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Effect of nitrogen partial pressure on microstructure and mechanical properties of Mo-Cu-V-N composite coatings deposited by HIPIMS

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Abstract: The Mo-Cu-V-N composite coatings were deposited by high power impulse magnetron sputtering (HIPIMS) using a single Mo-Cu-V spliced target in an Ar-N₂ atmosphere. The effect of nitrogen partial pressure on the microstructure, mechanical properties and tribological behavior of the coatings was investigated. The results indicated that the Mo-Cu-V-N composite coatings exhibited (111), (200) and (220) diffraction peaks of fcc B1-MoN phase, and then the phase structure changed to hex δ -MoN phase when the N₂ partial pressure was higher than 0.35 Pa. All the coatings showed a relatively smooth surface and columnar-type microstructure. As the N₂ partial pressure increased from 0.11 Pa to 0.35 Pa, the hardness showed a slight decrease from 20.6 GPa to 16.4 GPa, which would be due to the relaxation of residual stress, and then rebounded to 17.1 GPa with the formation of mixed phases of B1-MoN and δ -MoN. All of the Mo-Cu-V-N composite coatings exhibited a relatively low friction coefficient of approximately 0.3 and the wear rate was in the small range of 8.9×10^{-17} m³/N·m to 17.3×10^{-17} m³/N·m. The formation of mixed lubricious oxides of MoO₃ and V₂O₅ was expected to account for the excellent tribological properties.

Keywords: Mo-Cu-V-N; HIPIMS; Spliced target; N₂ partial pressure; Tribological properties.

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