STRUCTURE EVOLUTION DURING ELECTRON BEAM MELTING OF TITANIUM – TITANIUM CARBIDE COMPOSITE POWDERS[1]

M.G. KRINITCYN[1,2], G.A. PRIBYTKOV[1], A.V. BARANOVSKIY

[1] Institute of Strength Physics and Materials Science SB RAS, Tomsk, 2/4, pr. Akademicheskii, Tomsk, 634055, Russia
krinmax@gmail.com
[2]Tomsk Polytechnic University, Tomsk, Lenina str., 30, 634050

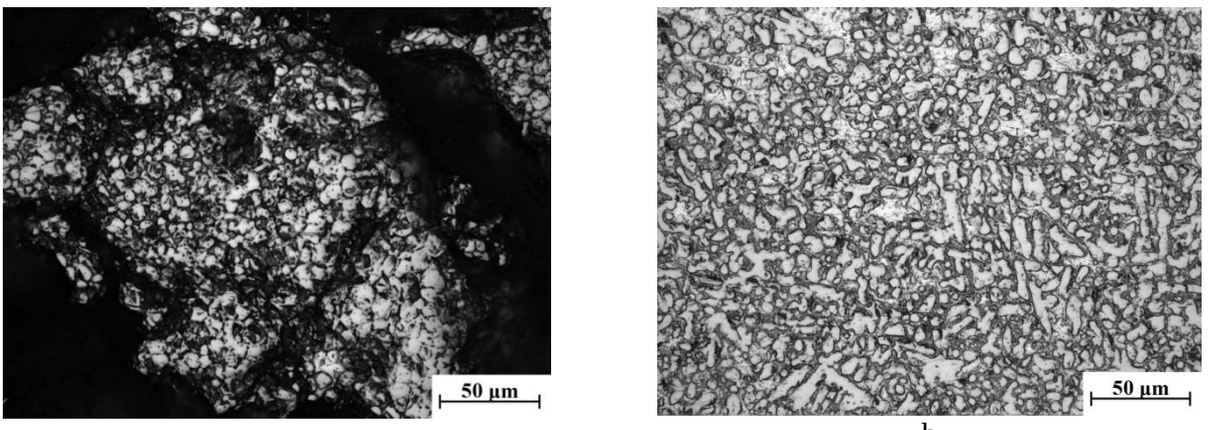
Composite powders with a calculated (in the assumption of the formation of titanium carbide of the equiatomic composition) with a content of a titanium bond of 30 to 60 volume % were obtained by layer-by-layer burning in argon medium of cylindrical compacts of powder mixtures of titanium (<160 μm) and carbon black (P-803). SHS powders were diluted with titanium powder to an integrated titanium content of 80% by volume in the coating in order to optimize melting process. The powder mixtures were melted on the substrates of titanium alloy on a special installation that includes a vacuum chamber with a pumping system, a powder dosimeter with a dosage control device, a manipulator and an electron gun with a high-voltage power supply and an electronic beam control system.

The structure and morphology of powders obtained by SHS method, as well as the structure and mechanical properties of surfacing with these powders were studied. It was demonstrated that the structure of surfacing is inherited from the powder (Fig. 1).

The structure of the coating formed by the electron beam surfacing of SHS composite powders "titanium carbide - titanium binder" is determined, first of all, by the degree of development of the recrystallization of the carbide phase in the melt of the surfacing bath. When surfacing with a mixture of large initial carbides of non-stoichiometric composition, the deposited coating has a structure with a bimodal distribution of the carbide phase represented by the initial carbides and recrystallized carbides of an order of magnitude smaller than the original ones. When surfacing with a mixture containing a composite powder with a fine carbide phase, a more significant recrystallization occurs.

With the appropriate selection of the technological mode of surfacing, it is possible to preserve the carbide inclusions of the fusion composite powder and, thus, the purposeful adjustment of the coating structure, namely the dispersion of the hardening carbide phase. The hardness and abrasive wear resistance of electron beam coatings deposited by SHS with composite powders "titanium carbide-titanium" are determined by structural characteristics, in particular - by the density (absence of internal porosity) of carbide inclusions in the titanium matrix and their dispersion. The main mechanism of abrasive wear of the deposited coatings is the wear of the intercarbide interlayers of the titanium bond, followed by the ejection of carbide inclusions with a weakened bond to the matrix.

Electron beam surfacing of coatings with composite powders "titanium carbide - titanium" provides an increase in hardness by 3.7 (2.2) times in comparison with titanium VT1-0 (alloy VT6), and abrasion resistance in 21.6 (13.8) times, respectively.



a b

Fig. 1. Microstructure of the “TiC + 60 vol.% Ti” powder (a) and electron beam coating with this powder (b)

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