

表面技术

SURFACE TECHNOLOGY

ISSN 1001-3660
CN 50-1083/TG

2020年9月
第49卷 第9期
Vol.49 No.9

EI Compendex 收录期刊

全国中文核心期刊

2017第三届全国百强报刊

中国科学引文数据库（CSCD）来源期刊（核心库）

中国科技核心期刊

第4届中国精品科技期刊

表面技术

第四十九卷

第九期

二〇二〇年九月

主办单位

出版单位

万方数据

中国兵器工业第五九研究所

重庆五九期刊社



目 次 CONTENTS

专题——减摩抗磨添加剂与表面的相互作用

Special Topic—Interaction between Friction-reduction and Anti-wear Additives and Surface

1 油溶性有机减摩抗磨添加剂的研究进展

Research Progress of Oil-soluble Organic Friction-reduction and Anti-wear Additives

于强亮, 蔡美荣, 周峰, 刘维民

YU Qiang-liang, CAI Mei-rong, ZHOU Feng, LIU Wei-min

19 润滑油纳米添加剂的研究进展

Research Progress of Nanomaterials as Lubricant Oil Additives

岳鹏, 张玉娟, 张平余, 张治军, 张晟卯

YUE Peng, ZHANG Yu-juan, ZHANG Ping-yu, ZHANG Zhi-jun, ZHANG Sheng-mao

35 非硫磷有机钼的摩擦学性能研究

Tribological Properties of Non-thiophosphorous Organic Molybdenum

戴媛静, 李小磊, 凌燕丽, 邹阳, 张继平, 张晨辉

DAI Yuan-jing, LI Xiao-lei, LING Yan-li, ZOU Yang, ZHANG Ji-ping, ZHANG Chen-hui

45 含磷极压抗磨剂抗微点蚀性能评价和机理分析

The Study of the Anti-micro-pitting Performance of the EP&AW Additives

张继平, 王鹏, 郝利峰, 戴媛静, 李小磊

ZHANG Ji-ping, WANG Peng, HAO Li-feng, DAI Yuan-jing, LI Xiao-lei

53 钛合金切削用磷酸酯类添加剂润滑特性及有机碱复配研究

Lubrication of Phosphate Esters as Titanium Alloy Cutting Fluid Additives and Compound of Organic Alkali

杨晔, 司丽娜, 王岩, 张晨辉

YANG Ye, SI Li-na, WANG Yan, ZHANG Chen-hui

61 二维纳米片状 MoS₂ 的制备及其作为润滑添加剂的减摩抗磨性能

The Synthesis of Two-dimensional MoS₂ Nanosheets and their Friction-reducing and Anti-wear Properties as Lubricating Additives

胡贊, 廖智忠, 易美荣

HU Yun, LIAO Zhi-zhong, YI Mei-rong

72 低黏度 0W-16 汽油机油减摩性能研究

Friction-reduced Property of 0W-16 Low Viscosity Engine Oil

郝丽春, 杨鹤, 张威力, 卢文彤, 刘顺涛, 张建荣

HAO Li-chun, YANG He, ZHANG Wei-li, LU Wen-tong, LIU Shun-tao, ZHANG Jian-rong

81 自动传动液中含磷摩擦改进剂与含钙清净剂影响抗颤性的协同效应

Synergistic Effect of P-containing Friction Modifier and Ca-containing Detergent in Automatic Transmission Fluid on Anti-shudder Characteristic

狄泽超, 姜禹, 张孟佳, 马永宏, 张雪涛

DI Ze-chao, JIANG Yu, ZHANG Meng-jia, MA Yong-hong, ZHANG Xue-tao

专题——热喷涂技术研究及应用 (2019 重庆市出版专项资金期刊资助项目)

Special Topic—Research and Application of Thermal Spraying Technology

91 低压冷喷涂 Al(Y)-Al₂O₃-MoS₂ 涂层的工艺优化及其耐磨损性能研究

Process Optimization and Wear Resistance Behavior of Al(Y)-Al₂O₃-MoS₂ Coatings via Low-pressure Cold Spray Technology

白杨, 王振华, 李相波, 李焰

BAI Yang, WANG Zhen-hua, LI Xiang-bo, LI Yan

101 氧化锆基双陶瓷层热障涂层表层材料研究进展
Research Progress on Top Coating Materials of Thermal Barrier Coatings with Double-ceramic-layer Based on Zirconia

吴硕, 赵远涛, 李文戈, 赵忠贤, 刘未来, 吴艳鹏

WU Shuo, ZHAO Yuan-tao, LI Wen-ge, ZHAO Zhong-xian, LIU Wei-lai, WU Yan-peng

109 纳米晶 NiCrC 涂层长时加热的显微组织和硬度变化
Microstructure and Hardness Variation of Nanocrystalline NiCrC Coating after Long-term Heating
陶凯, 韩璐, 李峰辉, 周香林, 张济山
TAO Kai, HAN Lu, LI Feng-hui, ZHOU Xiang-lin, ZHANG Ji-shan

研究综述 Review

118 选区激光熔化金属表面成形质量控制的研究进展
Research Progress in Forming Quality Control of Selective Laser Melting Metal Surface
李淮阳, 黎振华, 杨睿, 滕宝仁, 申继标
LI Huai-yang, LI Zhen-hua, YANG Rui, TENG Bao-ren, SHEN Ji-biao

125 固体氧化物燃料电池铈基电解质的研究进展
Research Progress in Ceria-based Electrolytes of Solid Oxide Fuel Cell
赵雪雪, 门引妮, 邢亚哲
ZHAO Xue-xue, MEN Yin-ni, XING Ya-zhe

133 喷丸奥氏体耐热钢抗蒸汽氧化性的研究与使用现状
Research and Application Status of Steam Oxidation Resistance of Shot Peening Austenitic Heat-resistant Steel
张骏, 蔡文河, 杜双明, 董树青, 谌康, 郑准备
ZHANG Jun, CAI Wen-he, DU Shuang-ming, DONG Shu-qing, SHEN Kang, ZHENG Zhun-bei

141 化学气相沉积钨涂层的研究现状与进展
Research Status and Development of Chemical Vapor Deposition Tungsten Coating
张福林, 王旋, 宋凯强, 李忠盛, 丛大龙, 何庆兵
ZHANG Fu-lin, WANG Xuan, SONG Kai-qiang, LI Zhong-sheng, CONG Da-long, HE Qing-bing

表面功能化 Surface Functionalization

149 聚多巴胺改性碳纳米管增强羧基丁腈橡胶动态力学性能的研究
Dynamic Mechanical Properties of Polydopamine Modified Multi-walled Carbon Nanotubes Reinforced Carboxyl Nitrile Rubber
陈多礼, 樊小强, 张林, 李文, 朱旻昊
CHEN Duo-li, FAN Xiao-qiang, ZHANG Lin, LI Wen, ZHU Min-hao

157 3D 打印制备各向异性超疏水功能表面的定向输送性能
Directional Transport Properties of Anisotropic Superhydrophobic Functional Surfaces Prepared by 3D Printing
唐昆, 李典雨, 陈紫琳, 杜家兵, 张明军, 毛聰, 张健, 胡永乐
TANG Kun, LI Dian-yu, CHEN Zi-lin, DU Jia-bing, ZHANG Ming-jun, MAO Cong, ZHANG Jian, HU Yong-le

167 水蒸气处理对钛合金表面羟基磷灰石涂层结构的影响
Effect of Steam Treatment on the Structure of Hydroxyapatite Coating on Titanium Alloy
杨学兵, 张林伟
YANG Xue-bing, ZHANG Lin-wei

175 电沉积 Ni-Fe-P 非晶合金析氢阴极材料及其去合金化处理
Electrodeposited Ni-Fe-P Amorphous Alloy as Cathode Material for Hydrogen Evolution and Its De-alloying Treatment
司迎迎, 任亚东, 赵永强, 闫叶祥, 谢广文, 王桂雪, 刘欣
SI Ying-ying, REN Ya-dong, ZHAO Yong-qiang, YAN Ye-xiang, XIE Guang-wen, WANG Gui-xue, LIU Xin

182 柠檬酸钠对 Ni-Sn-Mo 合金电沉积机理及析氢行为的影响
Effect of Sodium Citrate on Electrodeposition Mechanism and Hydrogen Evolution Behavior of Ni-Sn-Mo Alloy
张丽楠, 温林洁, 周宗熠, 崔鹏飞, 李运刚, 杨海丽
ZHANG Li-nan, WEN Lin-jie, ZHOU Zong-yi, CUI Peng-fei, LI Yun-gang, YANG Hai-li

191 准分子激光辐照对激光选区熔化成形 Ti6Al4V 合金表面浸润性的影响

Effect of Excimer Laser Irradiation on the Surface Wettability of Selective Laser Melted Ti6Al4V Alloy

徐仰立, 李婷婷, 曹玄扬, 谭援强

XU Yang-li, LI Ting-ting, CAO Xuan-yang, TAN Yuan-qiang

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

198 一种改性全氟聚醚衍生物在全氟聚醚基础油中的摩擦学性能研究

Friction Properties of Modified Perfluoropolyether Derivatives in Perfluoropolyether Base Oil

张建强, 高一鸣, 姜滢, 梁成峰, 张航文, 李久盛

ZHANG Jian-qiang, GAO Yi-ming, JIANG Ying,

LIANG Cheng-feng, ZHANG Hang-wen, LI Jiu-sheng

206 超声振幅对激光熔覆 WC/IN718 复合涂层组织及性能的影响

Effect of Ultrasound Amplitude on Microstructure and Properties of Laser Cladding WC/IN718 Composite Coatings

聂学武, 周建忠, 徐家乐, 黄舒, 孟宪凯, 黄蕾, 霍坤

NIE Xue-wu, ZHOU Jian-zhong, XU Jia-le, HUANG Shu,

MENG Xian-kai, HUANG Lei, HUO Kun

215 不同弧电流对 AlCrBN 涂层结构和性能的影响

Effects of Different Arc Currents on the Structures and Properties of AlCrBN Coatings

王建明, 蔡飞, 张林, 张世宏

WANG Jian-ming, CAI Fei, ZHANG Lin, ZHANG Shi-hong

225 低碳钢电弧熔覆增材层摩擦磨损及抗腐蚀性能

Friction and Wear Resistance and Corrosion Resistance of Low Carbon Steel Arc Welding Additive Layer

薛冰, 雷卫宁, 刘骁, 陈世鑫

XUE Bing, LEI Wei-ning, LIU Xiao, CHEN Shi-xin

233 激光熔覆 Inconel718 合金裂纹分析及裂纹控制研究

Crack Analysis and Control of Laser Cladding Inconel718 Alloy

鲁耀钟, 雷卫宁, 任维彬, 陈世鑫

LU Yao-zhong, LEI Wei-ning, REN Wei-bin, CHEN Shi-xin

244 偶件表面粗糙度对回转支承隔离体使用性能的影响

Effect of Surface Roughness of Counterpart on the Performance of Isolation Block in Slewing Bearing

黄传辉, 刘磊, 张宁

HUANG Chuan-hui, LIU Lei, ZHANG Ning

252 固/液界面润湿性对线接触油膜润滑的影响

Effect of Wettability of Solid/Liquid Interface on Film Lubrication in Line Contact

金微, 李书义, 荆兆刚, 郭峰

JIN Wei, LI Shu-yi, JING Zhao-gang, GUO Feng

表面失效及防护 Surface Failure and Protection

258 脉冲电源占空比对电弧离子镀 AlCrN 涂层结构和性能的影响

Effects of Duty Cycle on Structures and Properties of AlCrN Coatings Deposited by Pulsed Arc Ion Plating

赵鑫, 刘琰, 杨豆, 李敬雨, 杨兵

ZHAO Xin, LIU Yan, YANG Dou, LI Jing-yu, YANG Bing

266 基于 ABAQUS-Matlab 对 42CrMo 钢表面感应淬火奥氏体化参数的研究

42CrMo Austenitization Kinetic Parameters in Induction Hardening Process Based on ABAQUS-Matlab

钟汉烈, 汪舟, 甘进, 王晓丽, 杨莹, 闫占乱, 韦婷婷

ZHONG Han-lie, WANG Zhou, GAN Jin, WANG Xiao-li,

YANG Ying, YAN Zhan-luan, WEI Ting-ting

274 基于 DSMC-CFD 方法的气固两相流冲蚀预测研究

Erosion Prediction of Gas-Solid Flow Based on DSMC-CFD Method

孙晓阳, 曹学文, 谢振强, 付晨阳

SUN Xiao-yang, CAO Xue-wen, XIE Zhen-qiang, FU Chen-ying

281 X80 管线钢在硫酸盐还原菌作用下的腐蚀行为

Effect of SRB on Corrosion Behavior of X80 Pipeline Steel

万红霞, 李婷婷, 宋东东, 陈长风

WAN Hong-xia, LI Ting-ting, SONG Dong-dong, CHEN Chang-feng

291 C/SiC 复合材料与抗氧化陶瓷涂层的优化匹配

Optimal Matching of Anti-oxidation Ceramic Coatings with C/SiC Composites

杨彦龙, 张凯峰, 曹生珠, 汤富领, 薛红涛

YANG Yan-long, ZHANG Kai-feng, CAO Sheng-zhu, TANG Fu-ling, XUE Hong-tao

298 碳钢表面导电 PEDOT 涂层的电化学制备及防腐性能

Electrochemical Preparation and Corrosion Resistance of Conductive PEDOT Coating on Carbon Steel Surface

高博文, 王美涵, 闫茂成, 雷浩

GAO Bo-wen, WANG Mei-han, YAN Mao-cheng, LEI Hao

306 电弧离子镀偏压对 TiAlSiN 涂层结构及性能的影响

Effect of Arc Ion Plating Bias on Structure and Properties of TiAlSiN Films

宋智辉, 代明江, 李洪, 洪悦, 林松盛, 石倩, 苏一凡

SONG Zhi-hui, DAI Ming-jiang, LI Hong, HONG Yue, LIN Song-sheng, SHI Qian, SU Yi-fan

315 激光熔覆 WC/Ni 粉末对冷作模具刃口修复的实验研究

Experimental Study on Laser Cladding WC/Ni Powder to Repair the Cutting Edge of Cold Working Die

孙文强, 张德强, 贾云杰, 陈翔, 李伦翔

SUN Wen-qiang, ZHANG De-qiang, JIA Yun-jie, CHEN Xiang, LI Lun-xiang

324 固溶渗氮对 Cr18Mn21Mo2.5 钢组织及性能的影响

Effect of Solution Nitriding on Structure and Properties of Cr18Mn21Mo2.5 Steel

丁国刚, 隋小波, 刘可心, 陈咨伟, 黄岩, 金松哲

DING Guo-gang, SUI Xiao-bo, LIU Ke-xin, CHEN Zi-wei, HUANG Yan, JIN Song-zhe

332 钢板连续移动感应淬火温度场数值模拟及实验研究

Numerical Simulation and Experiment Research on the Temperature Field of Continual Induction Hardening for a Steel Plate

陈庆安, 王艳辉, 张建宇, 马鹏辉, 李河宗

CHEN Qing-an, WANG Yan-hui, ZHANG Jian-yu, MA Peng-hui, LI He-zong

339 湿固化型石墨烯改性重防腐涂料的性能研究

Properties of Moisture Curing Graphene Modified Marine Anticorrosive Coatings

孙阔腾, 蔡玮辰, 周经中, 钟万才, 韦扬志, 赵忠贤, 赵远涛, 李文戈

SUN Kuo-teng, CAI Wei-chen, ZHOU Jing-zhong, ZHONG Wan-cai,

WEI Yang-zhi, ZHAO Zhong-xian, ZHAO Yuan-tao, LI Wen-ge

348 2A12 铝合金不同阳极氧化膜在 NaCl 溶液中的电化学演变

Electrochemical Evolution of 2A12 Aluminum Alloy with Different Anodic Films in NaCl Solution

陈跃良, 张杨广, 卞贵学, 张勇, 张柱柱

CHEN Yue-liang, ZHANG Yang-guang, BIAN Gui-xue, ZHANG Yong, ZHANG Zhu-zhu

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

357 波前传感器电铸镍层应力实时检测精度评估

Accuracy Evaluation of Real-time Detection on Internal Stress of Nickel Electroforming Based on Wave Front Sensor

罗坤杰, 蒋炳炎, 强军, 董彦灼, 柴思佳

LUO Kun-jie, JIANG Bing-yan, QIANG Jun, DONG Yan-zhuo, CHAI Si-jia

364 基于研磨氧化锆陶瓷的金刚石/铁磁性磨粒制备研究

Preparation of Diamond/Iron Magnetic Abrasive Particles Based on Grinding Zirconia Ceramics

吕旖旎, 陈燕, 赵杨, 巫昌海, 康璐

LYU Yi-ni, CHEN Yan, ZHAO Yang, WU Chang-hai, KANG Lu

370 基于 GRA-RSM 的微铣削表面质量多目标参数优化

Multi-objective Parameters Optimization of Micro-milling Surface Quality Based on GRA-RSM

李文琴, 于占江, 许金凯, 江海宇, 于化东

LI Wen-qin, YU Zhan-jiang, XU Jin-kai, JIANG Hai-yu, YU Hua-dong

378 选区激光熔化成形 Inconel 718 合金孔隙缺陷的研究

Pore Defects of Inconel 718 Alloy Fabricated by Selective Laser Melting

王志强, 王学德, 谢瑞鹏, 周鑫, 张佩宇, 李秋良

WANG Zhi-qiang, WANG Xue-de, XIE Rui-kun, ZHOU Xin, ZHANG Pei-yu, LI Qiu-liang