A Comparison of the Corrosion Resistance and Wear Resistance Behavior of Cr-C, Ni-P and Ni-B Coatings Electroplated on 4140 Alloy Steel

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Different coatings such as Cr-C coatings (chromium sulfate bath), Cr-C coatings (chromium chloride bath), Ni-P coatings and Ni-B coatings are electrodeposited on 4140 alloy steel, respectively. The corrosion and wear resistance of these coatings are studied. The experimental results show that the Ni-B coatings has the highest hardness (approximately at 951 Hv) and the best adhesion strength (approximately at 11 MPa), these two excellent properties lead to the Ni-B coatings has the lowest wear rate (approximately at $0.66 \times 10^{-6} \text{ mm}^3/\text{Nm}$). According to the potentiodynamic polarization analysis results, it shows that Ni-B coatings has a better corrosion resistance ($i_{\text{corr}} = 9.62 \times 10^{-7} \text{ A/cm}^2$) than that of Cr-C coatings due to its crack-free structure and higher adhesion strength. All experimental results indicate that Ni-B coatings is the most suitable coatings which can be used to protect 4140 alloy steel substrates from corrosion and wear damages, and enhance the application of 4140 alloy steel in industry.

Keywords: adhesion strength; corrosion resistance; contact angle; Ni-B coatings

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