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Mechanical and tribological properties of TiN/CrN composite films deposited by Multi-pulse HIPIMS

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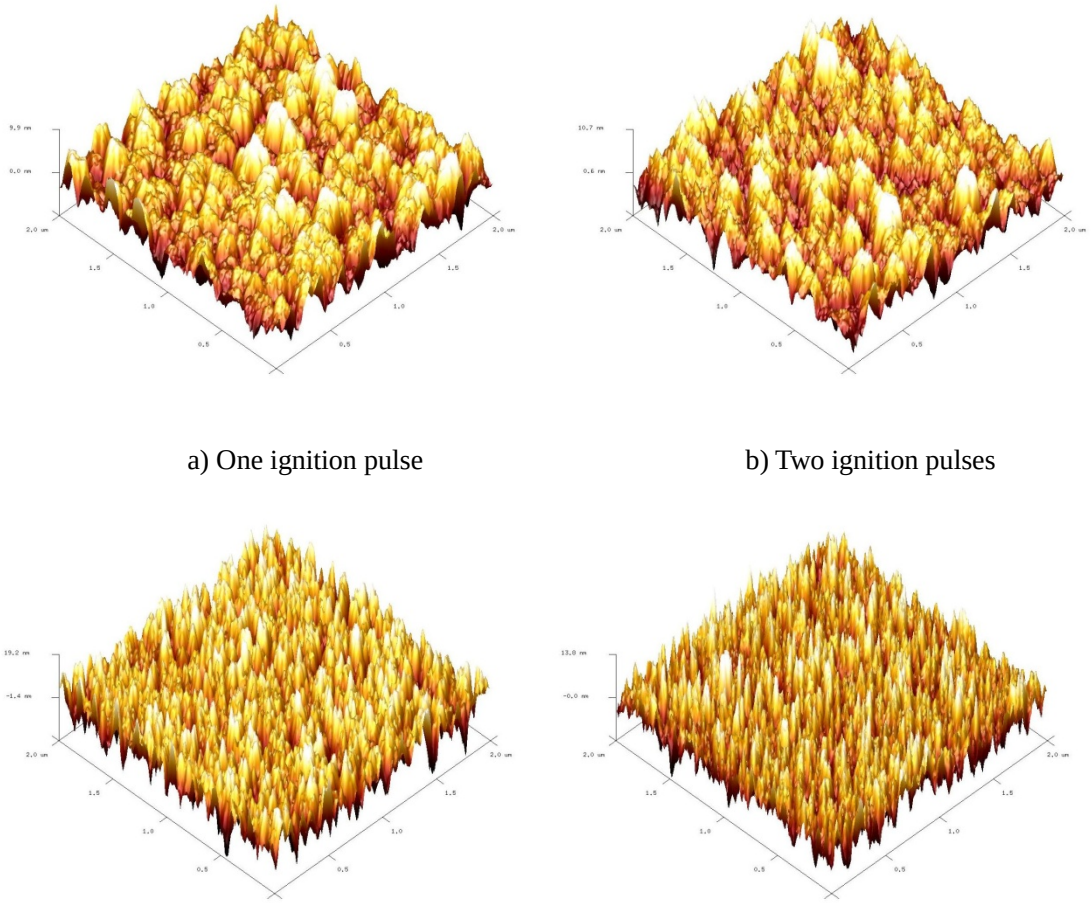
Abstract: High power magnetron sputtering has advantage of dense layer, good adhesion and film uniformity, but its low deposition rate becomes an important factor that restricts its development [1, 2]. Aimed at the shortcoming of high power magnetron sputtering technology, many technologies have been promoted to improve the deposition rate [3-5]. A new type of multi pulse high power magnetron sputtering technique has also been present. High voltage ignition pulse excites high density plasma, and work low voltage word pulse maintains plasma discharge, at the same time reducing the effect of target attracting ions.

The new multi pulse high power magnetron sputtering power source is connected with the Ti target, and the DC magnetron sputtering power source is connected with the Cr target. Effect of ignition pulse on the microstructure, structure and properties of TiN/CrN films has been researched. The mechanical and tribological properties of the TiN/CrN films were studied by various techniques, including atomic force microscope (AFM), X-ray photoelectron spectroscopy (XPS), and scanning electron microscopy (SEM). At the same time, hardness, indentation, and friction and wear characteristics under different ignition pulse parameters are also measured.

Compared with conventional methods, the TiN/CrN films prepared by multi-pulse HIPIMS were dense without defects, and the surface composed many dendritic islands with a little surface roughness but no macroparticles (Fig.1). The results demonstrated that the hardness and adhesion strength increase with the increase of the number of ignition pulses, which is up to 1312.3HV and HF1 class.

The new multi-pulse high power magnetron sputtering is a promising technology to achieve high ionization and high deposition rate. The TiN/CrN films prepared by multi-pulse HIPIMS have good mechanical and tribological properties.



a) One ignition pulse b) Two ignition pulses

c) Three ignition pulses d) Four ignition pulses

Figure 1 AFM surface micrograph of TiN/CrN films fabricated by different multi pulse ignition

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