Influences of frequency and duty cycle on the mechanical properties of TiCrBN thin films grown by a hybrid superimposed high power impulse magnetron sputtering and radio frequency sputtering technique

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Abstract

The high power impulse magnetron sputtering (HIPIMS) technique has been studied intensively due to its extremely high peak power density to grow thin films with dense microstructure and excellent mechanical properties. Lots of efforts have been made to improve the low deposition rate of HIPIMS technique. In this study, a hybrid coating system consisting of a radio frequency power supply and a superimposed HIPIMS system was used to deposit the TiCrBN coatings with higher deposition rate. 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. It can be found that the deposition rate increased greatly due to the superimposed module and also the addition of RF sputtering. Influences of the frequency and the duty cycle of HIPIMS on the microstructure, chemical composition and mechanical properties were studied in this work.

Keywords: hybrid coating system, superimposed high power impulse magnetron sputtering, radio frequency, CrTiBN thin film, duty cycle, nanoindentation, scratch