The Effect of Heat Treatment on the Corrosion Resistance, Mechanical Properties and Wear Resistance of Cr–C Coatings and Cr–C/Al₂O₃ Composite Coatings Electrodeposited on Low Carbon Steel

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In order to enhance the corrosion resistance, mechanical properties and wear resistance of Cr–C thin films, Cr–C/Al₂O₃ composite coating is electrodeposited from the Cr(III) plating bath containing Al₂O₃ particles in this study. The Cr–C/Al₂O₃ composite coating has the best corrosion resistance which i_{corr} is approximately at 2.84×10^{-7} A/dm², but the corrosion resistance will reduce with an increase of heating temperature due to the formation of cracks within Cr–C/Al₂O₃ composite coatings. The effect of heat treatment on the mechanical properties and tribological behavior of Cr–C coating and Cr–C/Al₂O₃ composite coating is examined. The experimental results show that the hardness of Cr–C coating and Cr–C/Al₂O₃ composite coating increased with a heat treatment process due to the precipitation of chromium carbide and chromium oxide. The incorporation of Al₂O₃ particles into the Cr–C matrix can significantly enhance the micro-hardness and reduce the wear rate of Cr–C/Al₂O₃ composite coating as compared to that of Cr–C coating. The highest micro-hardness of Cr–C/Al₂O₃ composite coatings (22.85 GPa) is achieved after the coatings heated at 600 °C. The co-deposition of Al₂O₃ particles within the Cr–C deposits will significantly improve the wear resistance of coatings and reduces the wear weight loss. The lowest specific wear rate (8.8×10^{-7} mm³/Nm) was obtained for the Cr–C/Al₂O₃ composite coatings heat treated at 200 °C.

Keywords: Cr–C/Al₂O₃ composite coating, wear rate, Cr(III) bath, heat treatment

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