Effect of TiN/Ti multilayer coatings with different microstructure on corrosion and wear properties of high-strength steel

Kai Zhou[1]，Daoxin Liu[1]，Xiaohua Zhang[1]，Kaifa Fan[1]

[1]Author's affiliation and full address: College of Civil Aviation, Northwestern Polytechnical University, Xi'an 710072, China

Presenter's e-mail address: kaizhou961@outlook.com

Abstract: High-strength steel, which is widely used in aircraft bearing components, are challenged by corrosion and wear when exposed to the marine environments. In this work, the TiN/Ti multilayer coatings with two types of microstructures were prepared on the surface of 30CrMnSiA high-strength steel using arc-ion plating. The two coatings had the same modulation ratio (TiN and Ti = 9 : 1), thickness (17 μm), but different modulation periods of 3.5 μm (4 layers) and 1.2 μm (12 layers), respectively. The electrochemical results showed that the open circuit potentials of 4-layer and 12-layer coating were 147 mV and 255 mV higher than the substrate. The corrosion potentials and corrosion current densities of 4 layers and 12 layers were -0.52 V, 5.03 E^{-8} A/cm^2 and -0.41 V，4.60 E^{-9} A/cm^2, respectively. And the corrosion current density of 12 layers was 77.5% lower than that of the substrate. The wear results showed that the coefficient of friction (CoF) of 4 layers and 12 layers coatings were 0.55 and 0.49, respectively, with a reduction of 21.4% and 30% compared to the substrate. The wear results showed that the multilayer coatings obviously improved the anti-wear properties of steel. The thinner modulation period of the TiN/Ti multilayer coating could inhibit the penetration of corrosive media into high-strength steels and increase the toughness of the multilayer coatings, thereby improving the corrosion and wear resistance of the steel.

Keywords: TiN/Ti coatings, Arc-ion plating, Modulation period, Electrochemical corrosion, Wear

Acknowledgements:

This work was supported by National Natural Science Foundation of China (52271071) and National Science and Technology Project (J2019-I-0016-0015, J2019-IV-0012–0080).