Influence of duty cycle on microstructure of TaN coatings prepared by high-power pulse magnetron sputtering technique

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Abstract

Nowadays quality requirements, such as higher hardness, wear resistance, sufficient toughness and adhesion strength are gathering much more attention for transition metal nitride, TMN, hard coating field. The selection of materials among various possible coating systems and related manufacturing processes is quite a challenge and requires careful consideration on the properties in the developing choices. Among TMNs, with high hardness, excellent tribological behavior, thermal and electrical performance, TaN has been chosen as a good protective layer for working components in versatile applications. In this study, TaN thin films are sputtered through high-power pulse magnetron sputtering, HPPMS, at different duty cycle. At a fixed power of 200 watt and a Ar/N_2 ratio of 18/2 sccm/sccm, the frequency and pulse off time, the related duty cycle and the shape of the current and voltage are manipulated. With the decrease of the duty cycle, the peak power increases when the high energy is applied in a short period of time, leading to an increase in ionization rate and plasma density. For such increase in plasma density, the grain size of TaN film is reduced within a well-defined columnar structure. This leads to the improvement in mechanical behavior, elastic modulus, and wear resistance of the films.

Keywords : TaN , protective, HPPMS, duty cycle, mechanical properties