

# **Third International Workshop on Materials Science and Mechanical Engineering (IWMSME 2020)**

IOP Conference Series: Materials Science and Engineering  
Volume 892

Hangzhou, China  
18 - 20 April 2020

Part 1 of 2

## **Editors:**

**Bingang Xu  
Xi Peng**

ISBN: 978-1-7138-4750-2  
ISSN: 1757-8981

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

This work is licensed under a Creative Commons Attribution 3.0 International Licence.  
Licence details: <http://creativecommons.org/licenses/by/3.0/>.

No changes have been made to the content of these proceedings. There may be changes to pagination and minor adjustments for aesthetics.

Printed with permission by Curran Associates, Inc. (2022)

For permission requests, please contact the Institute of Physics  
at the address below.

Institute of Physics  
Dirac House, Temple Back  
Bristol BS1 6BE UK

Phone: 44 1 17 929 7481  
Fax: 44 1 17 920 0979

[techtracking@iop.org](mailto:techtracking@iop.org)

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2633  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

## TABLE OF CONTENTS

### PART 1

Preface

Peer review statement

Texture and microstructure evolution of 321 austenitic stainless steel ultra-thin strip during asynchronous rolling .....	1
<i>Jingqi Chen, Liuqing Yang, Xianlei Hu, Xianghua Liu</i>	
Microstructural analysis of rail tracks defects: case study.....	7
<i>Msoyi Velaphi, Basson Conrad Charl Peter, Mabuwa Sipokazi</i>	
Self-assembled NiTe <sub>2</sub> nanocrystals as highly efficient and stable electrocatalyst for hydrogen evolution reaction.....	14
<i>Xinqiang Wang, Yuanfu Chen</i>	
TiO <sub>2</sub> -(Zn1/3Nb2/3)O <sub>2</sub> -ZrO <sub>2</sub> microwave dielectric ceramics with near-zero temperature coefficient of resonant frequency .....	20
<i>Geng Wang, Qiuyun Fu, Lu Zhang</i>	
Fatigue life extension of 42CrMo high-strength steel and its micro strengthening mechanism under laser shock peening.....	27
<i>Ruijian Sun, Weiqing Huang, Ziwen Cao, Zhigang Che, Shikun Zou, Junfeng Wu</i>	
Effect of nano titanium dioxide on mechanical properties of regenerated silk.....	35
<i>Yan Liu, Xiaoliang Wang, Chen Xu, Qiang Ma, Lin Ma, Guohua Wu</i>	
Effect of annealing temperature on the microstructure and optical properties of MoS <sub>2</sub> films .....	42
<i>Bianlian Zhang, Zhen Cheng, Yu Meng</i>	
Effect of sputtering power on the microstructure and photovoltaic properties of Al doped ZnO thin films.....	49
<i>Shuli Li, Yu Meng, Bianlian Zhang, Zhen Cheng, Yuanyuan Li, Xiaoxia Zhao</i>	
Preparation and characteristics of Co nanoporous magnetic materials synthesized by a template-free method.....	55
<i>Jing Kong, Yan Li, Hong Gao, Xiangke Wang, Xiangtian Yu, Ziyang Yao, Fenglong Wang, Jiurong Liu</i>	
Study on the fractal structure of carbon nanomaterials' smokescreen.....	64
<i>Xusheng Wang, Zibiao Song, Qian Gao, Rui Song</i>	
Perovskites for printed flexible electronics .....	70
<i>Lei Wang, Yang Wang</i>	
Multifunctional coatings formed using organic and inorganic nanomaterials.....	80
<i>Nadaraia Konstantine, Mashtalyar Dmitry, Opra Denis, Imshinetsky Igor, Sokolov Aleksandr, Sinebryukhov Sergey, Gnedenkov Sergey</i>	
Study on the processing map of antibacterial Ti-10Cu sintered alloy .....	86
<i>Liqiu Shi, Feng Yu, Chun Xiang</i>	

Application of S-doped TiO <sub>2</sub> photocatalysts in degradation of BTEX from synthetic surfaces .....	93
<i>Ronghui Yuan, Tinghua Wu, Tianyi Hu, Li Shi, Jing Shi</i>	
Effect of cryogenic-tempering treatment on the performance of high ni gear steel .....	101
<i>Xuan Chen, Mingming Song, Tao Liu, Ye Pu, Bin Ye, Yunping Zhang</i>	
Application of PVC-melamine-formaldehyde resin composite in drug adsorption.....	110
<i>Boyi Qi, Qinghao Yang</i>	
Effects of electromagnetic induction hardening on the microstructure and mechanical properties of B1500HS steel.....	117
<i>Pengyuan Qi, Qi Sun, Jingyu Zhong, Gang Wang, Xianghua Liu, Weijie Liu</i>	
Research on the preparation and properties of biodegradable wood-plastic composites.....	124
<i>Zhenghao Ge, Xiaoqian Li, Dange Si</i>	
Experimental analysis of damage mechanism and shrinkage performance of recycled concrete.....	131
<i>Ying Liu, Tianling Du</i>	
Effect of sputtering power on the microstructure of Mg doped ZnO thin films .....	136
<i>Zhen Cheng, Yu Meng, Bianlian Zhang</i>	
Experimental study on deformation region types and percentages of each region in asymmetrical rolling of strip .....	142
<i>Xiangkun Sun, Xianghua Liu, Junlong Qi, Ji Wang</i>	
Effect of different micro-texture shape on corrosion resistance of metal surface .....	149
<i>Rui Xu, Yongsheng Wang, Yipu Wang, Zhankui Wang, Jianxiu Su</i>	
The research status and summary of adsorption and retention mechanism of polymer .....	156
<i>Yang Liu, Xingcai Wu, Xuezhi Zhai, Gang Shi, Yinzhu Ye, Shichao Li, Peiwen Xiao</i>	
Synthesis and fluorescence properties of dansyl labeled triazine dendrons .....	163
<i>Long Li, Rong-chao Cheng, Cha Ma, Hui-jun Hao, Li-hua Li, Zhi-liang Zhao</i>	
Preparation and photoelectrochemical properties of porous silicon/carbon dots composites.....	170
<i>Xiang Kang, Lin Wu, Jinhui Xu, Dong Liu, Quanguo Song, Ya Hu</i>	
Analysis on corrosion of flat steel used in grounding grid for 220 kV substation.....	177
<i>Hao Chen, Wenxuan Fang, Kuo Han, Xin Qiao</i>	
Conductive WO <sub>3-x</sub> @CNT networks for efficient Li-S batteries .....	183
<i>Bo Yu, Yuanfu Chen</i>	
Coupled simulation for reentry ablative behavior of hypersonic vehicles.....	190
<i>Zongshu Mei, Chengying Shi, Xueling Fan, Xiaobin Wang</i>	
Structural design flow of typical aircraft components based on topology optimization.....	200
<i>Zhijie Feng, Jianbin Du, Haixi Zhang, Kai Wu</i>	
Research on the effect of vibration of aerial cameras on imaging quality under flight conditions.....	208
<i>Jieqiong Lin, Xin Guo, Yan Gu, Minghui Gao, Hanyuan Zhang</i>	
Application of tractor virtual test technology in product innovation design .....	215
<i>Xianghai Yan, Zhili Zhou, Zhongli Li</i>	

A loose self-checking method based on FBG for axle counting sensor .....	222
<i>Lu Zhang, Zhixin Wang, Qiuji Yan, Jinfeng Lin, Chunxiao Wu</i>	
Mechanical behavior of composite ship structures with open-hole.....	228
<i>Xiaowen Li, Zhaoyi Zhu, Yan Li, Qinglin Chen, Xiaoying Zhang</i>	
MPC-based path tracking with PID speed control for autonomous vehicles.....	237
<i>Shuping Chen, Huiyan Chen</i>	
Comparison and application of two time domain methods analysis to modal parameter identification of Songhuajiang River highway-railway bridge.....	252
<i>Bo Jin, Chuankai Zhu, Kunyang Yu, Zhongwei Li, Yu Bai</i>	
Radius survey of crawler crane base on total station.....	262
<i>Haixiang Xu, Jun Qiu, Fengqi Wu, Jiai Xue</i>	
Effect of non-metallic inclusions on fatigue life of high-speed railway bearings .....	269
<i>Can Yang Ma, Gang Zhang, Yong Wu Wang, Zhen Qiang Zhang, Zhong Ming Ren</i>	
Study on the collaborative design architecture of tractor performance prototype .....	280
<i>Yiwei Wu, Zhili Zhou</i>	
Research on multi-task command allocation method for flying wing aircraft.....	288
<i>Ning Zhang, Lixin Wang, Feng Li</i>	
Development of the flatness detection system for cement concrete pavement construction phase .....	298
<i>Ying Liu, Tianling Du, Jinde Xie</i>	
Extraction of typical driving cycles in plateau based on improved short-stroke method .....	304
<i>Feng Shi, Shichao Cui, Han Bu, Bingshuo Chen, Yulong He</i>	
Structural parameters of new rail transit system optimization theory research .....	312
<i>Zhifei Wang, Fan Li</i>	
Design of remote wireless cylinder pressure control system.....	319
<i>Ruihan Wu</i>	
Research on train fingerprint positioning based on LTE-R signal strength.....	328
<i>Miao Luo</i>	
Research on intelligent vehicle trajectory tracking based on model predictive control.....	336
<i>Yongshou Fang, Jin Cheng, Minyu Lv</i>	
Investigation on the thermal problems of wet clutches for the tracked DCT vehicle during the launching process .....	347
<i>Zhe Yang</i>	
Research on pavement garbage detection based on machine vision.....	354
<i>Jiawei Liu, Tian Guan, Yajing Zhen, Yaoming Zhang, Xiaoli Song, Zhaojian Wang, Dongsheng Zhang</i>	
Control strategy and simulation verification of hardware-in-the-loop system of automotive steering device .....	361
<i>Yajing Zhen, Zhaojian Wang, Jiawei Liu, Tian Guan, Yaoming Zhang, Mengen Wang, Xiaoli Song, Dongsheng Zhang</i>	

Design of license plate recognition system based on capsule network.....	368
<i>Tian Guan, Yajing Zhen, Xiaoli Song, Jiawei Liu, Mengen Wang, Zhaojian Wang, Yaoming Zhang, Dongsheng Zhang</i>	
Driverless simulation of path tracking based on PID control .....	375
<i>Zhaojian Wang, Mengen Wang, Yaoming Zhang, Tian Guan, Xiaoli Song, Jiawei Liu, Yajing Zhen, Dongsheng Zhang</i>	
Research on visual vehicle detection and tracking based on deep learning.....	382
<i>Yaoming Zhang, Xiaoli Song, Mengen Wang, Tian Guan, Jiawei Liu, Zhaojian Wang, Yajing Zhen, Dongsheng Zhang, Xiaoyi Gu</i>	
Research on optimal meshing speed difference based on shift success probability for dog Clutch in automated manual transmission.....	389
<i>Shaohua Sun, Maosen Gong, Baogui Wu, Yupeng Zou</i>	
The research on train resistance prediction of low vacuum pipeline based on different neural network algorithms.....	397
<i>Chengxin Du, Zhifei Wang, Fan Li, Ruilong Feng</i>	
Experiments on the damping characteristics of a high-speed train hydraulic damper under low-temperature conditions .....	404
<i>Wenlin Wang, Xin Kong, Yongming Wu</i>	
Enhancement of power generation of thermoelectric generator using phase change material .....	409
<i>Jianhui Mao, Anbang Liu, Yuanyuan Wang, Yihuai Li, Huaqing Xie, Zihua Wu</i>	
Exploration and practice of intelligent manufacturing of electronic information equipment.....	418
<i>Kecun Ben, Zhanying Feng, Yaqi Cao</i>	
Low-loss tunable dielectrics for millimeter-wave phase shifter: from material modelling to device prototyping .....	427
<i>Jinfeng Li</i>	
A HMM-based and multi-indicator driven network model for complex electromechanical system reliability analysis with considering reliability fluctuation .....	433
<i>Jiwu Li, Zhiyong Gao, Rongxi Wang</i>	
Application of hybrid MCGDM model combined with VIKOR method in power grid equipment optimization.....	442
<i>Yatang Yang, Gang Sun, Yansong Liu, Fumin Chen</i>	
Modeling and experiment of double-feet piezoelectric linear motor stator system.....	451
<i>Xiangqiang Zhong, Zhimin Di, Shunyu Yao, Huajie Fang, Jiang Feng</i>	

## PART 2

Effect of motor characteristics on uncertainty of electric flow diverter with large pipe diameter.....	459
<i>Haiyang Li, Xuejing Li, Yuyang Chen, Lijun Sun</i>	
Pole assignment PID controller based on parameter identification and its application .....	468
<i>Tong Lu, Ruliang Wu, Jun Zhang, Shouwen Liu, Fang Hu, Jiacheng Guo</i>	
Al/Ti-film-resistor based thermal heater with Zig-Zag configuration for MEMS application .....	476
<i>Xinghua Wang, Zhijie Jiang, Jiangyi Qin, Hongwei Liu, Guangteng Fan, Canbin Hu</i>	

Fully-digital tension control system with PID algorithm for winding ultra-fine enameled wires .....	481
<i>Zhewei Gu, Sheng Zeng, Kaijie Zhao, Chenliang Song</i>	
Simultaneously static and dynamic layout designs of stiffening structures.....	492
<i>Zhijie Feng, Kai Wu, Xuan Liang, Jianbin Du</i>	
Stress analysis and design of the waveguide bellows for EAST ECRH system.....	499
<i>Liyuan Zhang, Xiaojie Wang, Fukun Liu, Handong Xu, Dajun Wu, Yunying Tang</i>	
Numerical control press design based on quantitative evaluation of appearance area features.....	506
<i>Hao Yuan, Tong Wu, Mingzhu Li, Boke Liang, Qinglin Zhang</i>	
Fault diagnosis method of rolling bearing based on the multiple features of LMD and random forest .....	515
<i>Ning Liu, Bing Liu, Cungen Xi</i>	
Fault diagnosis of rolling bearing based on improved EMD algorithm .....	523
<i>Shuo Meng, Jianshe Kang, Kuo Chi, Xupeng Die</i>	
Active control simulation based on an active vibration isolator.....	531
<i>Yunfeng Wang, Yikang Du, Zhanxin</i>	
Simulation for drawing process of core filled tube.....	538
<i>Junlong Qi, Xianghua Liu, Haitao Gao, Xiangkun Sun</i>	
FEM simulation and frequency shift calculation of a quartz crystal resonator adhered with soft micro-particulates considering contact deformation.....	545
<i>Xuan Xie, Yuhong Liu, Yong Ye</i>	
Theoretical and micro simulation study on cutting temperature of SiCp/Al by ultrasound vibration cutting.....	552
<i>Liang Yang, Chunguang Xu, Bohua Fu, Mingjie Sun, Xiao Ming Liu</i>	
Simulation analysis of shot peening on the surface of high-load connecting rod.....	560
<i>Long Bai, Jianjun Chen, Guoxiang Liang, Tian Tian, Lijing Xie, Quanping Li</i>	
Fluid dynamic simulation of single cell sorting by fiber laser in microfluidics .....	570
<i>Xiaoxiang Zhong, Weixing Mao, Huali Zhang</i>	
Research on the application of neuroaesthetics in industrial design.....	577
<i>Mei Sun, Haocheng Han, Quanhong Jiang</i>	
Shafting stiffness calculation of satellite antenna scanning mechanism.....	584
<i>Jialong Zhu, Xiaofei Ma, Hui Wang, Jiang Zhao, Tingting Song</i>	
Innovative and optimized design of automatic adjustment system for beaded rope of new diamond wire sawing machine .....	590
<i>Bangju Wei, Huiping Liang, JiaHao feng, JianWei Liu, Shenyan Xie</i>	
Multi-target visual recognition and positioning methods for sorting robots.....	596
<i>Xinying Liu, Shoufeng Jin</i>	
Study on fuzzy duration of serial coupled iterative design tasks in product development .....	603
<i>Qi Hua Tian, Ci Zhang, Wei Zhu, Jia Kang Huang, Yu Rong Zhang, Xiang Man Zhou</i>	
Accuracy analysis and errors compensation of 4-DOF reconfigurable punching robot .....	610
<i>Zhenghao Ge, Hao Chen, Xiaoyu Han</i>	

Improved Elman neural network in turbine blade fault diagnosis .....	621
<i>Pengcheng Zhuo, Tangbin Xia, Kaigan Zhang, Zhen Chen, Lifeng Xi</i>	
Finite element analysis of the reinforced concrete special-shaped columns under axial force and torsion .....	628
<i>Ye He, Kui Zhang</i>	
Research on finite element analysis and modelling of bolted joint .....	635
<i>Pengyang Li, Wei Li, Peiliang Wei, Quandai Wang</i>	
A novel control method for roll gap of roller crusher based on Fuzzy-PID with decision factor self-correction .....	646
<i>Yinwei Yang, Kai Fan, Jing Xu</i>	
Fault monitoring of inner frame paper cutting transmission coupling of packaging machine based on intelligent analysis of noise .....	653
<i>Guangcai Li, Huanju Zhen, Deji Wang</i>	
Prediction study of temperature deviations on left and right sides of power plant boiler reheaters based on regression algorithm learning machine and expert experience .....	658
<i>Yu-jia Cui, Ying Huang, Xiao-chun Ma, Guo-hang Ma</i>	
Research on gear fault degree recognition method based on multi sensor fusion .....	665
<i>Xihui Chen</i>	
Study on mechanical properties of thin-walled cavity structure with a large aspect ratio for ultra-precision optical instrument .....	672
<i>Lin Li, Jun Zhong, Jie Sui, Yun-fang Zhang, Wei-zhen Lv, Xiao-yan Wang</i>	
Thickness effect on pinning properties for GdBa <sub>2</sub> Cu <sub>3</sub> O <sub>7-x</sub> films deposited with RF sputtering .....	679
<i>Jianming Xu, Zhongzhou Xie, Zhen Li, Xiaojing Luo, Yanyan Zhu, Tian Gao, Ying Wang</i>	
Analysis on failure mechanism of CFRP double-tap interference-fit joint.....	686
<i>Peng Zou, Hao Chen, Xue Bi</i>	
Applicability analysis of STM and SMCFT of RC beams with shear span-depth ratios $\leq 3.0$ .....	696
<i>Pengfei Yang, Xu Yang, Guanxi Liang, Weiwen Li, Jing Zheng, Sen Guo</i>	
Research on establishment and verification of projectile and artillery coupling system virtual prototype.....	703
<i>Xuemin You, Yezun Sun, Xu Xu, Bo Li, Zhenqian Yang, Jiangong Liu</i>	
Analysis of noise characteristics of spur face gear under different installation errors .....	709
<i>Yanzhong Wang, Guoying Su</i>	
Research on thin spray-on technology and equipment of coal mine .....	716
<i>Fusong Min, Ke Chen, Xiangyang Li, Shudong Pang</i>	
Clearance optimization of radial bearings for multi-bearing shafting system .....	722
<i>Yue Liu, Ming Mao, Zhen Tian, Xin Zhang</i>	
Synthesis and networking of tetrahedral deployable mechanism based on screw theory .....	730
<i>Zhirong Huang, Xiaofei Ma, Fei Hu, Jialong Zhu, Yundou Xu</i>	
Research and application of efficient milling process for surface casing .....	737
<i>Xu Zhang, Jianning Wang, Changqing Ma, Zhansheng Li, Mingzhe Han, Man Li, Jingqiang Yuan, Yunti Liu</i>	

A simple process optimization route to fabricate curved bionic compound eye array .....	746
<i>Shengzhou Huang, Lei Wang, Yanchang Zheng, Yongsheng Su, Fengtao Wang</i>	
Vibration control of deployable truss antenna reflector-scanning mechanism.....	753
<i>Fei Hu, Yanping Song, Xiaofei Ma, Yuzhu Duan, Fangfang Xie, Wan Li</i>	
A method based on ASTME1012 to adjust the alignment of the material testing machine .....	760
<i>Jian Xu, Yinming Zhao, Jixin Chai, Kexing Chen</i>	
Experimental study on vibration fatigue of a certain chassis .....	767
<i>Weizhong Cao, Changming Hu, Tao Liao, Shen Rui</i>	
Study on surface roughness of zirconia ceramics in high efficient and precision grinding process .....	774
<i>Kechong Wang, Songhua Li, Jian Sun</i>	
Dynamic performance of planar mechanism with joint clearance considering stochastic parameters .....	782
<i>Zhiqian Lu, Li Zhang, Junyong Tao</i>	
Analysis of the structure of wood-plastic composite coated co-extrusion head .....	792
<i>Zhenghao Ge, Hongli Chang, Shanshan Ren</i>	
Research on compressor blades fatigue life test under thermal-vibration combined load.....	800
<i>Zemin Yao, Shouqing Huang, Xiaokai Huang, Ruliang Wu, Shouwen Liu</i>	
Study on molding technique for millimeter-wave radome with frequency selective surface .....	809
<i>Chunxia Yang, Yongming Zhu, Tao Gui</i>	
Study on inner insulation tube for ITER axial insulation breaks.....	816
<i>Changchun Yang</i>	
Fracture analysis for reasons of bellows with braided hose .....	822
<i>Gang Sun, Lina Mao, Xiaolin Li, Xiaona Sun, Ningfei Huo</i>	
Natural lubrication mechanism of twisting in ring spinning and its experimental analysis.....	827
<i>Ge Chen, Yongshan Gao, Honglei Zhou, Wenliang Xue</i>	
Parameter identification of additional forces and torques for simulated space manipulator in zero-g simulation system.....	834
<i>Sihui Tian, Xiaoqiang Tang, Yuqi Li</i>	
Structural analysis of coreless spoiler.....	841
<i>Jia Song, Haicui Lv, Yanli Wang</i>	
Research on windage yaw characteristics of high-voltage insulators in complex wind field.....	847
<i>Jun Li, Dong Mao, Quan Zhu, Qiang Gao</i>	
Experimental research on laser micro-texture friction coefficient of V-clamp Mold.....	854
<i>Mei Mei, Shuqian Wu</i>	
Research on analysis method of dynamic friction torque of high speed precision miniature bearings .....	863
<i>Zhiqiang Zheng, Songsheng Li, Yangyang Liu, Guoqing He, Huanzhao Yang, Tongxu Yang</i>	
Research on adjusting size proportion of cut tobacco .....	870
<i>Jiawen Hou, Dong Dong Wang, Deji Wang</i>	

Study on fluidization process in jet flow dredging device and the effects of device structure to sand collecting performance .....	877
<i>Yue Zhang, Jinchun Song</i>	
A comparison of bending resistance of square thin-walled tubes with different internal reinforcements .....	884
<i>Zhongyou Xie</i>	
An evaluation method of synthetic force engineering support capability based on multi-level grey system.....	890
<i>Jisong Fan, Jiawei Xu, Hui Ren</i>	
The collapse response of web-core sandwich panels partially filled with metallic foams under drop-weight impact .....	898
<i>Zhongyou Xie</i>	
Static balancing of flexural pivots with two symmetrically arranged pre-compressing springs.....	905
<i>Qizi Yang, Shusheng Bi, Tian Liu</i>	
Experiments on the flow characteristics of hydraulic orifices under high or low temperature conditions .....	914
<i>Wenlin Wang, Zirong Zhou, Xin Kong, Yongming Wu</i>	

#### **Author Index**