

全 国 中 文 核 心 期 刊

2022年05月 第43卷 第9期

主管单位：中国兵器装备集团有限公司

主办单位：中国兵器工业第五九研究所

# 包装工程

Packaging Engineering



## 软封装锂电池铝塑膜成形性能研究进展

作 者：陈伟 雷中伟 冯绍辉 陈雨楠 陈明和

作者单位：中铝材料应用研究院有限公司 浙江华正能源材料有限公司 南京航空航天大学

# 包装工程

BAOZHUANG GONGCHENG

第43卷 第9期 2022年5月10日

## 目次

### 新材料技术

|                        |                                |    |
|------------------------|--------------------------------|----|
| 改性聚酯涂层的制备及在食品包装材料中的应用  | 王章薇, 宋鹏宇, 游波                   | 1  |
| 导电油墨及其印刷技术的研究进展        | 施彤, 邓巧云, 王海莹, 李大纲              | 11 |
| 软封装锂电池铝塑膜成形性能研究进展      | 陈伟, 雷中伟, 冯绍辉, 陈雨楠, 陈明和         | 22 |
| 辐照对常见塑料食品包装材料物理化学性能的影响 | 赵胜男, 李佳怡, 杨青华, 林勤保             | 31 |
| 烟用印刷白卡纸“返黄”机制的研究       | 朱红艳, 贾伟平, 孙鹏, 何攀, 刘文婷, 张一帆, 王磊 | 39 |
| 环保超疏水防潮瓦楞纸箱的制备及性能研究    | 陈枫, 胡泽顺, 姚镇城, 李兰辉, 陈利科         | 46 |
| 沙发坐垫丝瓜络填充料力学松弛特性研究     | 陈碧琪, 关惠元                       | 51 |

### 农产品贮藏加工

|                             |                                 |     |
|-----------------------------|---------------------------------|-----|
| 不同蓄冷包装对蟠桃贮藏后货架期品质的影响        | 宋方圆, 谢小燕, 郭慧静, 李自芹, 赵志永         | 58  |
| 基于电学特性库尔勒香梨冲击损伤模型构建         | 于世辉, 牛希跃, 唐玉荣, 兰海鹏, 刘扬, 张宏      | 65  |
| 二氧化硫和二氧化氯组合处理对采后阳光玫瑰葡萄质地的影响 | 集贤, 朱志强, 商佳胤, 张平, 李志文, 冯瑶       | 74  |
| 壳聚糖/花青素复合薄膜的制备及鱼肉新鲜度监测      | 姚乐, 王诗意, 周斐, 郑为贤, 高宝善, 李中波, 郑家辉 | 83  |
| 海水温度对金鲳鱼保活过程中应激和代谢的影响       | 张坤, 周结倩, 范秀萍, 魏帅, 孙钦秀, 夏秋瑜, 刘书成 | 92  |
| 温度对无铅腌制皮蛋凝胶特性的影响            | 包欢欢, 王修俊, 沈畅萱, 何春霞, 李佳敏, 许九红    | 100 |
| 抗氧化型轻食千页豆腐的开发及其贮藏品质研究       | 赵矩阳, 孙昕萌, 袁惠萍, 熊淳               | 107 |

### 食品流通与包装

|                         |                                |     |
|-------------------------|--------------------------------|-----|
| 胶态酶型时间温度指示器的制备研究        | 孙若楠, 张敏, 夏斯璇, 钱静               | 115 |
| 纳米动物蛋白包埋技术研究进展          | 李尽哲, 冯鑫, 黄雅琴                   | 122 |
| 基于改进支持向量机的药品包装纸盒快速鉴别研究  | 孙家政, 刘津彤, 张岚泽, 姜红, 曾文远, 段斌, 刘峰 | 131 |
| 新形势下高校《食品添加剂》课程思政教学改革研究 | 蓝蔚青, 卢瑛, 包海蓉, 孙晓红, 谢晶          | 138 |

---

## 工艺与装备

---

|                               |                                     |     |
|-------------------------------|-------------------------------------|-----|
| 智能便携式低温生物转运箱的设计与实验研究          | 赵子威, 杨诚, 方舒超, 刘宝林                   | 143 |
| 基于割灌机的机械臂设计与分析                | 王慧, 于昊楠, 张时雨, 任长清, 马岩, 曲文           | 150 |
| 棉秆自动捆包装置的设计与仿真                | 朱金达, 杨晨虎, 牛虎利, 张嘉钰, 赵永衡             | 157 |
| 经济型快递物流安检标记机器人设计与研究           | 刘凯旋, 郑华栋, 陈鹿民, 贺振东, 吕善文, 霍亚奇, 崔良建   | 163 |
| 基于模糊神经网络的包装机械臂定位方法研究          | 田勇, 李俊霞                             | 171 |
| 基于 CRITIC 赋权法的细支烟物理指标综合质量评价研究 | 周沅桢, 和小娟, 王泽宇, 乔俊峰, 王永, 范兴, 祁林, 资文华 | 176 |
| 包装过程称量信号处理方法研究                | 孟文晔                                 | 184 |
| 应用 TRIZ 理论解决旅行分装按压瓶二次密封渗漏问题   | 王秀宇, 李昂, 王志刚                        | 189 |

---

## 图文信息技术

---

|                                   |                                 |     |
|-----------------------------------|---------------------------------|-----|
| 基于 FFST 和 Hessenberg 分解的立体图像零水印算法 | 韩绍程, 张鹏, 李鹏程                    | 197 |
| 改进樽海鞘群优化 K-means 算法的图像分割          | 李志杰, 王力, 张习恒                    | 207 |
| 基于 YOLOv5 的瓷砖表面缺陷检测               | 王淑青, 顿伟超, 黄剑锋, 王年涛              | 217 |
| 基于二值化灰度图像的大豆蛋白液喷雾相对雾化程度的研究        | 龚国腾, 杨传民, 邢炯, 常淑英               | 225 |
| 应用卷积神经网络的锂电池极片涂布缺陷分类              | 鲁永帅, 唐英杰, 马鑫然, 刘爽               | 231 |
| 基于视觉显著性和感知相似性的全参考图像质量评价方法         | 王茜, 郑斌军, 孔玲君, 顾萍                | 239 |
| 基于机器视觉的柔性包装袋喷码缺陷检测研究              | 周玮, 门耀华, 辛立刚                    | 249 |
| 基于水性油墨的双重防伪二维码的设计与实现              | 武军, 沈荣波, 陈俊忠, 刘时波, 杨伟栋, 沈海生, 魏华 | 257 |
| 滚筒跳动对柔性版印刷质量的影响                   | 徐嘉妮, 袁英才, 李艳, 乔俊伟, 范振宇, 王轩, 顾天祺 | 264 |

---

## 装备与防护

---

|                          |              |     |
|--------------------------|--------------|-----|
| 气相防锈热收缩包装技术应用于核电设备防锈     | 姜锐, 谭振洲, 徐欣轶 | 270 |
| 国防和军队现代化建设背景下军品智能包装的理论研究 | 周代芳          | 275 |

## 广告索引

---

|                           |
|---------------------------|
| 封二 普拉斯包装材料有限公司            |
| 封三 中国兵器工业第五九研究所包装工程技术研究中心 |
| 插页                        |
| A1 国防科技工业自然环境试验研究中心       |
| A2 装备环境工程杂志               |

# PACKAGING ENGINEERING

(Initial Issue 1980) (Semimonthly) Vol.43 No.9 (Total No.471) May 10, 2022

## Contents

### Advanced Materials Technologies

---

|   |  |    |
|---|--|----|
| Preparation of Modified Polyester Coating and Its Application in Food Packaging Materials                               | WANG Zhang-wei, SONG Peng-yu, YOU Bo             | 1  |
| Research Progress of Conductive Ink and Its Printing Technology   | SHI Tong, DENG Qiao-yun, WANG Hai-ying, et al.   | 11 |
| Research Progress on Forming Performance of Aluminum-plastic Laminated Film for Soft Encapsulated Lithium-ion Batteries | CHEN Wei, LEI Zhong-wei, FENG Shao-hui, et al.   | 22 |
| Effect of Irradiation on Physical and Chemical Properties of Common Plastic Food Packaging Materials                    | ZHAO Sheng-nan, LI Jia-yi, YANG Qing-hua, et al. | 31 |
| Brightness Reversion Mechanism of White Cardboard for Tobacco Printing  | ZHU Hong-yan, JIA Wei-ping, SUN Peng, et al.     | 39 |
| Preparation and Performance of Environmentally Friendly Super-hydrophobic and Moisture-proof Corrugated Box             | CHEN Feng, HU Ze-shun, YAO Zhen-cheng, et al.    | 46 |
| Mechanical Relaxation Characteristics of Sofa Cushion Luffa Sponge Filling  | CHEN Bi-qi, GUAN Hui-yuan                        | 51 |

---

### Storage and Processing of Agricultural Products

---

|   |  |     |
|---|--|-----|
| Effect of Different Cold Storage Packages on the Shelf Life Quality of Flat Peach after Storage                         | SONG Fang-yuan, XIE Xiao-yan, GUO Hui-jing, et al.   | 58  |
| Construction of Impact Damage Model of Korla Fragrant Pear Based on Electrical Characteristics                          | YU Shi-hui, NIU Xi-yue, TANG Yu-rong, et al.         | 65  |
| Effect of Combination Preservation of Sulfur Dioxide and Chlorine Dioxide on Post-harvest Texture of Shine-Muscat Grape | JI Xian, ZHU Zhi-qiang, SHANG Jia-yin, et al.        | 74  |
| Preparation of Chitosan/Anthocyanin Composite Film for Monitoring of Fish Freshness                                     | YAO Le, WANG Shi-yi, ZHOU Fei, et al.                | 83  |
| Effect of Temperature on Stress and Metabolism of Golden Pompano during Keep-alive Transportation                       | ZHANG Kun, ZHOU Jie-qian, FAN Xiu-ping, et al.       | 92  |
| Effects of Temperature on the Gel Properties of Lead-free Pickled Preserved Egg   | BAO Huan-huan, WANG Xiu-jun, SHEN Chang-xuan, et al. | 100 |
| Development of Antioxidant Light Food Chiba Tofu and Its Storage Quality  | ZHAO Ju-yang, SUN Xin-meng, YUAN Hui-ping, et al.    | 107 |

---

### Food Distribution and Packaging

---

|   |   |     |
|---|---|-----|
| Preparation of Colloidal Enzyme Type Time and Temperature Indicator                 | SUN Ruo-nan, ZHANG Min, XIA Si-xuan, et al.       | 115 |
| Research Progress of Nano-animal Protein Encapsulation Technology                   | LI Jin-zhe, FENG Xin, HUANG Ya-qin                | 122 |
| Rapid Identification of Drug Packaging Box Based on Improved Support Vector Machine | SUN Jia-zheng, LIU Jin-tong, ZHANG Lan-ze, et al. | 131 |

---

## Process and Equipment

---

Design and Experimental Study of Intelligent Portable Low-temperature Biological Transfer Box

ZHAO Zi-wei, YANG Cheng, FANG Shu-chao, et al. 143

Design and Analysis of Robot Arm Based on Brush Cutter

WANG Hui, YU Hao-nan, ZHANG Shi-yu, et al. 150

Design and Simulation of a Multifunctional Cotton Stalk Baling Device

ZHU Jin-da, YANG Chen-hu, NIU Hu-li, et al. 157

Design and Research of an Economical Courier Security Marking Robot

LIU Kai-xuan, ZHENG Hua-dong, CHEN Lu-min, et al. 163

Positioning Method of Packaging Mechanical Arm Based on Fuzzy Neural Network

TIAN Yong, LI Jun-xia 171

Comprehensive Quality Assessment for Physical Indexes of Slim Cigarette Based on CRITIC Weighting Approach

ZHOU Yuan-zhen, HE Xiao-juan, WANG Ze-yu, et al. 176

Processing Method of Weighing Signal in Packaging Process

MENG Wen-ye 184

Solving the Leaking Problem of Packing Pressing Bottle after Second Seal Based on TRIZ Theory

WANG Xiu-yu, LI Ang, WANG Zhi-gang 189

---

## Graphic Information Technology

---

Stereo Image Zero Watermarking Algorithm Based on FFST and Hessenberg Decomposition

HAN Shao-cheng, ZHANG Peng, LI Peng-cheng 197

Improved Salp Swarm Optimization K-means Algorithm for Image Segmentation

LI Zhi-jie, WANG Li, ZHANG Xi-heng 207

Ceramic Tile Surface Defect Detection Based on YOLOv5

WANG Shu-qing, DUN Wei-chao, HUANG Jian-feng, et al. 217

Relative Atomization Degree of Soybean Protein Liquid Spray Based on Binary Gray Image

GONG Guo-teng, YANG Chuan-min, XING Jiong, et al. 225

Defect Classification of Lithium Battery Pole Piece Coating Using Convolutional Neural Network

LU Yong-shuai, TANG Ying-jie, MA Xin-ran, et al. 231

Full Reference Image Quality Assessment Based on Visual Saliency and Perception Similarity Index

WANG Qian, ZHENG Bin-jun, KONG Ling-jun, et al. 239

Inspection of Coding Defects in Flexible Packaging Bags Based on Machine Vision

ZHOU Wei, MEN Yao-hua, XIN Li-gang 249

Design and Implementation of Dual Anti-counterfeiting QR Code Based on Water-based Inks

WU Jun, SHEN Rong-bo, CHEN Jun-zhong, et al. 257

Effect of Cylinder Runout on the Quality of Flexography

XU Jia-ni, YUAN Ying-cai, LI Yan, et al. 264

---

## Equipment Protection

---

Application of Gas-phase Anti-rust Thermal Shrinkage Packaging Technology in Anti-corrosion of Nuclear Power Equipment

JIANG Rui, TAN Zhen-zhou, XU Xin-yi 270

Theoretical Research on Intelligent Packaging of Military Supplies under the Background of National Defense and Military Modernization

ZHOU Dai-fang 275