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Effect of substrate current on the microstructure and corrosion behavior of TiCN coating deposited by pulse enhanced arc evaporation

CHUNZHI GONG[1], Yinghe Ma[2], Jianping Xu[3], Chunwei Li[4], Xiubo Tian[2]

[1]Harbin Institute of Technology, Harbin, China [2]State Key Lab. of Advanced Welding and Joining, Harbin Institute of Technology, Harbin, China [3]Department of Materials and Chemical Engineering, Heilongjiang Institute of Technology, Harbin, China [4] College of Engineering and Technology, Northeast Forestry University, Harbin, China

chunzhigong@163.com

Pulse enhanced arc evaporation(PEAE) is a new approach in PVD which utilizes direct-current(DC) as well as pulsed operation of the arc sources. The pulsed high current produces much higher plasma density, which leads to superior growth dynamics and microstructure of deposited films. And the better surface properties are speculated. Compared with the traditional DC cathodic arc, PEAE is featured by larger substrate current in the pulse period. This may generate more energetic particles, which may aid in densifying the growing films and improving corrosion resistance and so on. TiCN films are synthesized on stainless steel by PEAE technique. The evaporation arc runs with a continuous base current of 50A, superposed with a pulse current of 50-400 A at pulse frequency of 500 Hz and pulse width of 0.5 ms. In the study, the DC arc current is constant and the pulse arc current varies to achieve different substrate current. The results have demonstrated that the substrate current rises to about 5-6 times compared to DC vacuum arc with the same average current. The microstructure becomes denser. The surface roughness and the number of macroparticles decrease. Also the TiCN films grow with (111) or (220) of preferential orientation affected by the pulse operation. The PEAE technique has improved the corrosion resistance of the stainless substrate, although the corrosion behaviors of TiCN coatings are not much dependent on substrate current. The corrosion current is about 3.0E-6 A and the corrosion potential is about -0.4981 V for TiCN coating fabricated by PEAE mode, while they are about 4.0E-6 A and -0.6185 V respectively by DC arc evaporation. It may be speculated that PEAE is an effective tool to produce hard coatings with much denser microstructure.

Keywords
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