Effects of processing parameters on the fabrication of TiCrSiN thin films deposited by a hybrid HiPIMS and RF sputtering system

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ABSTRACT

High power impulse magnetron sputtering (HiPIMS) is a relatively new physical vapor deposition technology, which is characterized for its ultra-high peak current, peak power density and high-density plasma to achieve unique thin film mechanical properties, such as high hardness, good adhesion and good wear resistance. In this work, a radio frequency (RF) and HiPIMS hybrid coating system was used to deposit TiCrSiN coatings with higher deposition rate. The TiCr and Si targets were connected to the HiPIMS and RF power supplies, respectively. The phase of each coating was studied by means of the X-ray diffractometer. The microstructures of thin films were examined by the field-emission scanning electron microscopy. Atomic force microscopy was used to characterize the surface morphology. The nanoindentation and scratch tests were used to evaluate the hardness and adhesion properties of thin films, respectively. The pin-on-disk wear test was employed to study the tribological property of coating. Effects of processing parameters, including duty cycle and pulse frequency of HiPIMS power on the microstructure, mechanical and tribological properties of TiCrSiN coatings were further discussed in this work.

Keywords: High power impulse magnetron sputtering, HiPIMS, TiCrSiN, RF sputtering, duty cycle, pulse frequency, tribological properties