

前一个

后一个

本期目录 | 下期目录 | 过刊浏览 | 高级检索

[打印本页] [关闭]

研究报告

电弧喷涂铝涂层的腐蚀电化学行为

刘存,赵卫民,艾华,王勇,董立先

中国石油大学(华东)机电工程学院 东营 257061

摘要: 用电弧喷涂方法在钢表面制备铝涂层,研究其在3.5% NaCl溶液中的电化学腐蚀行为。采用电子探针技术(EPMA)分析研究浸泡30 d后涂层横截面的成分分布特征,发现腐蚀介质可沿孔隙或夹杂物向涂层内部渗入,且已有部分Cl⁻渗透涂层深处。动电位极化实验结果显示,原始铝涂层具有明显的钝化现象,这与胶冻状腐蚀产物Al(OH)₃的附着力较强以及Al₂O₃膜的形成有关。电化学阻抗谱(EIS)测试结果表明,铝涂层在测试期内的EIS图谱变化可分成4个阶段:孔蚀萌生阶段、孔内酸化析氢阶段、介质渗透钢基体后涂层作为牺牲阳极的阶段和孔蚀群急剧发展阶段。提出电极在腐蚀过程中的不同阻抗模型。

关键词: 电化学阻抗谱 电弧喷涂 金属涂层 铝涂层

ELECTROCHEMICAL CORROSION BEHAVIORS OF ARC-SPRAYED ALUMINUM COATING

LIU Cun, ZHAO Weimin, AI Hua, WANG Yong, DONG Lixian

School of Mechanical and Electrical Engineering, China University of Petroleum, Dongying 257061

Abstract: Aluminum was deposited on steel using arc spraying, and the corrosion electrochemical behavior of the coatings in 3.5% NaCl aqueous solution was investigated. The electron probe micro-analysis (EPMA) was used to examine composition profiles of the coating cross section after 30 day immersion. The results showed that the corrosion medium could penetrate into the coatings along the pores or inclusions, and chloride ions have penetrated into the depth of the coatings. The potentiodynamic polarization curves showed the passivation phenomenon of the original aluminum coating, which was related to the strong adhesion of jelly corrosion product Al(OH)₃ and the existence of Al₂O₃ films. The corrosion failure process of aluminum coating was investigated by means of electrochemical impedance spectroscopy (EIS) measurements. On the basis of the impedance diagram changes during the testing, the process can be separated into four stages: initiation of cavitations, acidification and hydrogen evolution in the hole, coating as the sacrificial anode when the corrosion medium penetrates into steel substrate and rapid development of cavitation groups. Finally various models for the electrode in the corrosion process were proposed.

Keywords: electrochemical impedance spectroscopy arc spraying metal coating, aluminum coating

收稿日期 2009-11-25 修回日期 2010-03-05 网络版发布日期 2011-01-28

DOI:

基金项目:

国家高技术研究发展(863)计划海洋技术领域项目(2008AA09A106)和山东省科技攻关项目(2007GG30004008)资助

通讯作者: 赵卫民

作者简介: 刘存, 男, 1982年生, 硕士生, 研究方向为材料失效与表面改性

通讯作者E-mail: zhaowm@hdpu.edu.cn

扩展功能

本文信息

Supporting info

PDF(1139KB)

[HTML] 下载

参考文献[PDF]

参考文献

服务与反馈

把本文推荐给朋友

加入我的书架

加入引用管理器

引用本文

Email Alert

文章反馈

浏览反馈信息

本文关键词相关文章

电化学阻抗谱

电弧喷涂

金属涂层

铝涂层

本文作者相关文章

刘存

赵卫民

PubMed

Article by Liu,c

Article by Diao,W.M

参考文献:

- [1] Xu B S, Li C J, Liu S S, et al. Surface engineering an thermal spraying technology and their developments [J]. Chin. Surf. Eng., 1998, 38(1): 3-10

徐滨士, 季长久, 刘世参等. 表面工程与热喷涂技术及其发展 [J]. 中国表面工程, 1998, 38(1): 3-10

- [2] Li J G, Zheng J S. Surface Engineering Technology and Corrosion Inhibitors [M]. Beijing: China Petrochemical Press, 2007
- [3] Xiao W G. Application of electric arc thermal spraying technique with wire material to anticorrosion of offshore steel structures in Shengli oilfield [J]. Pet. Eng.Constr., 2004, 30(3): 33-34
肖文功. 线材电弧喷涂技术在浅海钢结构防腐中的应用 [J]. 石油工程建设, 2004, 30(3): 33-34 
- [4] Fischer K P, Thomason W H. Performance history of thermal-sprayed aluminum coatings in offshore service [J]. Mater Perform., 1995, 34(4): 27-35
- [5] Yin Y S, Huang X, Dong L H. Marine Engineering Materials [M]. Beijing: Science Press, 2008
- [6] Meroufel A, Touzain S. EIS characterization of new zinc-rich powder coatings [J]. Prog. Org. Coat., 2007, 59(3): 197-205 
- [7] O'Donoghue M, Garrett R, Datta V, et al. Electrochemical impedance spectroscopy: Testing coatings for rapid immersion service [J]. Mater. Perform., 2003, 42(9): 36-41
- [8] Marchebois H, Keddam M, Savall C, et al. Zinc-rich powder coatings characterization in artificial sea water EIS analysis of the galvanic action [J]. Electrochim. Acta, 2004, 49(11): 1719-1729 
- [9] Popa M V, Drob P, Vasilescu E, et al. Electrochemical characterization of electrodeposited organic coatings [J]. Mater. Corros., 2002, 53(2): 91-97 
- [10] He J, Yan R, Ma S N. Study on corrosion behaviors of epoxy coatings/substrate immersed in 3.5% NaCl solution by electrochemical methods [J]. China. Surf. Eng., 2006, 19(2): 47-50
何杰, 阎瑞, 马世宁. 电化学方法研究环氧涂层/基体在3.5% NaCl溶液中的腐蚀行为 [J]. 中国表面工程, 2006, 19(2): 47-50
- [11] Sami M. Electrochemical impedance spectroscopy of epoxy-coated steel exposed to dead sea water [J]. J. Miner. Mater. Charact. Eng., 2005, 4(2): 75-84
- [12] Abreu C M, Cristobal M J, Losada R, et al. High frequency impedance spectroscopy study of passive films formed on AISI 316 stainless steel in alkaline medium [J]. J. Electroanal.Chem., 2004, 572(2): 335-345 
- [13] El-Mahdy G A, Nishikata A, Tsuru T. AC impedance study on corrosion of 55% Al-Zn alloy-coated steel under thin electrolyte layers [J]. Corros. Sci., 2000, 42(9): 1509-1521 
- [14] Shibli S M A, George S. Electrochemical impedance spectroscopic analysis of activation of Al-Zn alloy sacrificial anode by RuO₂ catalytic coating [J]. Appl.Surf. Sci., 2007, 253(18): 7510-7515 
- [15] Yang Z H, Xu N, Qiu Z X. Measurement of aluminium of corrosive potential-pH and the polarization curve [J]. J. Northeast. Univ. (Nat.Sci.), 2000, 21(4): 401-403
杨振海, 徐宁, 邱竹贤. 铝的电位-pH图及铝腐蚀曲线的测定 [J]. 东北大学学报 (自然科学版), 2000, 21(4): 401-403
- [16] Hou B R, Marine Corrosive Environment Theory and Application [M]. Beijing: Science Press, 1999
- [17] 侯保荣. 海洋腐蚀环境理论及其应用 [M]. 北京: 科学出版社, 1999
- [18] Creus J, Mazille H, Edrissi H. Porosity evaluation of protective coatings onto steel, through electrochemical techniques [J]. Surf. Coat Technol., 2000, 130(2-3): 224-232 

本刊中的类似文章

1. 李娟, 李进, 焦迪. 再生水中硫酸盐还原菌对铜合金的腐蚀[J]. 中国腐蚀与防护学报, 2011,23(1): 18-24
2. 张驰, 李澄, 徐国跃. 两种低红外发射率涂层的防腐蚀效果研究[J]. 中国腐蚀与防护学报, 2011,23(1): 53-56
3. 周小敏, 王小辉, 崔金喜, 刘钧泉. 环氧煤沥青涂层在原油积水中的寿命研究[J]. 中国腐蚀与防护学报, 2011,23(1): 89-92
4. 贾志军, 杜翠薇, 刘智勇, 高瑾, 李晓刚. 3Cr低合金钢在含饱和CO₂的NaCl溶液中的腐蚀电化学行为[J]. 中国腐蚀与防护学报, 2011,25(1): 39-44

5. 宋利晓 张昭 张鉴清 曹楚南.纳米结构黑镍薄膜的电沉积机理[J]. 中国腐蚀与防护学报, 2011,47(01): 123-128
 6. 施锦杰 孙伟 耿国庆.碳化对模拟混凝土孔溶液中HRB335钢腐蚀行为的影响[J]. 中国腐蚀与防护学报, 2011,47(01): 17-24
 7. 朱庆振 薛文斌 鲁亮 杜建成 刘贯军 李文芳. $(Al_2O_3-SiO_2)_x/AZ91D$ 镁基复合材料微弧氧化膜的制备及电化学阻抗谱分析 制备及电化学阻抗谱分析[J]. 中国腐蚀与防护学报, 2011,47(01): 74-80
 8. 王毅, 盛敏奇, 钟庆东, 钮晓博, 林海, 范成诚.表面沉积镍的低碳钢在3.5%NaCl溶液中的电化学行为[J]. 中国腐蚀与防护学报, 2010,22(6): 490-494
 9. 方志刚, 黄一.有机涂层在深海环境中的失效行为研究[J]. 中国腐蚀与防护学报, 2010,22(6): 518-520
 10. 龚利华, 程东亮, 张波.电化学法分析超级双相不锈钢焊接接头的耐点蚀性[J]. 中国腐蚀与防护学报, 2010,22(6): 521-525
-