Preparation and Corrosion Resistance of Superhydrophobic Ni-P-Al₂O₃ Coating on Pipeline Steel in simulated alkaline soil solution

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Superhydrophobic coating with good corrosion resistance has become a research hotspot. The nano-Ni-P-Al₂O₃ composite coating was prepared on the surface of pipeline steel by electrodeposition technology with nano-Al₂O₃ particles into the bath, which aimed to reduce the corrosion of pipeline steel in the alkaline soil environment. The micromorphologies, hydrophobicity, and corrosion resistance of the electrodeposited composite coatings at different concentrations of nano-Al₂O₃ (0, 5, 10, and 15 g/L) were studied by scanning electron microscope (SEM), energy disperse spectroscopy-mapping (EDS-mapping), contact angle, and electrochemical measurements. The papillary protrudes grew on the surface of the coating with the increase of the nano-Al₂O₃ content. The coating surface was uniform and compact when the nano-Al₂O₃ particle concentration was 15 g/L. The nano-Ni-P-Al₂O₃ composite coating was superhydrophobic, and the maximum contact Angle was 158.3°. The electrochemical test results showed that the shape characteristics of EIS and potentiodynamic polarization curve of the coating were not changed by the content of nano-Al₂O₃. With the increase of the nano-Al₂O₃ concentration, the capacitive arc radius and E_{corr} of the composite coating increased, while I_{corr} decreased, which indicated that the corrosion resistance of the composite coating in the simulated soil solution was gradually enhanced. The coating with 15 g/L nano-Al₂O₃ particles had the best corrosion resistance, and the corrosion rate was significantly lower than that of X100 pipeline steel.

Keywords: Superhydrophobic, nano-Al₂O₃, composite coating, corrosion resistance

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