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ORIGINAL CONTRIBUTION

Corrosion Behaviour of Borohydride Reduced Ni–B, Ni–B–W, Ni–B–Mo, Ni–B–W–Mo Coatings with Varying Composition: A Comparison

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Abstract The borohydride reduced binary (Ni–B), ternary (Ni–B–W, Ni–B–Mo) and quaternary (Ni–B–Mo) alloy coatings are deposited by chemical deposition method. The same coatings are used to study the variation in corrosion behaviour of the coatings with the inclusion of W, Mo individually or together. The coatings are deposited over steel substrate with changing bath composition to study the role of coating bath parameters on corrosion resistance behaviour. The coating characterisation based on roughness, morphology and phase structure are performed using stylus type roughness tester, scanning electron microscopy (SEM) and x-ray diffraction (XRD), respectively. A potentiostat is employed to measure corrosion response of the coatings by potentiodynamic polarisation (PDP) and electrochemical impedance spectroscopy (EIS) test method. The tests are carried out using a corrosive medium of 3.5% NaCl solution. All the coatings are observed to exhibit cauliflower like surface morphology. The roughness of the coatings increases with bath parameter concentration. The corrosion resistance of the Ni–B–Mo coatings are found to be better than other three variants till mid-level of concentrations. The Ni–B coated specimens show higher corrosion resistance at higher level of concentrations compared to the ternary and quaternary coatings.

Keywords Electroless coating · Ni–B · Ni–B–W · Ni–B–Mo · Ni–B–W–Mo · Bath composition · Corrosion resistance

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Introduction

The coatings are generally used as a protective layer over a substrate to prevent the base material from harsh environment or to achieve a surface property which the base material does not possess. Different soft coatings are used for packaging, providing soft touch feelings in interior decorations, mobile phone covers etc. The hard coatings are used widely starting from domestic purposes to decorate or as protective layer in automobile industries over the base metal surface to protect against corrosion, abrasion etc. These coatings may be deposited over the base metal using different methods like electrodeposition, PVD, CVD, electroless methods. The electroless nickel-based coatings are being used widely for their excellent physical, mechanical, and tribological behaviours. Thin film coatings may be developed using chemical deposition process or electroless coating methods. Thin film nickel-based coatings are deposited using electroless method to make smooth surface and improve corrosion behaviour, surface hardness and the wear resistance.

The electroless nickel-boron (ENB) coatings are well known for their tribological behaviour. The ENB coatings are widely known for its friction and wear performance because of its cauliflower like morphology [1–3] and electroless nickel-phosphorous coatings are well known for their mechanical behaviour [4]. The addition of boron or phosphorous like hard elements into coating enhances the hardness of steel specimens [4, 5]. Chemically deposited ENB coated specimens are evaluated for plating rate, thickness, morphology, etc. [4–9]. Coating characteristics are known to vary with composition and operating conditions [1–6]. The coating characteristics may also be altered upon heat treatment [8, 9]. The amorphous phase of coatings in untreated conditions transform into crystalline structure after heat treatment [5–9]. These are also found to depend on coating

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