# Mechanical property evaluation of ZrCN films deposited by a hybrid superimposed high power impulse- middle frequency sputtering system

**Qi-Lin Tang[1], Yu-Chuan Wu[2], Jyh-Wei Lee[3, 4, 5]**

[1] Institute of Materials Science and Engineering, National Taipei University of Technology, Taipei, Taiwan
[2] Department of Materials and Mineral Resources Engineering, National Taipei University of Technology, Taipei, Taiwan
[3] Department of Materials Engineering, Ming Chi University of Technology, New Taipei, Taiwan
[4] Center for Thin Film Technologies and Applications, Ming Chi University of Technology, New Taipei, Taiwan
[5]College of Engineering, Chang Gung University, Taoyuan, Taiwan

[†]Presenter: **Qi-Lin Tang**
[*]Corresponding author's e-mail: jefflee@mail.mcut.edu.tw

## ABSTRACT

High power impulse magnetron sputtering (HiPIMS) is a relatively new physical vapor deposition technology, which is characterized by 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. Recently, a superimposed HiPIMS-middle frequency (MF) power system has been proved to increase the deposition rate of HiPIMS technique effectively. In this study, a superimposed HiPIMS-MF power system was used to deposit the ZrCN films with different carbon content on hardened tool steel disks and silicon wafer substrates. The phase of each coating was studied by means of the X-ray diffractometer. The microstructures of thin films were examined by a field-emission scanning electron microscopy. Atomic force microscopy was used to characterize the surface morphology and roughness. 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 carbon content on the microstructure, mechanical and tribological properties of ZrCN coatings were further discussed in this work..

Keywords: superimposed high power impulse magnetron sputtering, HiPIMS, middle frequency, ZrCN, nanoindentation