The Effect of Boron Content, Crystal Structure, Crystal Size on the Hardness and the Corrosion Resistance of Electrodeposited Ni-B Coatings

J.R. López^{1,2}, P.F. Méndez^{1,2}, J. J. Pérez-Bueno¹, G. Trejo¹, G. Stremsdoerfer³, Y. Meas^{1,*}

¹ Centro de Investigación y Desarrollo Tecnológico en Electroquímica (CIDETEQ), Parque Tecnológico Querétaro, Sanfandila, Pedro Escobedo, Querétaro, P.O. Box. 76700, México

² Universidad Autónoma de Sinaloa, Facultad de Ciencias Químico Biológicas, Ciudad Universitaria, Culiacán Sinaloa, CP 80000, México

³ Ecole Centrale of Lyon, Tribological & Dynamical Systems Laboratory, 36 Avenue Guy de Collongue, P.O. Box 163, 69134 Ecully, France

*E-mail: yunnymeas@cideteq.mx

doi: 10.20964/2016.06.23

Received: 9 November 2015 / Accepted: 3 December 2015 / Published: 4 May 2016

In this work Ni-B coatings with different boron content (0.6 to approximately 3.4 wt.%) were produced by electrodeposition from a sulfamate bath containing dimethylamineborane (DMAB). The influence of boron concentration on the structure, morphology, crystal size and hardness of the coatings was investigated using plasma emission spectroscopy (ICP), scanning electron microscopy (SEM) and X-ray diffractometry (XRD). Crystal size and structure were evaluated in both as-plated and thermal-treatment conditions to establish their relationship to the hardness of the coating. The corrosion resistance of the coatings was evaluated in 5% NaCl, employing electrochemical polarization measurement and salt spray testing. The results showed that the increased hardness of the as-plated Ni-B coatings is primarily caused by a reduction in crystal size rather than boron composition. Thus, Ni-B coatings can be produced with high hardness (716 ± 22.5 HV) with a relatively low boron composition (1.8 wt. %). On the other hand, Ni-B coatings produced after thermal treatment showed that hardness depends on two factors: composition (Ni_3B) and crystal size, achieving the highest hardness at 350°C (1105 ± 19.4 HV). Unless the obtained Ni-B coatings showed a high hardness, the corrosion resistance is low due to the presence of cracks.

Keywords: Ni-B, electroplating, hardness, corrosion, sulfamate bath

[FULL TEXT](#)

© 2016 The Authors. Published by ESG (www.electrochemsci.org). This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).