

研究论文

(Ti, Al, Zr)N多元氮梯度硬质反应膜的组织结构和性能

吕会敏¹, 张钧^{1,2}

1. 沈阳大学机械工程学院 沈阳 110044

2. 大连理工大学三束材料改性教育部重点实验室 大连 116024

摘要: 采用多弧离子镀技术和Ti--Al合金靶及Zr单质靶的组合, 在高速钢基体上制备了(Ti,Al,Zr)N多元N梯度硬质反应膜。分别用扫描电镜、X射线衍射仪观察测定(Ti, Al, Zr)N梯度膜膜层的表面、断面形貌、成分以及相结构, 研究了(Ti, Al, Zr)N多元氮梯度硬质反应膜的组织结构和性能。结果表明, 与TiN、(Ti, Al)N、(Ti,Zr)N及(Ti, Al, Zr)N等单层硬质膜相比, 采用Ti--Al合金靶及单质Zr靶组合方式制备的(Ti, Al, Zr)N多元氮梯度硬质反应膜具有较高的硬度和膜/基附着力, 硬度最高可达HV6000, 膜/基附着力大于180 N。同时, 膜层还具有良好的抗热震性能。

关键词: 材料表面与界面 (Ti, Al, Zr)N膜 多弧离子镀 显微硬度 热震

Microstructure and Properties of (Ti, Al, Zr)N Multi - components Hard Reactive Films with N - gradient Distributions

L · U Huimin¹, ZHANG Jun^{1,2}

1. College of Mechanical Engineering, Shenyang University, Shenyang 110044

2. Key Laboratory of Materials Modification by Laser, Ion, and Electron Beams Ministry of Education, Dalian University of Technology, Dalian 116042

Abstract: (Ti, Al, Zr)N multi - component hard films with N - gradient distributions were prepared by multi arc ion plating (MAIP) technology using the combined pure Zr and Ti - Al alloy targets. The surface and cross - fracture morphology, the surface compositions and the phase structure of the as - deposited films were observed and measured. The effects of bias voltage on the film quality, phase structure, the micro - hardness, the adhesion between film and substrate and the thermal shock resistance were investigated. In comparison with TiN, (Ti, Al)N and (Ti, Zr)N films, the as - deposited (Ti,Al,Zr)N films from the combination of pure Zr and Ti - Al alloy targets exhibited higher micro - hardness values even up to HV6000. Each of the as - deposited films has very high adhesion strength, in terms of critical load, larger than 180 N. The good heat shock resistance was also reached for each of the as - deposited films.

Keywords: surface and interface in the materials (Ti, Al, Zr)N films multi - arc ion plating micro - hardness thermal shock

收稿日期 2010-09-21 修回日期 2011-01-10 网络版发布日期 2011-02-25

DOI:

基金项目:

辽宁省高等学校优秀人才支持计划RC--05--05及沈阳市科技计划1091178--1--00资助项目。

通讯作者: 张钧

作者简介:

通讯作者E-mail: zhjun11@sohu.com

扩展功能

本文信息

- ▶ Supporting info
- ▶ PDF(1118KB)
- ▶ [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

- ▶ 材料表面与界面
- ▶ (Ti, Al, Zr)N膜
- ▶ 多弧离子镀
- ▶ 显微硬度
- ▶ 热震

本文作者相关文章

- ▶ 吕会敏
- ▶ 张钧

PubMed

- ▶ Article by Lv,H.M
- ▶ Article by Zhang,j

参考文献:

- [1] L.A.Dobrzański, L.W. Zkowska, J.Mikula, K.Golombek, D.Pakul, M.Pancielejko, Structure and mechanical properties of gradient PVD coatings, Journal of Materials

- [2] WEN Lishi, HUANG Rongfang, New progress in TiN-based protective coatings deposited by arc ion plating, *Vacuum*, (1), 1(2000)
- [3] CAO Meng, LI Qiang, DENG Xiangyun, LI Dejun, Effect of ion bombarding energy on the properties of ZrN/TiAlN nanometer multilayered coatings, *Chinese Journal of Materials Research*, 21(6), 627(2007)
- [4] J.C.Oliveria, A.Manaia, Hard amorphous Ti-Al-N coatings deposited by sputtering, *Thin Solid Film*, 516(15), 5032(2008)
- [5] V.V.Uglov, V.M.Anishchik, S.V.Zlotski, I.D.Feranchuk, T.A.Alexeeva, A.Ulyanenkov, J.Brechbuehl, A.P.Lazar, Composition and phase stability upon annealing of gradient nitride coatings, *Surface and Coatings Technology*, 202(11), 2389(2008)
- [6] Jun Zhang, Wengying Guo, Yu Zhang, Qiang Guo, Chuang Wang, Lipeng Zhang, Mechanical properties and phase structure of (TiAlZr)N films deposited by multi arc ion plating, *Thin Solid Films*, 517(17), 4830(2009)
- [7] CUI Guanying, ZHANG Jun, LV Huimin, Microstructure and properties of (Cr, Ti, Al, Zr)N multi-component super-hard gradient films deposited by multi-arc ion plating, *Journal of Materials Protection*, 43(6), 24(2010)
- [8] ZHANG Haoyang, ZHOU Lanying, TIAN Jianchao, Effect of substrate-bias on the characteristic of tiain coatings, *Surface Technology*, 35(6), 15(2006)
- [9] A.Rizzo, M.A.Signore, M.F.De Riccardis, L.Capodiecici, D.Dimaio, T.Nocco, Influence of growth rate on the structural and morphological properties of TiN, ZrN and TiN/ZrN multilayers, *Thin Solid Films*, 515(17), 6665(2007)
- [10] G.Abadias. Stress and preferred orientation in nitride-based PVD coatings, *Surface and Coatings Technology*, 202(11), 2223(2008)
- [11] Youn J.Kim, Ho Y.Lee, Tae J.Byun, Jeon G.Han, Microstructure and mechanical properties of TiZrAlN nanocomposite thin films by CFUBMS, *Thin Solid Films*, 516(11), 3651(2008)
- [12] A.Hoerling, J.Sjöölén, H.Willmann, T.Larsson, M.Odén, T.Larsson, M.Odén, L.Hultman. Thermal stability, microstructure and mechanical properties of Ti_{1-x}Zr_xN thin films, *Thin Solid Films*, 516(18), 6421(2008)
- [13] YANG Honggang, LI Shu, ZHANG Ronglu, Influence of bias voltage and N₂ partial pressure on structure of TiN film and performance of film/substrate, *China Surface Engineering*, 22(2), 20(2009)
- [14] Jong-Keuk Park, Young-Joon Baik. Increase of hardness and thermal stability of TiAlN coating by nanoscale multi-layered structurization with a BN phase, *Thin Solid Films*, 516(11), 3661(2008)
- [15] PAN Xiaolong, WANG Shaopeng, LI Zhengxian, HUANG Chunliang, WANG Baoyun, YAN Peng, JI Shouchang, Thermal fatigue and oxidation resistance of TiAlN coating grown by arc ion plating, *Journal of Vacuum Science and Technology*, 28(S), 60(2008)

本刊中的类似文章

1. 陈旭.Fatigue behaviors of Z2CND 18.2N stainless steel under thermal -mechanical cycling[J]. *材料研究学报*, 2011,24(2): 101-108
2. Masayuki Arai.Inelastic Constitutive Equation of Plasma-sprayed Ceramic Thermal Barrier Coating [J]. *材料研究学报*, 2011,24(2): 161-168
3. 张健, 郭策安, 张罡, 郝士明.两种NiCrAlY涂层的室温摩擦磨损性能[J]. *材料研究学报*, 2011,23(2): 107-110
4. 吴靓 董虹星 贺跃辉.Ni₃Al金属间化合物多孔材料的制备及抗腐蚀性能[J]. *材料研究学报*, 2011,25(2): 118-123
5. 杨卫华 付芳 杨武涛.聚乙烯吡咯烷酮对PbO₂电极微结构和性能的影响[J]. *材料研究学报*, 2011,25(2): 199-204

6. 吴姚莎 邱万奇 余红雅 钟喜春 刘仲武 曾德长 李尚周. PS45/CuAl8伪合金复合涂层高温循环氧化行为[J]. 材料研究学报, 2011,25(2): 129-134
 7. 李绮 刘新杰 王泽庆 颜廷亭 谭丽丽 张炳春 杨柯. AZ31B镁合金表面氟涂层的生物相容性和抗菌性能[J]. 材料研究学报, 2011,25(2): 193-198
 8. 许富民. Influence of Heat Treatment on Microstructure and Mechanical Properties of Al/Al-Cu Graded Materials[J]. 材料研究学报, 2011,24(2): 118-124
 9. Opiekun. The temperature influence of ceramic form on the structure of castings made of cobalt alloy MAR-M509[J]. 材料研究学报, 2011,24(1): 23-33
 10. 刘东戎 康秀红 桑宝光 李殿中. Numerical study of macrosegregation formation in ingot cast in normal sand mold and water-cooled sand mold[J]. 材料研究学报, 2011,24(1): 54-64
-