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PII: S0257-8972(17)31014-9
DOI: doi:10.1016/j.surfcoat.2017.09.078
Reference: SCT 22755

To appear in: *Surface & Coatings Technology*

Received date: 1 April 2017
Revised date: 12 September 2017
Accepted date: 28 September 2017

Please cite this article as: Xu Yang-tao, Dai Yu-jie, Zhang Wei, Xia Tian-dong , Microstructure and texture evolution of electrodeposited coatings of nickel in the industrial electrolyte. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Sct(2017), doi:10.1016/j.surfcoat.2017.09.078

Microstructure and Texture Evolution of Electrodeposited Coatings of Nickel in the Industrial Electrolyte

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Abstract: Nickel is an important strategic metal material, which has been widely used in modern industry. The different electrolyte systems and main parameters have a great effect on microstructure and mechanical properties of electrodeposited coatings. In order to investigate the evolution of texture and preferential orientation of nickel electro-crystallization in sulfide nickel soluble anode/sulfate solution, and grain size, microstructure of electrodeposited coatings of nickel were characterized by electrochemical workstation, XRD and SEM methods.

The results show that nickel electro-crystallization conforms to the classical nucleation theory and crystal growth theory. The preferential orientation of electrodeposited coatings of nickel can be changed initially from (111) and (200) planes to (220) plane after 16 h. The surface morphology changes slowly from pyramid to cellular structure, while the growth mechanism changes from screw dislocation growth to cumulative growth model. The cross sectional microstructure of electrodeposited coatings is non-uniform and mostly grains are columnar and perpendicular to the sheet. The distribution of grains abides by stepwise distribution along the thickness. The microstructure of electrodeposited coatings is fine equiaxed grain region and coarse columnar grain region, which are perpendicular to starting sheet when the electrodeposition time is 144 h. Angle grain boundary is related to grain size, whereas the coincidence site lattice (CSL) is associated with preferential orientation. Therefore the grain boundary misorientation are mainly above 15°, being more than angle grain boundaries and coincidence site lattice Σ3 appearing highest frequency.

Key Words: electro-crystallization; nucleation and growth; electrodeposited coatings of