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COLD SPRAY METHOD FOR "ALUMINUM-ALUMINA-CNF" COMPOSITE PREPARATION*

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One of the possible approaches to enhance hardness of ductile aluminum alloys are different surface treatment, among them: laser welding deposition [1], thermal spraying [2], anodizing [3], and others. The cold spray method is a relatively new manufacturing process [4] during which particles do not reach the melting point and form a solid material due to the high kinetic energy of collision [5]. Present study is aimed to study the synthesized coatings from aluminum - alumina - carbon nanofibers (CNF) composite material using cold spray method. In our previous studies, binary composites (aluminum-carbon nanomaterial or alumina-carbon nanomaterial) were used while the present study considers a ternary system in the range of CNF concentrations of 0.5-1.5 wt. %. The investigation considers the process of preparation of the specified composite by ball milling as well as the process of synthesis of a solid object (coating) by cold spray method. It also should be noted that both the original aluminum powder and the substrate were made from the same alloy. Therefore, the present study is of high practical importance since the considered composites and synthesis regimes can be used to increase the surface properties of a particular aluminum alloy. Feedstock powder was prepared using planetary mill, that allowed a uniform distribution of CNFs on the aluminum particles' surface (see Figure 1).

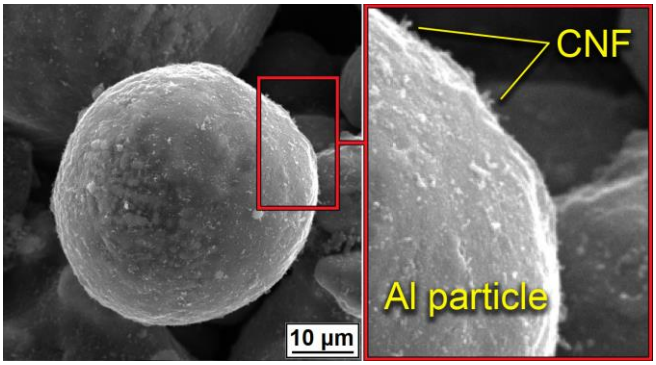

Fig.1. Distribution of CNF on the surface of Al powder after mixing.

The different combinations of hard alumina micron-sized particles and soft micron-sized aluminum particles as well as the hard nano-CNF lead to different morphology of the synthesized coatings. There are limits from both sides: low content of hard particles will not lead to sufficient improving of the surface mechanical properties, but too high content of alumina could not form the coating because of poor bonding and adhesion between brittle Al_2O_3 particles. The microstructure of samples synthesized by cold spray method are also affected by CNF content due to an increase in the bulk density of the feedstock powder, as well as high antifriction properties of carbon. CNF content of 1.5 wt. % led to 20 % increase in the microhardness of samples which is due to the mechanism of dispersive strengthening.

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