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# Microstructures and Mechanical properties of Ti/TiC/Ti-DLC films deposited by hybrid High-power Magnetron sputtering (HPPMS)

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## Abstract

The titanium/titanium carbide/titanium diamond-like-carbon (Ti/TiC/Ti-DLC) films were deposited by HPPMS (high power pulsed magnetron sputtering) process and mid-frequency magnetron sputtering (MFMS) using Ti and C targets with the purity of 99.99% on the surface of stainless steel and silicon as substrate. Compared with direct current magnetron sputtering (DCMS), hybrid HPPMS plus MFMS achieves dense and void-free films. The structures, compositions and surface morphologies of the samples were characterized by X-ray diffraction, scanning electron microscope, and X-ray photoelectron spectrometer. The mechanical properties of Ti/TiC/Ti-DLC films are investigated by micro hardness tester, friction wear test instrument and scratch tester. The results show that the depth profile of the films agrees well with the designed substrate/transition layer/DLC and that a gradient transition was observed with strong interfacial adhesion. The TiC layer grows with weak columnar crystal structure. In the Ti-DLC film, Ti element was found to be doped into amorphous DLC layer in the form of TiC nanoparticles. The proper thickness of Ti/TiC transition layer may effectively enhance the adhesion between the film and substrate

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