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综述

再制造的热喷涂合金涂层的结构完整性与服役寿命预测研究

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摘要: 热喷涂技术是再制造工程的支撑技术, 热喷涂涂层是再制造领域中常见的表面涂覆层, 其初始质量和服役寿命为人关注. 本文以等离子喷涂为例, 研究了与工艺相关的涂层完整性和与服役条件相关的涂层寿命和失效机理. 以不同H₂流量、功率和送粉量为条件, 研究了工艺参数对涂层孔隙率和微观力学性能的影响. 以接触疲劳过程为手段, 研究了涂层寿命预测方法和寿命衰退机理. 结果表明, 工艺参数可以不同程度地影响涂层的结构完整性, 通过优化设计可以大幅提高涂层质量; 基于大样本空间建立的S-N曲线可以直观预测涂层接触疲劳寿命, 机理分析表明, 点蚀、剥落和分层失效诱因不尽相同, 分别由粗糙接触、近表面缺陷和剪切应力导致.

关键词: 再制造 热喷涂 合金涂层 结构完整性 寿命预测

INVESTIGATION OF STRUCTURAL INTEGRITY AND LIFE TIME PREDICTION OF THE THERMAL SPRAYED ALLOY COATING FOR REMANUFACTURING

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Abstract: Thermal spray technique is one of the key techniques in remanufacture engineering. The thermal sprayed coatings are commonly used in remanufacturing applications, their initial performance and service lifetime are critical to the success of remanufacturing. In the present paper, structural integrity, lifetime and failure mechanism of plasma sprayed coatings were investigated. The influences of hydrogen gas flow, spraying powder and powder feed rate on porosity in coatings and their mechanical properties were described. The rolling contact fatigue (RCF) experiment was conducted to develop a method of life time prediction and to reveal the failure mechanism for plasma sprayed coatings. The results show that the structural integrity of coatings can be obviously influenced by spraying process and an optimal design of spraying process can remarkably promote the coating performance. For this purpose, the S-N curve was established based on the large sample space to be used to easily predict coating lifetime. It is found that corrosive pitting, spalling and hierarchical failure are the main failure modes, those results from asperity contact, subsurface defect propagation and shear stress distribution, respectively.

Keywords: remanufacturing thermal spray alloy coating structural integrity life prediction

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参考文献:

- [1] Xu B S. China Surf Eng, 2010; 23: 1
- [2] Xu B S. Remanufacturing Engineering and Its Application. Harbin: Harbin Institute of Technology Press, 2005: 1
- [3] (徐滨士. 再制造工程基础及其应用. 哈尔滨: 哈尔滨工业大学出版社, 2005: 1)
- [4] Xu B S, Zhu S H. Surface Engineering Theory and Technology. 2nd Ed. Beijing: National Defense Industry Press, 2010: 1
- [5] Zhu Z X, Liu Y, Xu B S, Ma S N. Trans China Weld Inst, 2005; 26: 1
- [6] Wu Z J. Thermal Spray Technology and Applications. Beijing: China Machine Press, 2005: 1
- [7] (吴子健. 热喷涂技术与应用. 北京: 机械工业出版社, 2005: 1)
- [8] Piao Z Y, Xu B S, Wang H D, Pu C H. Tribol Int, 2010; 43: 252 
- [9] Zhang X C. PhD Thesis, Shanghai Jiao Tong University, 2007
- [10] (张显程. 上海交通大学博士学位论文, 2007)
- [11] Zhang X C, Xu B S, Xuan F Z, Wang H D, Wu Y X, Tu S D. J Alloys Compd, 2009; 467: 501 
- [12] Zhang X C, Xu B S, Wu Y X, Xuan F Z, Tu S D. Appl Surf Sci, 2008; 254: 3879 
- [13] Zhang X C, Xu B S, Tu S D, Xuan F Z, Wang H D, Wu
- [14] Y X. Appl Surf Sci, 2008; 254: 6318 [11] Pfender E. Surf Coat Technol, 1987; 34: 1
- [15] Bianchi L, Leger A C, Vardelle M, Vardelle A, Fauchais P. Thin Solid Films, 1997; 305: 35 
- [16] Gawne D T, Liu B, Bao Y, Zhang T. Surf Coat Technol, 2005; 191: 242 
- [17] Sampath S, Jiang X, Kulkarni A, Matejicek J, Gilmore D L, Neiser R A. Mater Sci Eng, 2003; A348: 54
- [18] Gnaeupel-Herold T, Prask H J, Barker J, Biancianiello F S, Jiggetts R D, Materjicek J. Mater Sci Eng, 2006; A421: 77
- [19] Chwa S O, Klein D, Toma F L, Bertrand G, Liao H L, Coddet C, Ohmori A. Surf Coat Technol, 2005; 194: 215 
- [20] Zhang X C, Xu B S, Xuan F Z, Wang H D, Wu Y S, Tu S D. Wear, 2008; 265: 1875 
- [21] Zhang X C, Xu B S, Xuan F Z, Tu S D, Wang H D, Wu Y X. Appl Surf Sci, 2008; 254: 3734 
- [22] Zhang X C, Xu B S, Xuan F Z, Tu S D, Wang H D, Wu Y X. Int J Fatigue, 2009; 31: 906 
- [23] Holmberg K, Matthews A, Ronkainen H. Tribol Int, 1998; 31: 107 

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2. 邓春明, 刘敏, 曾翠丽, 邓畅光, 邝子奇, 毛杰. 耐锌液腐蚀热喷涂涂层的研发现状[J]. 金属学报, 2011,23(6): 453-456
3. 丁智平 王腾飞 李明 陈吉平. 镍基单晶合金多轴非比例加载低周疲劳单胞模型[J]. 金属学报, 2011,25(5): 455-463
4. 秦承鹏, 郑玉贵. 17-4PH不锈钢表面激光熔覆钴基合金涂层的空蚀行为研究[J]. 金属学报, 2011,23(3): 209-213
5. 李刚, 贾孟东, 况军, 刘丽, 侯俊英. 激光熔覆Ni₆₀Zr₂₀Nb₁₅Al₅非晶合金涂层组织及性能研究[J]. 金属学报, 2011,23(1): 9-12
6. 宋波 傅倩 刘小云 庄启昕 韩哲文. 环境因素对PBO纤维老化的影响和储存寿命预测[J]. 金属学报, 2010,24(5): 487-492
7. 马壮; 曲文超; 李智超; 袁晓光. 纯铜SHS反应热喷涂Al₂O₃基复合陶瓷涂层的性能研究[J]. 金属学报, 2010,22(1): 28-31
8. 董杰 陈学东 范志超 江慧丰 姜恒 陆守香. 316L不锈钢的高温疲劳蠕变行为和寿命预测[J]. 金属学报, 2009,23(5): 541-545
9. 董杰; 陈学东; 范志超; 江慧峰; 陆守香. 基于微裂纹扩展的疲劳蠕变寿命预测方法[J]. 金属学报, 2008,44(10): 1167-1170
10. 张忠礼; 何越; 鄂世国; 孙磊. 纯铜表面热喷涂扩散制备铝化物层工艺与组织结构[J]. 金属学报, 2008,20(1): 29-31

