

研究论文

不锈钢表面阴极微弧电沉积氧化铝膜层的性能

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摘要: 以0.4 mol/L Al(NO₃)₃乙醇溶液为电解液, 用阴极微弧电沉积方法在304不锈钢表面制备了80 μm厚的氧化铝膜层。分析了膜层的形貌、成分和相组成, 测试了膜层的抗高温氧化和电化学腐蚀性能。结果表明, 电沉积膜层由γ-Al₂O₃和α-Al₂O₃组成。膜层中含有少量的Fe、Cr、Ni元素, 表明膜/基界面附近的不锈钢基体在微弧放电作用下也参与氧化铝膜层的沉积和烧结过程。氧化铝膜层使不锈钢在800℃恒温氧化速率明显降低, 表明其抗高温氧化性能得到提高。同时, 其腐蚀电位正向移动, 腐蚀电流密度降低1个数量级, 表明其耐腐蚀性能得到提高。

关键词: 无机非金属材料 阴极微弧电沉积 不锈钢 氧化铝膜层 性能

Preparation and Characterization of Alumina Coating on Stainless Steel by Cathodic Microarc Electrodeposition

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Abstract: An alumina coating of 80 μm thick was fabricated on the surface of 304 stainless steel by cathodic microarc electrodeposition in 0.4 mol/L Al(NO₃)₃ ethanol solution. The morphology, composition and phase constituent of the alumina coating were analyzed by scanning electron microscope (SEM) and X-ray diffraction (XRD), and the high-temperature oxidation and electrochemical corrosion behaviors of the coating were evaluated. The results show that the coating is composed of γ-Al₂O₃ and α-Al₂O₃ phases, and the coating contains a little Fe, Cr, Ni elements, which confirm that the stainless steel substrate near the coating/steel also takes part in the deposition and sintering process of alumina coating under cathodic microarc discharge. The oxidation rate of the coated stainless steel at 800 °C isothermal oxidation test is obviously reduced. Meanwhile, its corrosion potential increases positively and its corrosion current density decreases about one order of magnitude, indicating that the corrosion resistance is improved.

Keywords: inorganic non-metallic materials cathodic microarc electrodeposition stainless steel alumina coating, properties

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参考文献:

- [1] T.Irisawa, H.Matsumoto, Thermal shock resistance and adhesion strength of plasma-sprayed alumina coating on cast iron, *Thin Solid Films*, 509, 141(2006) 
- [2] A.L.Yerokhin, X.Nie, A.Leyland, A.Matthews, S.J.Dowey, Plasma electrolysis for surface engineering, *Surf. Coat. Technol.*, 122, 73(1999) 
- [3] A.L.Yerokhin, A.Leyland, A.Matthews, Kinetic aspects of aluminium titanate layer formation on titanium alloys by plasma electrolytic oxidation, *Appl Surf Sci*, 200, 172 (2002) 
- [4] W.Xue, Z.Deng, Y.Lai, R.Chen, Analysis of phase distribution for ceramic coatings formed by microarc oxidation on aluminum alloy, *J. Am. Ceram. Soc.*, 81(5), 1365 (1998)
- [5] W.Xue, Q.Jin, Q.Zhu, M.Hua, Y.Ma, Anti-corrosion microarc oxidation coatings on SiCp/AZ31 magnesium matrix composite, *J. Alloys Compd.*, 482, 208(2009) 
- [6] LU Lihong, SHEN Dejiu, WANG Yulin, TIAN Xinhua, MAO Zhiqiang, Microarc oxidation of the hot-dipped aluminum on the Q235 steel substrate, *Corr. Prot.*, 22(2), 58(2001)
- [7] Z.Wu, Y.Xia, G.Li, F.Xu, Structure and mechanical properties of ceramic coatings fabricated by plasma electrolytic oxidation on aluminized steel, *Appl. Surf. Sci.*, 253 (20), 8398(2007)
- [8] GU Weichao, SHEN Dejiu, WANG Yulin, LIAO Bo, Microarc oxidation of arc-spraying aluminum coatings, *Mater. Prot.*, 35(12), 37(2002)
- [9] W.Gu, D.Shen, Y.Wang, G.Chen, W.Feng, G.Zhang, S.Fan, C.Liu, S.Yang, Deposition of duplex Al₂O₃/aluminum coatings on steel using a combined technique of arc spraying and plasma electrolytic oxidation, *Appl. Surf. Sci.*, 252, 2927(2006) 
- [10] Y.Wang, Z.Jiang, Z.Yao, Preparation and properties of ceramic coating on Q235 carbon steel by plasma electrolytic oxidation, *Current Appl. Phys.*, 9, 1067(2009) 
- [11] YANG Xiaozhan, HE Yedong, WANG Deren, GAO Wei, Yttria-stabilized zirconia thin film by cathodic microarc electrodeposition, *Chin. Sci. Bull.*, 47(7), 525(2002)
- [12] LI Xinmei, LI Yinshuo, HAN Yong, Preparation of alumina coatings on titanium by cathodic micro-arc electrodeposition, *J. Inorg. Mater.*, 20(6), 1493(2005)
- [13] LI Xinmei, LI Yinshuo, HAN Yong, Effects of electrolyte composition and electrical parameter on alumina coatings by cathodic microarc electrodeposition on titanium, *J. Chin. Ceram. Soc.*, 33(7), 799(2005)
- [14] Q.Jin, W.Xue, X.Li, Q.Zhu, X.Wu, Al₂O₃ coating fabricated on titanium by cathodic microarc electrodeposition, *J. Alloys Compd.*, 476, 356(2009) 
- [15] W.Xue, Q.Jin, Q.Zhu, High temperature oxidation behavior of titanium coated by cathodic microarc electrodeposition, *Trans. Mater. Heat Treat.*, 31(9), 124,132(2010)
- [16] LI Xijin, XUE Wenbin, CHENG Guoan, High temperature oxidation properties of Al₂O₃ coating on TiAl alloy fabricated by cathodic microarc deposition method, *Chin. J. Aerospace Mater.*, 30(4), 26(2010)

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2. 郎丰军, 阮伟慧, 李谋成, 沈嘉年. 温度对316L不锈钢耐海水腐蚀性能的影响[J]. 材料研究学报, 2012,24(1): 61-64

3. 朱晓磊, 陆晓峰, 凌祥. 三种压力管道金属材料的流动加速腐蚀性能研究[J]. 材料研究学报, 2012,24(1): 57-60
 4. 刘彬, 段继周, 侯保荣. 天然海水中微生物膜对316L不锈钢腐蚀行为研究[J]. 材料研究学报, 2012,32(1): 48-53
 5. 肖正涛, 李相波, 王佳, 黄国胜, 周雄. 冷喷涂铬铅铜涂层在海水中的耐蚀性能[J]. 材料研究学报, 2012,32(1): 18-22
 6. 曹晓晖 陈威宏 刘宇 孙杰 曹晓晖 王文举 于名讯. 二次化学共沉淀法制备片状钡铁氧体的形成历程及磁性能研究[J]. 材料研究学报, 2012,26(1): 107-112
 7. 黄本生, 江仲英, 潘欢欢, 袁鹏斌, 刘清友. 热处理工艺对G105钻杆材料抗腐蚀性能的影响[J]. 材料研究学报, 2012,32(1): 67-69
 8. 江克, 陈学东, 杨铁成, 张玮, 梁春雷. 典型奥氏体不锈钢高温环烷酸腐蚀行为研究[J]. 材料研究学报, 2012,32(1): 59-63
 9. 刘婧 陈福义 张吉晔 樊莉红 张金生. 银铜双金属纳米合金的制备和电催化性质[J]. 材料研究学报, 2012,26(1): 49-54
 10. 刘圆圆, 王伟, 王燕华, 王佳. NaCl液滴下304不锈钢表面电化学性质研究[J]. 材料研究学报, 2012,32(1): 28-33
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