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# Modulation Effects of Controllable Waveform configuration of Pulsed Bias on Microstructure and Properties of CrN Films by Magnetron Sputtering

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## Abstract

The application of bias voltage to substrate can significantly improve the film performance. New bias power supply with controllable waveform configuration has been developed. The CrN films are deposited on 201 stainless steel samples by DC magnetron sputtering deposition technology coupled with variable wave shape of sample bias using specially designed power supply. The microstructure, surface morphology, phase structure, Nano-hardness, and electrochemical properties of the coatings were characterized by scanning electronic microscope (SEM), atomic force microscope (AFM), X-ray diffraction (XRD), Nanoindenter and electrochemistry tester respectively. SEM results indicate that the surface morphology of CrN film is mainly featured by island-like structure, and with discrete step bias waveforms which are produced by controlling the rising and falling edge of pulsed bias the grains are finer and more homogeneous. AFM results suggest that surface roughness of the films is greatly reduced with discrete steps bias waveforms. The results also show that compared to the traditional rectangular shape of bias waveform, sample bias with discrete steps can lead to better mechanical and electrochemical performance of the films.

**Keywords:** controllable bias, magnetron sputtering, CrN films, modulation effect

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