steel. It enables the substitution of the high-alloy steels by a carbon steels according to the wear resistance parameters what is very important in conditions of alloying elements shortage.

The examples of practical realization the technology of MPT for hardening of the heavy loaded machine elements (protective sleeves of pump's shafts and coal pumps, conveyor pins, pump elements of the mining transfer stations, valve seats and plates of the boring pumps, etc) were shown. The service life of the above-mentioned machine elements increased in 2-3 times.