Receiving Wear-Resistance Coverings Additives of Nanoparticles of Refractory Metals at a Laser Cladding

V N Petrovskiy¹, M F Murzakov¹, A O Andreev¹, D P Bykovskiy¹, and V P Birukov²

¹National Research Nuclear University (MEPhI), 31 Kashirskoe sh., Moscow, Russia. Contact Phone: +74993248766
²Institute of Machines Science of the Russian Academy of Sciences, 4 Maly Kharitonyevsky Pereulok, Moscow, Russia. Contact Phone: +74956288730 Contact Email: vnpetrovskij@mephi.ru

Use of additives of nanoparticles of refractory connections such as carbide of tantalum (TaC) and carbide of tungsten (WC), leads to that superficial properties of a covering improve (wear-resistance, microhardness). Wear-resistance of coverings with a nickel matrix can increase considerably with addition of refractory particles such as WC, TaC, NiC.

Experiments were made with use of the powders two types on a nickel basis of production of HOGANAS firm – 1360 and 1559. The sizes of granules of powders were 50-140 µm, as additives of nanopowders are chosen – TaC and WC, with sizes up to 100 nm. Cladding of standard powder and powder with additives of nanopowder was carried out on flat surfaces of substrates from steel 34XH1MA with sizes of 15×70×10 mm. As binding substance water solution of an oxidcellulose. Power of radiation varied in the range from 500 to 3000 W. Speed of movement of a laser beam of 5-25 mm/s.

In the first part of experiments the layer of mix of powders 1559 and the nanopowder WC with various volume concentration was applied on a substrate (5%, 10%, 15% and 20% respectively), mix was prepared with binding substance of an a oxidcellulose on a water basis, thickness of previously put layer made about 1 mm.

In figure 1 comparison of measurements of microhardness of the built-up samples powder 1559 without nanocarbide additives (≈ 6000 MPa), and with additives of 15% nano-WC (≈9000 MPa) is carried out. Apparently from comparison, there is a significant increase in microhardness in the claddings with additives of nanoparticles of carbide of tungsten.

In the second series of experiments applied powders on a nickel basis 1360 with a size of particles of 40-150 µm. With increasing of the amount of nanocarbide of tantalum with 10 to 40% average microhardness increases with 7400 (10% of TAS) to 8600 (40% of TAS) MPa.

Tantalum carbide nanopowder introduction within 10% of the volume mixture allows to increase wear-resistance of the built-up layers by 4 times. The further increase in the content of nanopowder up to 40% of the volume of furnace charge leads to increase of wear-resistance to 6 times.