

## 目 次 CONTENTS

### 特邀综述 Invited Review

1 表面强化后梯度结构与残余应力对疲劳寿命的影响

Influence of Gradient Structure and Residual Stress on Fatigue Life after Surface Hardening

李国禄, 李少凡, 董丽虹, 王海斗, 靖建农

LI Guo-lu, LI Shao-fan, DONG Li-hong, WANG Hai-dou, JING Jian-nong

11 可生物降解镁及镁合金表面改性研究进展

Research Progress on Surface Modification of Biodegradable Magnesium and Magnesium Alloys

胡怡娟, 毕衍泽, 何东磊, 于宏燕, 李岩

HU Yi-juan, BI Yan-ze, HE Dong-lei, YU Hong-yan, LI Yan

### 专题——高能冲击磁控溅射技术及工程应用

#### Special Topic—High Power Impulse Magnetron Sputtering Technology and Engineering Application

20 高功率脉冲磁控溅射 (HiPIMS) 等离子体放电时空特性研究进展

Temporal/Spatial Characteristics of Plasma Discharge by High Power Impulse Magnetron Sputtering (HiPIMS)

韩明月, 李刘合, 李花, 艾猛, 罗阳

HAN Ming-yue, LI Liu-he, LI Hua, AI Meng, LUO Yang

53 高功率脉冲磁控溅射制备非晶碳薄膜研究进展

Research Progress on Preparation of Amorphous Carbon Thin Films by High Power Impulse Magnetron Sputtering

左潇, 孙丽丽, 汪爱英, 柯培玲

ZUO Xiao, SUN Li-li, WANG Ai-ying, KE Pei-ling

64 直流和高功率磁控溅射制备氮化铬薄膜及其结构性能比较

Comparison of Chromium Nitride Thin Films Deposited by Reactive Direct Current Magnetron Sputtering and High Power Pulsed Magnetron Sputtering

李倩, 李花, 王正铎, 张海宝, 杨丽珍, 刘忠伟, 陈强

LI Qian, LI Hua, WANG Zheng-duo, ZHANG Hai-bao,

YANG Li-zhen, LIU Zhong-wei, CHEN Qiang

70 直流磁控溅射和高功率脉冲磁控溅射 TiSiN 涂层的结构与性能比较

Comparative Study on Structure and Properties of TiSiN Coatings Prepared by DCMS and HiPIMS

李林儒, 王振玉, 左潇, 刘林林, 黄美东, 柯培玲, 汪爱英

LI Lin-ru, WANG Zhen-yu, ZUO Xiao, LIU Lin-lin,

HUANG Mei-dong, KE Pei-ling, WANG Ai-ying

78 三靶共溅射纳米复合 Cr-Al-Si-N 涂层的制备及摩擦学性能研究

Preparation and Tribological Properties of Cr-Al-Si-N Nanocomposite Coatings by Three Target Co-sputtering

王铁钢, 蒙德强, 李柏松, 赵彦辉, 刘艳梅, 姜肃猛

WANG Tie-gang, MENG De-qiang, LI Bai-song, ZHAO Yan-hui, LIU Yan-mei, JIANG Su-meng

87 304 不锈钢管内壁沉积耐磨防腐 DLC 涂层

Deposition of Anti-corrosion and Wear-resisting DLC Coatings on Inner Wall of 304SS Tube

魏徐兵, 张明蓝, 王焱, 鲁志斌, 张广安, 林博

WEI Xu-bing, ZHANG Ming-lan, WANG Yan, LU Zhi-bin, ZHANG Guang-an, LIN Bo

## 表面强化及功能化 Surface Strengthening and Functionalization

97 不锈钢基板表面粗糙度对水膜吸附夹持的影响

Effect of Surface Roughness of Stainless-steel Substrate on Water-film Adhesion

黃晟, 杭伟, 陈芝向, 袁巨龙, 赵萍, Duc-Nam Nguyen

HUANG Sheng, HANG Wei, CHEN Zhi-xiang, YUAN Ju-long, ZHAO Ping, Duc-Nam Nguyen

104 微纳结构对硅基超疏水表面冷凝特性的影响

Effect of Micro/Nano Structure on Condensation Characteristics of Hierarchical Superhydrophobic Silicon Surface

董健, 董鹤, 龙芝剑, 郭有海, 叶森斌

DONG Jian, DONG He, LONG Zhi-jian, GUO You-hai, YE Sen-bin

113 热丝增强等离子体辅助渗氮中氮在不锈钢中的扩散与析出机制

Diffusion and Precipitation Mechanism of Nitrogen in Austenitic Stainless Steel during Hot-wire Enhanced Plasma-assisted Nitriding

滕越, 周艳文, 郭媛媛, 张鑫, 张泽, 陶思友, 陈军, 梁英爽

TENG Yue, ZHOU Yan-wen, GUO Yuan-yuan, ZHANG Xin,

ZHANG Ze, TAO Si-you, CHEN Jun, LIANG Ying-shuang

121 不同丸粒对铝合金表面喷丸影响的仿真分析及实验

Simulation and Experiment for Shot Peening Effect of Different Projectiles on Al-based Alloy

陈家伟, 廖凯, 李立君, 高自成, 钟利萍

CHEN Jia-wei, LIAO Kai, LI Li-jun, GAO Zi-cheng, ZHONG Li-ping

127 飞机钛合金接耳孔边激光冲击强化应力场优化与试验研究

Stress Field Optimization and Experimental Investigation of Titanium Alloy Lugs in Aircraft by Laser Shock Peening

冯晓泰, 何卫锋, 周留成, 田乐, 田增, 陈海波

FENG Xiao-tai, HE Wei-feng, ZHOU Liu-cheng, TIAN Le, TIAN Zeng, CHEN Hai-bo

135 含氟电解液中钛基铱钽氧化物电极的稳定性

Stability of Titanium-based  $\text{IrO}_2\text{-Ta}_2\text{O}_5$  Electrode in Electrolyte Containing Fluorine

蒋玉思, 肖方明, 王继民, 张建华

JIANG Yu-si, XIAO Fang-ming, WANG Ji-min, ZHANG Jian-hua

140 能量输入对 TC4 钛合金超声喷丸力学影响的仿真研究

Simulation Study on Effect of Energy Input on Mechanical Properties of TC4 Titanium Alloy by Ultrasonic Shot Peening

蔡晋, 刘建邦

CAI Jin, LIU Jian-bang

150 扫描速度对激光熔覆薄板高速钢变形与组织的影响

Effect of Scanning Speed on Deformation and Microstructure of Thin Plate High-speed Steel by Laser Cladding

陈翔, 张德强, 孙文强, 王一臣, 张吉庆

CHEN Xiang, ZHANG De-qiang, SUN Wen-qiang, WANG Yi-chen, ZHANG Ji-qing

158 AerMet100 钢喷丸强化前后表面完整性及疲劳性能分析

Effect of Shot Peening on Surface Integrity and Fatigue Properties of AerMet100 Steel

钱昂, 金平, 谭晓明, 王德, 王鹏

QIAN Ang, JIN Ping, TAN Xiao-ming, WANG De, WANG Peng

## 表面摩擦磨损与润滑 Surface Friction Wear and Lubrication

167  $\text{La}_2\text{O}_3$  改性  $\text{Ti}/\text{MoS}_2$  镍基复合涂层微观组织和摩擦学性能研究

Microstructure and Tribological Properties of  $\text{La}_2\text{O}_3$  Modified  $\text{Ti}/\text{MoS}_2$  Nickel-based Composite Coatings

韩雪, 刘金娜, 崔秀芳, 卢熙群, 金国

HAN Xue, LIU Jin-na, CUI Xiu-fang, LU Xi-qun, JIN Guo

177 激光熔覆  $\text{NiCrBSi}/\text{Ag}$  复合涂层结构及空间摩擦学性能

Microstructure and Space Tribological Properties of  $\text{NiCrBSi}/\text{Ag}$  Composite Coating Prepared by Laser Cladding

郭纯, 马明亮, 陈丰, 魏宝丽

GUO Chun, MA Ming-liang, CHEN Feng, WEI Bao-li

## 表面失效及防护 Surface Failure and Protection

185 NiCrWMoCuCBFe 涂层的制备及其力学性能研究

Preparation and Mechanical Properties of NiCrWMoCuCBFe Coatings

王怡静, 郝恩康, 赵晓琴, 安宇龙, 周惠娣

WANG Yi-jing, HAO En-kang, ZHAO Xiao-qin, AN Yu-long, ZHOU Hui-di

193 喷枪扫描速度对等离子喷涂 Mo/8YSZ 梯度热障涂层温度场的影响规律研究

Effects of Scanning Speed of Spraying Gun on Temperature Field of Mo/8YSZ Gradient Thermal Barrier Coatings by Plasma Spraying

庞铭, 张啸寒, 刘光

PANG Ming, ZHANG Xiao-han, LIU Guang

204 铫合金表面涂层耐高温高压动水腐蚀性能的研究

High Temperature and High Pressure Hydrodynamic Corrosion of Zirconium Alloy Surface Coating

杨振, 樊湘芳, 邱长军, 李涛, 刘艳红, 王晓婧, 李怀林

YANG Zhen, FAN Xiang-fang, QIU Chang-jun, LI Tao,

LIU Yan-hong, WANG Xiao-jing, LI Huai-lin

211 超音速火焰喷涂 Cr<sub>3</sub>C<sub>2</sub>-NiCr 涂层在 NaOH 溶液中的腐蚀及冲蚀腐蚀磨损性能

Corrosion Resistance and Erosion-corrosion Wear Performance of HVOF Sprayed Cr<sub>3</sub>C<sub>2</sub>-NiCr Coating in NaOH Solution

王井, 何冰, 罗京帅, 员霄, 蹤雪梅

WANG Jing, HE Bing, LUO Jing-shuai, YUAN Xiao, ZONG Xue-mei

218 机械沉积 Cd 镀层的制备及性能研究

Preparation and Properties of Mechanically Deposited Cd Coatings

侯云波, 王胜民, 赵晓军, 张俊

HOU Yun-bo, WANG Sheng-min, ZHAO Xiao-jun, ZHANG Jun

224 等离子喷涂 Cr<sub>2</sub>O<sub>3</sub>/TiO<sub>2</sub> 高温氧化物陶瓷复合涂层的微观组织及电化学性能

Microstructure and Electrochemical Properties of Cr<sub>2</sub>O<sub>3</sub>/TiO<sub>2</sub> High Temperature Oxide Ceramic Composite Coating by Plasma Spraying

陈春江, 贾碧, 王云飞, 徐榕, 陈思静

CHEN Chun-jiang, JIA Bi, WANG Yun-fei, XU Rong, CHEN Si-jing

230 含砂流动海水中 Q235 钢冲刷腐蚀行为研究

Erosion-corrosion Behavior of Q235 Steel in Flowing Seawater Containing Sand Particles

彭文山, 刘雪键, 刘少通, 侯健, 邱日, 刘峰, 宋泓清

PENG Wen-shan, LIU Xue-jian, LIU Shao-tong, HOU Jian, QIU Ri, LIU Feng, SONG Hong-qing

238 WC 含量对激光熔覆 NiCrBSi-WC 复合涂层显微结构及力学性能的影响

Effect of WC Particle Content on Microstructure and Mechanical Properties of Laser Cladded NiCrBSi-WC Composite Coating

杨二娟, 李勇, 李巍, 李太江, 李毅超, 刘峰, 米紫昊, 王博

YANG Er-juan, LI Yong, LI Wei, LI Tai-jiang, LI Yi-chao, LIU Feng, MI Zi-hao, WANG Bo

## 膜层材料与技术 Coating Material and Technology

245 高功率脉冲磁控溅射制备的 TiN 薄膜应力释放及其结合稳定性研究

Stress Release and Adhesion Stability of TiN Films Deposited by High Power Pulsed Magnetron Sputtering

唐鑫, 马东林, 陈畅子, 冷永祥, 黄楠

TANG Xin, MA Dong-lin, CHEN Chang-zi, LENG Yong-xiang, HUANG Nan

252 磁场方向对脉冲电沉积制备 Ni-ZrO<sub>2</sub> 纳米复合镀层性能的影响

Effects of Magnetic Field Direction on Properties of Ni-ZrO<sub>2</sub> Nanocomposite Coatings Prepared by Pulse Electrodeposition

贾卫平, 吴蒙华, 贾振元, 周绍安, 佐姗姗, 俞维文

JIA Wei-ping, WU Meng-hua, JIA Zhen-yuan, ZHOU Shao-an, ZUO Shan-shan, YU Wei-wen

260 钕铁硼在 CuCl-EMIC 离子液体中电沉积铜层的研究

Electrodeposition of Copper on NdFeB in CuCl-EMIC Ionic Liquid

庄晨, 凌国平

ZHUANG Chen, LING Guo-ping

266 硫酸铈铵对甲烷磺酸浸镀银结晶过程的影响

Effect of Ceric Ammonium Sulfate Sulphate on Crystallization Process of Immersion Silver Plating in Methane Sulfonic Acid System

吴道新，杨荣华，肖忠良，王毅玮，姚文娟，周光华，王伟业

WU Dao-xin, YANG Rong-hua, XIAO Zhong-liang, WANG Yi-wei,

YAO Wen-juan, ZHOU Guang-hua, WANG Wei-ye

273 电弧离子镀电磁线圈电压对 TiAlN 涂层结构及性能的影响

Effect of Electromagnetic Coil Voltage on Microstructure and Properties of TiAlN Coating Prepared by Arc Ion Plating

李洪，杨鸿泰，林松盛，石倩，韦春贝，郭朝乾，苏一凡，唐鹏

LI Hong, YANG Hong-tai, LIN Song-sheng, SHI Qian,

WEI Chun-bei, GUO Chao-qian, SU Yi-fan, TANG Peng

280 紫外光固化聚氨酯自愈合涂层的合成和性能研究

Synthesis and Properties of UV Curable Polyurethane Self-healing Coating

巴森，王宪委，范芳欣，王玉丰，张占平，高强

BA Miao, WANG Xian-wei, FAN Fang-xin, WANG Yu-feng, ZHANG Zhan-ping, GAO Qiang

287 射频辅助磁控溅射制备梯度 Cr/CrC 膜的性能

Performance of Gradient Cr-DLC Film Prepared by RF Enhanced Magnetron Sputtering

黄珂，刘文军，谭科，罗书径

HUANG Ke, LIU Wen-jun, TAN Ke, LUO Shu-jing

293 工业电解液中镍阴极沉积和阳极溶出过程的 EQCM 研究

EQCM of Nickel Cathode Deposition and Anode Dissolution in Industrial Electrolyte

徐仰涛，黄凯，朱珍旭

XU Yang-tao, HUANG Kai, ZHU Zhen-xu

## 表面质量控制及检测 Surface Quality Control and Detection

300 铜镍合金微金字塔阵列模具线切割加工工艺研究

Wire Cutting Process for Micro-Pyramid Array Die of Copper-Nickel Alloy

管鹭伟，尹韶辉，黄帅，贾红鹏，陈逢军

GUAN Lu-wei, YIN Shao-hui, HUANG Shuai, JIA Hong-peng, CHEN Feng-jun

307 湿式主轴式滚磨光整加工中铝合金试件的材料去除行为研究

Material Removal Behavior of Aluminum Alloy Workpiece in Wet Spindle Barrel Finishing Process

王程伟，李秀红，李文辉，王娜，曹波

WANG Cheng-wei, LI Xiu-hong, LI Wen-hui, WANG Na, CAO Bo

315 基于模糊聚类和案例推理的滚抛磨块优选模型

Optimal Model of Abrasive Blocks Based on Fuzzy Clustering and Case-based Reasoning

杨炎，高炜，杨胜强，田建艳，高云松

YANG Yan, GAO Wei, YANG Sheng-qiang, TIAN Jian-yan, GAO Yun-song

321 金属粉末增强机械抛光单晶金刚石

Mechanical Polishing Single Crystal Diamond Reinforced by Metal Powder

刘浩，李佳君，李震睿，徐锴，陈正佳，孙占峰，陈广超

LIU Hao, LI Jia-jun, LI Zhen-rui, XU Kai, CHEN Zheng-jia, SUN Zhan-feng, CHEN Guang-chao

327 工件表面缺陷图像检测中的自适应聚类

Adaptive Clustering Method of Image Detection for Work-piece Surface Defect

周友行，马逐曦，石弦韦，刘汉江

ZHOU You-hang, MA Zhu-xi, SHI Xian-wei, LIU Han-jiang

336 光整滚光和开缝衬套挤压孔结构表面完整性及疲劳行为研究

Surface Integrity and Fatigue Behaviour of Holes Treated by Finishing & Burnishing and Split Sleeve Cold Expansion

王燕礼，卞小芳，符彬，曹强

WANG Yan-li, BIAN Xiao-fang, FU Bin, CAO Qiang