Preparation of Cr-Ni Alloy by Electrochemical Codeposition in a NaCl-KCl-NaF-Cr₂O₃-NiO Molten Salt

Shixian Zhang^{1,2}, Yungang Li^{1,*}, Kai Hu³, Xiaoping Zhao², Hui Li¹, Jinglong Liang¹

¹ Key Laboratory of Ministry of Education for Modern Metallurgy Technology, College of Metallurgy and Energy, North China University of Science and Technology, 21# Bohai Road, Caofeidian Xincheng, Tangshan 063210, China

² Hebei College of Industry and Technology, 626# Hongqi Street, Shijiazhuang 050091, China

³ School of Materials Science and Engineering, Chongqing University, 174# Shazhengjie, Shapingba, Chongqing 400044, China

*E-mail: liyungang59322@163.com

doi: 10.20964/2018.08.62

Received: 22 April 2018 / Accepted: 2 June 2018 / Published: 5 July 2018

The feasibility of electrochemical reduction in a NaCl-KCl-NaF-Cr₂O₃-NiO molten salt is analysed by thermodynamic calculation. The electrochemical reaction mechanism and the electrocrystallization process of chromium and nickel in the same molten salt are investigated at 1073 K by electrochemical workstation. Cyclic voltammetry, chronopotentiometry and chronoamperometry have been used. The results show that it is thermodynamically feasible to reduce NiO and Cr₂O₃ to pure metal by electrochemical reduction and indicate that the electrochemical reduction from Cr(III) to Cr takes two steps: $\text{Cr}^{3+} + \text{e} \rightarrow \text{Cr}^{2+}$ and $\text{Cr}^{2+} + 2\text{e} \rightarrow \text{Cr}$. Meanwhile, the electrochemical reduction from Ni(II) to Ni takes only one step: $\text{Ni}^{2+} + 2\text{e} \rightarrow \text{Ni}$. All the electrochemical processes of Cr(III), Cr(II) and Ni(II) are reversible reactions, and the electrocrystallization processes of Cr and Ni are an instantaneous hemispheroid three-dimensional nucleation process. The atomic growth process, composition and morphology of the coating are investigated by SEM and EDS, and close and uniform alloy particles are deposited on the substrate. The polarization curves are determined by the potentiodynamic scanning method, and the results show that the corrosion reaction of the alloy coating is higher, and the corrosion rate is lower. It is also found that the corrosion resistance of the Cr-Ni alloy coating is stronger than that of low carbon steel.

Keywords: Cr-Ni alloy, coating, electrochemical codeposition, molten salt, characterization

[FULL TEXT](#)

© 2018 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/>).