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Structure, Morphology, and Mechanical Properties of High Temperature Resistant Ta(-Hf)-C/a-C:H Coatings Deposited by Conventional DC-Magnetron Sputtering or HiPIMS

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Abstract

Transition metal carbide films have been a hot topic for industrial applications and academic research for decades due to their high hardness, high melting point and excellent chemical stability. The metal carbide/amorphous carbon nanocomposites are widely used as protective coatings on surfaces of precision steel components, cutting tools and machinery components. TaC/a-C:H films with varying carbon content within a narrow window were deposited employing HiPIMS in the Ar/C_2H_2 atmosphere. The DC deposited TaC/a-C:H reference films were prepared under the same deposition parameters for comparison. Analysis and comparison of the chemical bonding state, structure, mechanical and tribological properties, and oxidation resistance of the films were conducted, with the aim of emphasizing the differences in the nanocomposite structure and properties of the films correlated to deposition conditions. It reveals that the HiPIMS deposited TaC/a- C:H films outperform the DC deposited ones, exhibiting higher hard-ness and toughness, lower friction coefficient and wear rate, and stronger oxidation resistance.The results obtained on Ta, Hf, TaCx, HfCx, and $Ta_xHf_{1-x}C_y$ coatings, deposited by reactive pulsed Direct Current (DC) magnetron sputtering of Ta or Hf pure metallic targets in Ar plus CH_4 gas mixtures are also described.