STRUCTURAL-PHASE STATES AND WEAR RESISTANCE OF SURFACE FORMED ON STEEL BY SURFACING

Kapralov E. V., Rajkov C. V., Romanov D.A., Gromov V.E.

Siberian State Industrial University, Novokuznetsk, Russia,
gromov@physics.sibsiu.ru

The tribological test has shown that the formation of surfacing on the surface of steel Hardox 400 results in the increase of wear resistance of material surface layer by a factor of ~2.25 and decrease of friction coefficient — by a factor of –1.05.

The structure of surfacing is shown. A large number of inclusions are of edged shape. Inclusion sizes vary within 1 to 5 μm. The second morphological element of the deposited layer is a structure of dendritic and cellular crystallization. The cell sizes vary within 0.3 to 0.8 μm. The cells are separated by interlayers of 50 to 100 nm thickness.

X-ray spectral analysis of surfacing sites, designated by frame, has shown that particles of the edged shape are enriched by atoms of niobium; zones of dendritic crystallization are enriched by atoms of iron, chromium and carbon. A characteristic feature of the cellular crystallization structure being formed largely by atoms of iron is the presence of carbon and chromium atoms of large concentration.

Phase composition of surface surfacing layer was analyzed by X-ray diffraction method. X-ray diffraction pattern obtained from the surface surfacing layer is shown. When analyzing the results shown it can be noted that the basic phase of the tested surfacing is α-iron, the average size of coherent scattering zone of which is D = 30 nm. The revealed parameter of α-iron crystal lattice is somewhat higher than that of α-iron containing no admixture (a_0 = 0.28668 nm [1]). Suppose the increase of crystal lattice parameter of surfacing α-phase is caused by formation of solid solution oversaturated by carbon atoms. In this case, using the estimation expression, given in, it can be shown that carbon concentration located in crystal lattice on the base of α-iron is 0.018%wt.

Phase composition is represented by a second phase particles: by particles of iron carbide of composition Fe_3C (cementite), the volume fraction of which is 10%, of niobium and chromium carbides NbC and Cr3C2 (sum volume fraction of carbides is 20%) and of boride of iron Fe3B, the volume fraction of which is 10%.

Cross-section analysis of surfacing substrate system made it possible to reveal the multilayer structure which according to morphological characteristics can be presented by surfacing, transition layers and a layer of thermal transformation of steel. Surfacing layer has principally a structure of cellular crystallization and is characterized by the presence of particles, enriched by niobium. Sizes of crystallization cells vary within 0.5 to 1.0 μm; a thickness of interlayers separating them is 0.1–0.3 μm.

The first transition layer has an island-type structure. Islands of sizes 5–10 μm are separated by extended interlayers having a complex substructure, the element sizes of which vary within 300–600 nm. The second transition layer, directly adjacent to steel interface is comparatively thin 10–20 μm and is characterized by column dendritic structure being formed from the steel interface.

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