Short Communication

Effect of Low Temperature Plasma Nitriding on Salt Spray Corrosion and Electrochemical Corrosion of H13 Hot Work Mould Steel

Zhao Wen, Kong Dejun *

School of Mechanical Engineering, Changzhou University, Changzhou 213164, China

*E-mail: kong-dejun@163.com

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A nitrided layer was fabricated on H13 hot work mould steel using a low temperature plasma nitriding (LTPN). The morphologies, distributions of chemical elements and phases of obtained nitrided layer were characterized using a scanning electron microscopy (SEM), energy dispersive spectrometer (EDS) and X-ray diffractometry (XRD), respectively, its nanohardness and modulus of elasticity was measured using a nanoindentation, and its bonding strength was tested using a scratch test. The corrosion properties of substrate and nitrided layer were analyzed using a salt spray corrosion and electrochemical corrosion. The results show that the nitrided layer is primarily composed of nitrides, whose nanohardness and modulus of elasticity is 11.0 and 213.0 GPa, respectively, and the average bonding strength of nitrided layer is 50.23 N measured by scratch test, showing high bonding strength between the nitrided layer and the substrate. The corrosion products on the substrate and nitrided layer after SSC are γ -FeOOH and α -FeOOH, of which the α -FeOOH prevents further the nitride layer and substrate from corrosion. The corrosion potential of substrate and nitrided layer is -0.79 and -0.65 V, respectively, exhibiting that the nitrided layer has higher electrochemical corrosion resistance. The capacitive impedance loop of nitrided layer is significantly larger than that of substrate, its lowest measurement frequency $|Z|_{0.01\text{Hz}}$ and low-frequency phase angle values are also greater than the substrate, showing that the nitrided layer is acted as an effective anti-corrosion barrier layer to prevent corrosive ions from entering into the substrate, which increases its electrochemical corrosion resistance.

Keywords: low temperature plasma nitriding (LTPN); nitrided layer; salt spray corrosion (SSC); electrochemical corrosion; corrosion mechanism

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