Nanostructured surfaces

Modifying of the Al2024 alloy surface by carbon nanotubes

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Within the past years some trials have been made to incorporate multi-wall carbon nanotubes (MWNTs) into aluminum alloys matrix via powder based methods because of their exceptionally light weight, high strength and large aspect ratio. However, very few studies using MWNTs as a surface composite reinforcement.

In our present work the first effort was made to modify Al2024 alloy surface reinforced with MWNTs using ultrasonic impact treatment (UIT). UIT of the alloy surface was performed using an instrument described elsewhere [1].The influence of UIT in an inert atmosphere on the structure, phase composition and micromechanical properties of the alloy surface without and with composite layers was investigated. Studies were performed on specimens of the precipitation hardened ccommercial Al2024 alloy. MWCNTs were fabricated by the well-known catalytic chemical vapor deposition method.

It was observed that Al/MWNTs composite in the near surface layers of the Al2024 alloy was formed thanks to the UIT induced mechanical mixing of the deposited carbon reinforcing particles. The surface layer microstructure of this alloy induced by the UIT consists of the nanocrystalline structure at the top surface with an average grain size of about 20-50 nm at a depth of approximately 4-8 μm (size of the initial grain is 3-5 μm). The thickness of the modified layer is 230 μm (without MWNTs -140 μm).

Finally, microhardness and wear resistance of the composite surfaced layer have been evaluated in details and correlated with the duration of treatment. Maximal effect of the microhardness increasing under UIT makes as a result ~250% in comparison with the initial state of the alloy. Our studies have reported a decrease in the coefficient of friction by ~2 times and increase in the wear resistance by ~3 times with addition of MWNTs to the alloy surface compared to as-received Al2024 alloy. Several hypotheses about the possible reinforcing mechanisms that could explain the enhanced the surface mechanical properties Al/ MWNTs composites are discussed.

1. *Mordyuk B.N., Prokopenko G.I.* Ultrasonic impact peening for the surface properties' management // J. Sound Vib. -2007.-**308**.- P. 855-866.