

中国化工学会会刊

Journal of Chemical Industry and Engineering Society of China



2016

第35卷

8

ISSN 1000-6613 / CN 11-1954/TQ

Chemical Industry and Engineering Progress

EI收录期刊

化工进展

第三十五卷  
第八期



主办



中国化工学会



化学工业出版社



北京中能环科技术发展有限公司

ISSN 1000-6613



9 771000 661164

二〇一六年八月



## 目 次

### 特约评述

渣油深度加氢裂化技术应用现状及新进展.....任文坡, 李振宇, 李雪静, 金羽豪(2309)

乙丙橡胶生产工艺与技术.....张涛, 邹云峰, 车浩, 孙聚华, 邹向阳, 王积悦, 郑翔, 蔡小平(2317)

### 化工过程与装备

2,3-丁二醇分离提取工艺研究进展.....樊亚超, 张霖, 廖莎, 王领民(2323)

缬沙坦在乙酸乙酯中的溶解度及介稳区.....王清清, 孙勤, 杨阿三, 程榕, 郑燕萍(2329)

纳米流体冲击射流换热特性实验.....孙斌, 曲艺, 杨迪(2334)

同轴式内部热耦合精馏塔的传热性能.....方静, 赵蕊, 李春利, 轩碧涵(2342)

碳酸锂在水中的溶解度和超溶解度的测定及热力学分析.....宋昌斌, 李润超(2350)

基于 Fluent 网格变形的旋流器的形状优化.....蒋明虎, 谭放, 金淑芹, 龙桂兰, 陈桂芹, 徐保蕊(2355)

非均匀受热条件下螺旋管内流动沸腾换热特性.....刘伟, 崔文智, 刘晓见(2362)

新型三维脉动热管的性能.....王亚雄, 丁祥云(2367)

熔盐冷冻壁厚度测量方法.....周金豪, 孙波, 余长锋, 窦强, 李晴暖, 吴国忠(2373)

CuO-水纳米流体多孔球层池沸腾传热特性.....祝啸, 陈威, 李林星(2381)

LNI-66A 型分级式冲击磨锤头参数研究.....陈俊冬, 王晓天, 曾川, 李鹏超, 林龙沅, 陈海焱(2387)

### 能源加工与技术

航空汽油发展概述及前景展望.....向海, 柳华, 陈凯, 夏祖西, 肖勇(2393)

以废白土为原料制备生物柴油及其资源化利用.....乔宝权, 周丹, 李琪, 李根, 徐琴琴, 银建中(2398)

生物技术在老化油处理中的研究与应用进展.....孟祥娟, 陈德飞, 曹献平, 徐海霞, 陈箐, 赵静(2406)

聚甲氧基二甲醚的研究进展及前景.....郑妍妍, 唐强, 王铁峰, 王金福(2412)

高硫石油焦热解过程及硫形态的变化特性.....杜鸿飞, 段钰锋, 余敏(2420)

典型气流床煤气化炉气化过程的建模.....东赫, 刘金昌, 解强, 党钾涛, 王新(2426)

### 工业催化

低毒金属配合物催化丙交酯开环聚合研究进展

.....王富贵, 胡明刚, 邓启刚, 马文辉, 宋伟明, 初红涛(2432)

我国合成气一步法制低碳烯烃催化剂研究新进展

.....程金燮, 胡志彪, 王科, 邹鑫, 徐晓峰, 李倩, 黄宏, 吴熙宇(2439)

光催化剂 TiO<sub>2</sub> 改性的研究进展.....刘文芳, 周汝利, 王燕子(2446)

异构化制清洁汽油工艺及催化剂.....赵文康, 樊洁, 朱博超, 蒙延双, 朱福良, 刘小燕(2455)

焙烧程序对一步合成 Cu-SSZ-13 催化剂 NH<sub>3</sub>-SCR 性能的影响.....谢利娟, 刘福东, 石晓燕, 贺泓(2464)

钛铝比对溶胶凝胶法制 CuZnAlTi 催化剂结构和性能的影响.....王民, 乔丽娜, 崔荣基, 樊金串, 黄伟(2469)

助剂对 Pd/ $\gamma$ -Al<sub>2</sub>O<sub>3</sub> 催化剂一步法合成二甲醚反应稳定性的影响

.....褚睿智, 徐婷婷, 孟献梁, 吴国光, 侯文心(2474)

### 材料科学与技术

聚偏氟乙烯膜亲水改性研究进展.....张松峰, 吴力立(2480)

小分子离子自组装制备功能超分子材料.....张丽, 崔尚科, 周庆成(2488)

双钙钛矿型复合氧化物 A<sub>2</sub>BB'O<sub>6</sub> 的最新合成方法.....安宏乐, 杨秋华, 邱学倩(2495)

表面活性剂引导合成非硅基介孔材料的研究进展.....潘登, 王亚明, 蒋丽红(2500)

聚乙烯醇水凝胶自修复性能.....龚桂胜, 刘景勃, 钟玉鹏, 林强, 张发爱(2507)

核壳型 PS@ZnO 纳米复合材料的制备及其光催化性能

.....李素娟, 陈勐, 郑星, 郑经堂, 许倩, 胡平, 郭建波(2513)

溶剂辅助超细二氧化锆纳米晶体的可控合成.....石国亮, 于峰, 王琰, 潘大海, 李瑞丰(2518)

高温煅烧铝及铝合金熔渣制备氧化铝.....侯蕊红,王皓,陈津,张风林,宋嘉伟(2523)  
**生物与医药化工**

橘黄酮的提取及其抑菌特性.....赵悦,孙庆元,孙琦(2528)  
以6-氯嘌呤为原料合成2-氟腺嘌呤的新方法.....夏然,孙莉萍,渠桂荣(2533)  
米格列奈钙的合成新工艺.....林富荣,秦亮,蒋明(2537)  
两种碱性pH调节剂对1,3-丙二醇发酵过程的影响.....张霖,樊亚超,李晓妹,廖莎,王鹏翔,乔凯(2542)

## 资源与环境化工

湿法脱硫浆液的氧化控制缺陷及对策.....马双忱,杨静,张立男,华继洲,于伟静(2547)  
萃取蒸馏脱除油品中硫的过程模拟与优化.....张清珍,代成娜,韩敬莉,雷志刚(2553)  
湿法脱硫浆液的真空蒸馏特性.....洪永强,陈桂芳,毛岩鹏,马春元(2561)  
Fe(II)(EDTA)/O<sub>3</sub>工艺处理含聚废水实验.....于忠臣,魏震,董喜贵,刘书孟,王松,钟柳波(2569)  
软硬性填料对MBR处理效率和膜污染的影响.....梁乾伟,李永峰,程国玲(2575)  
氨-碳酸盐法分离PTA废渣中的钴和锰.....何沁华,刘维桥,邹超,魏成文,尚通明,周全法,高峰(2580)  
固体吸附剂对油页岩半焦燃烧过程中重金属元素的影响.....柏静儒,张伟,陈定形,邵佳晔,白娜,王擎(2586)

大豆蛋白负载魔芋葡甘聚糖对Cd(II)的吸附性能.....刘锋,陈雪怡,邹海良,熊美金(2592)

## 应用技术

新型秸秆洗涤装置试验研究.....孙国友,方书起,马力,陈俊英,刘利平,白净(2598)  
合成氨压缩机级间换热器结焦超声清洗的研究.....田蒙奎,姜颖,王军,王国维,王昌敏,简万国(2604)  
微萃取-聚结分离技术在碳四脱甲醇中的应用.....刘森,杨强,张学清,苗志强(2609)

## 化工园区

面向化工园区的知识产权建设研究.....纪红兵,林名钦(2615)

## 产品与市场

基于德温特专利数据的低维纳米碳材料发展态势文献分析.....张静端,姚静,荣海琴(2622)

## 行业动态

产品信息(2349, 2591, 2597)

## 广告索引

封面：北京中能环科技发展有限公司  
封二：赛普科技企业集团  
封三：广西碳酸钙产业化工程院  
封四：中山大学惠州研究院  
彩插1：青岛科大隆腾科技发展有限公司  
彩插2：北京泽华化学工程有限公司  
彩插3：北京泽华化学工程有限公司  
彩插4：大唐国际化工技术研究院有限公司  
彩插5：大唐国际化工技术研究院有限公司  
彩插6：江苏中圣高科技产业有限公司

彩插7：石家庄波特无机膜分离设备有限公司  
彩插8：北京中能环科技发展有限公司  
彩插9：天津市天大北洋化工设备有限公司  
彩插10：北京三聚环保新材料股份有限公司  
内插1：浙江丰利粉碎设备有限公司  
内插2：温州市中伟磁传密封设备厂  
内插3：北京北方新沪机电设备有限公司  
内插4：南通富莱克流体装备有限公司  
内插5：浙江力普粉碎设备有限公司  
内插6：上海申银机械（集团）有限公司

责任编辑 奚志刚

英文顾问 龙秉文, 王运东, 李宝庆

主 管	中国科学技术协会	主 编	曹湘洪	国际标准刊号	ISSN 1000-6613
主 办	中国化工学会	编辑部主任	黄丽娟	国内统一刊号	CN 11-1954/TQ
	化学工业出版社	广告负责人	胡晓丹	广告经营许可证	京东工商广字第8036号
编 辑	《化工进展》编辑部	编辑部电话	010-64519500/9501/9502	网 址	www.hgjz.com.cn
出 版	化学工业出版社	广告部电话	010-64519466/9499	印 刷	北京科信印刷有限公司
通讯地址	北京市东城区青年湖南街13号	开 户 银 行	中国工商银行北京和平里支行	订 阅 处	全国各地邮局
邮 编	100011	账户名称	北京进展期刊社	邮发代号	82-311
E-mail	hgjz@263.net	银行账号	0200004219200176319	定 价	85元(国内) 20美元(国外)



## Contents

### Invited reviews

- Application situation and new progress of residuum deep hydrocracking technologies ..... REN Wenpo, LI Zhenyu, LI Xuejing, JIN Yuhao ( 2309 )  
On the production of ethylene propylene diene monomer ..... ZHANG Tao, ZOU Yunfeng, CHE Hao, SUN Juhua, ZOU Xiangyang, WANG Jiyue, ZHENG Xiang, CAI Xiaoping ( 2317 )

### Chemical processes and equipments

- Progress on the separation of 2,3-butanediol ..... FAN Yachao, ZHANG Lin, LIAO Sha, WANG Lingmin ( 2323 )  
Solubility and metastable zone of valsartan in ethyl acetate ..... WANG Qingqing, SUN Qin, YANG Asan, CHENG Rong, ZHENG Yanping ( 2329 )  
Experimental study on heat transfer characteristics of nanofluids impacted jet ..... SUN Bin, QU Yi, YANG Di ( 2334 )  
Heat transfer property of concentric internally heat integrated distillation column ..... FANG Jing, ZHAO Rui, LI Chunli, XUAN Bihan ( 2342 )  
Measurement and thermodynamic analysis of the solubility and supersolubility of lithium carbonate in water ..... SONG Changbin, LI Runchao ( 2350 )  
Sharp optimization of hydrocyclone based on Fluent mesh morphing ..... JIANG Minghu, TAN Fang, JIN Shuqin, LONG Guilan, CHEN Guiqin, XU Baorui ( 2355 )  
Flow boiling heat transfer characteristics in helically coiled tube with circumferentially non-uniform heating ..... LIU Wei, CUI Wenzhi, LIU Xiaojuan ( 2362 )  
Performance study for new type of three-dimensional pulsating heat pipe ..... WANG Yaxiong, DING Xiangyun ( 2367 )  
Experimental study on the thickness detection of molten salt frozen-wall ..... ZHOU Jinhao, SUN Bo, SHE Changfeng, DOU Qiang, LI Qingnuan, WU Guozhong ( 2373 )  
An experimental investigation on heat transfer performance of CuO-H<sub>2</sub>O nanofluid pool boiling with porous bead-packed structures ..... ZHU Xiao, CHEN Wei, LI Linxing ( 2381 )  
Technologic study on beaters of LNI-66A classify-impact mill ..... CHEN Jundong, WANG Xiaotian, ZENG Chuan, LI Pengchao, LIN Longyuan, CHEN Haiyan ( 2387 )

### Energy processes and technology

- Overview of the development of aviation gasoline and its prospect ..... XIANG Hai, LIU Hua, CHEN Kai, XIA Zuxi, XIAO Yong ( 2393 )  
Biodiesel production from spent bleaching clay and its resource utilization ..... QIAO Baoquan, ZHOU Dan, LI Qi, LI Gen, XU Qingqin, YIN Jianzhong ( 2398 )  
Progress on aged oil treatment by biological technology ..... MENG Xiangjuan, CHEN Defei, CAO Xianping, XU Haixia, CHEN Qing, ZHAO Jing ( 2406 )  
Progress and prospect of polyoxymethylene dimethyl ethers ..... ZHENG Yanyan, TANG Qiang, WANG Tiefeng, WANG Jinfu ( 2412 )  
Research on pyrolysis process of high sulfur petroleum coke and the changes of sulfur species ..... DU Hongfei, DUAN Yufeng, SHE Min ( 2420 )  
Modeling of coal gasification reaction in typical entrained-flow coal gasifiers ..... DONG He, LIU Jinchang, XIE Qiang, DANG Jiatao, WANG Xin ( 2426 )

### Industrial catalysis

- Progress in ring-opening polymerization of lactide catalyzed by low-toxic metal complexes ..... WANG Fugui, HU Minggang, DENG Qigang, MA Wenhui, SONG Weiming, CHU Hongtao ( 2432 )  
New advances in the catalysts for one-step light olefins production from syngas in China ..... CHENG Jinxie, HU Zhobia, WANG Ke, ZOU Xin, XU Xiaofeng, LI Qian, HUANG Hong, WU Xiyu ( 2439 )  
Research progress on modification of TiO<sub>2</sub> photocatalyst ..... LIU Wenfang, ZHOU Ruli, WANG Yanzi ( 2446 )  
Isomerization process for producing clean gasoline and the catalyst ..... ZHAO Wenkang, FAN Jie, ZHU Bochao, MENG Yanshuang, ZHU Fuliang, LIU Xiaoyan ( 2455 )  
Influence of calcination procedure on the one-pot synthesized Cu-SSZ-13 catalysts and their performance in NH<sub>3</sub>-SCR ..... XIE Lijuan, LIU Fudong, SHI Xiaoyan, HE Hong ( 2564 )  
Influence of Ti/Al molar ratio on the structure and performance of CuZnAlTi catalyst prepared by sol-gel method ..... WANG Min, QIAO Lina, CUI Rongji, FAN Jinchuan, HUANG Wei ( 2469 )  
Influence of promoters on the stability of Pd/γ-Al<sub>2</sub>O<sub>3</sub> catalyst for one-step synthesis of dimethylether ..... CHU Ruizhi, XU Tingting, MENG Xianliang, WU Guoguang, HOU Wenxin ( 2474 )

## Material science and technology

- Research progress of hydrophilic modification of polyvinylidene fluoride membranes.....*ZHANG Songfeng, WULili (2480)*  
Small molecular ions based ionic self-assembly in preparation of functional supramolecular materials.....*ZHANG Li, CUI Shangke, ZHOU Qingcheng (2488)*  
The latest synthesis methods of double perovskite-type composite oxides  $A_2B'B''O_6$ .....*AN Hongle, YANG Qiuahua, DI Xueqian (2495)*  
Progress in surfactant synthesis of non-silica mesoporous materials.....*PAN Deng, WANG Yaming, JIANG Lihong (2500)*  
Self-healing performance of poly(vinyl alcohol) hydrogel.....*GONG Guisheng, LIU Jingbo, ZHONG Yupeng, LIN Qiang, ZHANG Faai (2507)*  
Synthesis and photocatalytic properties of PS@ZnO core-shell structure nano-composites.....*LI Sujuan, CHEN Meng, ZHENG Xing, ZHENG Jingtang, XU Qian, HU Ping, GUO Jianbo (2513)*  
Solvent-assisted controllable synthesis of ultrafine zirconia nanocrystals.....*SHI Guoliang, YU Feng, WANG Yan, PAN Dahai, LI Ruiqiang (2518)*  
High temperature calcinations of aluminum dross for alumina.....*HOU Ruihong, WANG Hao, CHEN Jin, ZHANG Fenglin, SONG Jiawei (2523)*

## Biochemical and pharmaceutical engineering

- Extraction of flavonoids from *Citrus reticulate* and their antimicrobial characteristics.....*ZHAO Yue, SUN Qingyuan, SUN Qi (2528)*  
A novel method for the synthesis of 2-fluoroadenine from 6-chloropurine.....*XIA Ran, SUN Liping, QU Guirong (2533)*  
A novel process for synthesizing mitiglinide calcium.....*LIN Furong, QIN Liang, JIANG Ming (2637)*  
Effects of two alkaline pH regulators on the fermentation of 1,3-propanediol.....*ZHANG Lin, FAN Yachao, LI Xiaoshu, LIAO Sha, WANG Pengxiang, QIAO Kai (2542)*

## Resource and environmental engineering

- Defects and countermeasures of slurry oxidation control in the Wet-FGD.....*MA Shuangchen, YANG Jing, ZHANG Linan, HUA Jizhou, YU Weijing (2547)*  
Desulfurization of oil products by extractive distillation: simulation and optimization.....*ZHANG Qingzhen, DAI Chengna, HAN Jingli, LEI Zhigang (2553)*  
Distillation characteristics of wet flue gas desulfurization serosity.....*HONG Yongqiang, CHEN Guifang, MAO Yanpeng, MA Chunyuan (2561)*  
Study on the degradation of polymer-contained wastewater by the Fe(II)(EDTA)/O<sub>3</sub> process.....*YU Zhongchen, WEI Zhen, DONG Xigui, LIU Shumeng, WANG Song, ZHONG Liubo (2569)*  
Effect of soft and hard carriers on the treatment efficiency and membrane fouling in membrane bioreactor (MBR).....*LIANG Qianwei, LI Yongfeng, CHENG Guoling (2575)*  
Study on separation of cobalt and manganese from waste residue of PTA by ammonia-carbonate leaching.....*HE Qinhuai, LIU Weiqiao, ZOU Chao, WEI Chengwen, SHANG Tongming, ZHOU Quanfa, GAO Feng (2580)*  
Influence of absorbents on heavy metals during combustion of oil shale semi-coke.....*BAI Jingru, ZHANG Wei, CHEN Dingxing, SHAO Jiaye, BAI Na, WANG Qing (2586)*  
Investigation of the adsorption performance of Cd(II) by soy protein loaded konjac glucomannan.....*LIU Feng, CHEN Xueyi, ZOU Hailiang, XIONG Meijin (2592)*

## Applied technology

- Experimental study on new straw washing device.....*SUN Guoyou, FANG Shuqi, MA Li, CHEN Junying, LIU Liping, BAI Jing (2598)*  
Study on ultrasonic cleaning of ammonia compressor heat exchanger coking.....*TIAN Mengkui, JIANG Ying, WANG Jun, WANG Guowei, WANG Changmin, JIAN Wanguo (2604)*  
Removal of methanol in carbon four by microextraction-coalescence separation technology.....*LIU Sen, YANG Qiang, ZHANG Xueqing, MIAO Zhiqiang (2609)*

## Chemical industry park

- Study of establishing intellectual property for chemical industrial park.....*JI Hongbing, LIN Mingqin (2615)*

## Product and market

- Patent analysis on the development trend of low-dimensional carbon nanomaterials by Derwent innovations index.....*ZHANG Jingduan, YAO Jing, RONG Haiqin (2622)*

<b>Superintend:</b> China Association for Science and Technology	<b>Address:</b> No. 13 Qingnianhu South Street, Dongcheng District, Beijing, China	<b>E-mail:</b> hgjz@263.net huagongjz@126.com
<b>Sponsor:</b> The Chemical Industry and Engineering Society of China; Chemical Industry Press	<b>Post Code:</b> 100011	<b>http:</b> //www.hgjz.com.cn
<b>Editor:</b> Editorial Department of Chemical Industry and Engineering Progress	<b>Editor in Chief:</b> CAO Xianghong <b>Managing Editor:</b> HUANG Lijuan <b>Executive Editor:</b> XI Zhigang	<b>Price:</b> \$ 20 <b>ISSN</b> 1000-6613 <b>CN</b> 11-1954/TQ
<b>Publisher:</b> Chemical Industry Press	<b>Tel:</b> (010) 64519466/9499/9500/9501/9502	<b>CODEN</b> HUJIEK