Pulsed current electrodeposition of Ni/W-TiN coatings on X52 steel substrate. Surface characteristics and corrosion resistance

Lixin Wei¹, Yu Zhang^{1,*}, Guifen Liu², Chunyang Ma³, Wei Zheng⁴

¹ School of Petroleum Engineering, Northeast Petroleum University, Daqing 163318, China;

² Bidding Center, Jidong Oilfield Company, Tangshan 063004, China

³ College of Mechanical Science and Engineering, Northeast Petroleum University, Daqing 163318, China;

⁴ CNOOC Enter Tech-Drilling & Production Co. Shenzhen, Branch Guangdong, Shenzhen 518067, China

*E-mail: wangyiyouxian1399@163.com

Received: 14 April 2021 / *Accepted:* 16 July 2021 / *Published:* 10 September 2021

The pulse current electrodeposition (PCE) technique was employed to successfully deposit Ni/W-TiN coatings on X52 steel. The effect of frequency and duty cycle on coating parameters like surface morphological characteristics, grain orientation, micro-hardness, crystal size, the number of deposited TiN CNPs, and corrosion resistance was investigated in detail. The findings show that TiN particles agglomerate, resulting in particle clouds with mean diameters of approximately 116.1 nm that are enclosed as second phases in the Ni/Co coating matrix. The Ni/W-TiN coating generated at a duty cycle of 10% and a pulse frequency of 10 Hz was able to process a maximum TiN content of 11.6 v/v%. It also showed that the coating grain became smaller when the duty cycle decreased or pulse frequency increased. The maximum micro-hardness value of the Ni/W-TiN coating synthesized at a duty cycle of 10% and a 10 Hz pulse frequency was 671.8 kg/mm, whereas the Ni/W-TiN coating deposited at 20 Hz and 30% had a maximum micro-hardness value of 642.4 kg/mm. Furthermore, the size of the semicircle was affected by charge-transfer resistance at the electrode/solution, therefore the size was observed to grow with the decrease in duty cycle and pulse frequency.

Keywords: oil pipeline; Ni/W-TiN coating; X52 steel; corrosion resistance; surface morphology

[FULL TEXT](#)

© 2021 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/>).