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Adhesion and hardness of duplex treated MoN-Cu coatings deposited by ICP assisted reactive sputtering

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The effects of plasma nitriding on the adhesion and hardness of MoN-Cu coatings deposited on AISI M2 steel substrates were studied. Plasma nitriding was conducted at > 650 K, and the subsequent deposition of MoN-Cu coatings was performed by inductively coupled plasma sputtering. The structure and mechanical properties of the nitrided substrates and MoN-Cu coatings were studied by X-ray diffraction (XRD), atomic force microscopy (AFM), micro hardness test, and scratch test. X-ray diffraction of the nitride substrate showed no particular diffraction peaks for nitrided compunds, while AFM revealed an overall increase in surface roughness. Inconsistent hardness values of the coatings were obtained due to the increased surface roughness. In order to obtain more reliable hardness values, two approaches were conducted: direct removal of the surface roughness and modification of the Oliver-Pharr method. The hardness of the substrate surface had an overall increase. From the natural hardness of 10 GPa of the substrate, surface hardness increased to 16 GPa at 750 K and dropped to 11 GPa at 850 K. Advanced adhesion strengths were monitored in the MoN-Cu coatings deposited on the nitrided substrates. MoN-Cu coating deposited on the substrate nitride at 750 K displayed a critical load of 65 N from the scratch test. Compared to samples of other nitriding temperatures, spallation and buckling were less observed even at 80 N of induced load.

Keywords
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