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Bilayer coatings obtained by a combination of electro-spark deposition, magnetron sputtering and pulsed arc evaporation

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Deposition of multilayer and functionally graded coatings can improve erosion, corrosion, abrasion and fatigue strength of machine parts and structural materials. Herein two-layer coatings were deposited using a combination of different methods: electro-spark deposition (ESD), pulsed arc evaporation (PAE), and magnetron sputtering (MS). Using this approach, it is possible to combine the main advantages of each method when depositing coatings in a single technological cycle. The surface treatment was performed in a mixture of various gases at a pressure from atmospheric to 0.01 Pa. ESD in a reaction medium at a reduced pressure, optimal for gas discharge, is characterized by high process efficiency. The gradual decrease in pressure to 0.1 Pa, which is a characteristic of PVD processes, and the gradual increase in the distance between the electrode and the surface, provides a transition to the process of PAE or MS. Two-layer coatings have several advantages over their single-layer counterparts: ESD layer provides exceptionally high adhesion and a sufficiently high coating thickness (up to 100 μm), whereas the upper, more thinner layer (up to 10 μm), deposited by PAE or MS, ensures high mechanical and tribological properties. Two examples are considered. (1) Bilayer coatings in which the bottom Ti-C-Ni-Fe layer obtained by ESD using TiCNi electrode and adjacent to steel substrate has a relatively high thickness and toughness, whereas the top Ti-C-Ni-Al layer fabricated by MS of TiCNiAl target has enhanced tribological properties and high corrosion resistance. The chemical, mechanical, and tribological characteristics of such bilayer coatings are compared with their single-layer Ti-C-Ni-Fe and Ti-C-Ni-Al counterparts. (2) Two-layer WC/C coatings in which the sublayer, consisting of TiC, WC_{1-x}, α- and β-Ti phases, was formed by ESD and the top layer, consisting of W_2C and WC_{1-x} phases, was fabricated by PAE either in argon or in nitrogen atmosphere.

Keywords
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