

# 化学教育(中英文)

Chinese Journal of Chemical Education

2023 年 第 44 卷 第 6 期 Vol.44 No.6



布鲁姆教学目标分类

教学问题设计

课堂教学内容

记忆

什么是厌氧消化?  
厌氧消化分为哪几个阶段?

厌氧消化过程各阶段的化学反应

水解阶段 酸化阶段 乙酸化阶段 甲烷化阶段

理解与应用

厌氧消化涉及氧化还原过程吗?  
厌氧消化四阶段中有哪些氧化还原反应?

厌氧消化过程中的氧化还原反应和电子转移

物质的氧化态与还原态 电子供体与电子受体

厌氧消化中的化学反应都可自发发生吗?  
吉布斯自由能变大于零的反应如何自发发生?

厌氧消化反应热力学和串联反应过程

生物化学反应限度问题 打破热力学限制的途径

分析

厌氧消化过程在自然界物质循环中有什么作用?  
人类利用厌氧消化过程能实现什么?

厌氧消化在自然界物质循环和人类生产生活中的关键作用

厌氧消化与自然界物质大循环 厌氧消化在生产生活中的应用

评价与创造

有氧分解和厌氧消化过程有什么异同?  
如何计算不同氢分压下的吉布斯自由能变?  
如何提高原料在厌氧消化时的水解效率?

厌氧消化知识的发散拓展

拓宽学生视野 激发科研兴趣

如何用最简单的材料开展厌氧消化实验?

厌氧消化知识的综合运用和创新

将知识学以致用 培养创新思维 提升综合能力

邮发代号：2-106

ISSN 1003-3807



06

9 771003 380239 HUAXUE JIAOYU

万方数据



CHINESE  
CHEMICAL  
SOCIETY



主管：中国科学技术协会  
主办：中国化学会  
北京师范大学

2023年3月

# 化学教育(中英文)

第44卷

第6期

## 目 次

### 化学·生活·社会

- 量子点微型光谱传感技术在水质实时监测中的应用 ..... 杨松铭 刘森阳 张大伟 袁金颖 (1)

### 课程·教材·评价

- 化学工程领域本科生国际化全英文通识课程“过程强化”教学探索 ..... 王丹 蒲源 王洁欣 陈建峰 (7)

- “双碳”目标下“膜科学与技术”教学改革 ..... 赵颂 王志 (12)

### 理论教学

- 基于OBE理论构建无机化学课程思政教学体系及教学实践 ..... 刘晓塘 余林梁 陈洁 (17)

- 大学化学习题课的困境与有效教学策略 ..... 邢双喜 郑龙 (24)

- 体现知识、能力、素质有机融合的“ds区元素”教学内容设计 ..... (29)

..... 蒋育澄 李淑妮 翟全国 魏灵灵 刘志宏 胡满成 高胜利

### 实验教学

- 航天探月工程科研成果转化的教学实验：仿生荷叶掺铝氧化锌薄膜应用于月尘防护 ..... (36)

..... 李杨 任惠雯 郭宝 王群 吴晓宏

- 信息化教学背景下无机化学元素性质实验教学模式的重构与实践 ..... (41)

..... 王静 李会平 于乐 王小燕 罗世忠 高洪涛 王书文

- 基于双重预防机制的高校化学化工类实验实训室安全管理实施路径 ..... 范剑明 武新岗 (47)

- 计算化学探索性实验设计：气体在固体表面的吸附现象及其对催化作用的影响 ..... 张欣 王思 丰海松 (53)

### 教师教育

- STEAM教育跨学科思维评价研究——基于化学师范生的实证分析 ..... 阙荣辉 周丽芳 (59)

### 职业教育

- 高职药物分析课程思政的教学探索与实践 ..... 孔兴欣 田清青 张平 王青溪 (67)

### 非化学专业化学教育

- 厌氧消化过程化学变化的教学研究 ..... 陈畅 宋超 (76)

- 基于OBE和EHS理念的制药过程安全与环保课程体系建设 ..... 尹宏权 陈甫雪 (84)

- 面向一流专业人才培养的中药制药化学探究式实验教学——甘草酸缔合态 ..... 李存玉 郑云枫 彭国平 (90)

### 研究生教育

- OBE理念下化学教育硕士教育实习评价体系的构建 ..... 沈明雾 刘宝 (95)

### 问题讨论与思考

- 卤代烷亲核取代反应的理论基础与影响因素 ..... 杨占会 陈宁 (103)

- 从统计热力学角度理解重要的热力学概念 ..... 张琪 杜军 李军 (109)

### 化学史与化学史教育

- 化学课程思政育人元素探究——以化学史上简称为“费歇尔”的人物为例 ..... (114)

..... 张大伟 程一伦 王川琪 王嵩 任书乐 刘美含 王绍彬

### 书 评

- 新工科背景下化学化工的有效教学方法——评《化学产品设计》 ..... 杨文 易瑾婷 沈亮 罗江水 (126)

- 《化学教育》订阅通知 ..... (89)

- 封面图片 ..... (77)

本期责任编辑 杨金瑞 齐娜

万方数据

# CHINESE JOURNAL OF CHEMICAL EDUCATION

2023 Vol. 44 No. 6

Sponsored by Chinese Chemical Society and Beijing Normal University

## Chemistry-Life-Society

- Application of Quantum Dot Micro-Spectral Sensing Technology in Real-Time Water Quality Monitoring ..... YANG Song-Ming LIU Sen-Yang ZHANG Da-Wei YUAN Jin-Ying (1)

## Curriculum-Teaching Materials-Assessment

- Investigation on Teaching the International English Course of Process Intensification for Undergraduates of Chemical Engineering ..... WANG Dan PU Yuan WANG Jie-Xin CHEN Jian-Feng (7)

- Teaching Reform of Membrane Science and Technology Under the Goal of Carbon Peak and Carbon Neutralization ..... ZHAO Song WANG Zhi (12)

## Theory Teaching

- Systematic Construction of Course Ideological and Political Education and Teaching Practice of Inorganic Chemistry Based on OBE ..... LIU Xiao-Tang YU Lin-Liang CHEN Jie (17)

- Dilemma and Effective Teaching Strategies of Exercise Courses for College Chemistry ..... XING Shuang-Xi ZHENG Long (24)

- Teaching Content Design of "Elements in ds-Block" Embodying the Internal Integration of Knowledge, Ability and Quality ..... JIANG Yu-Cheng LI Shu-Ni Zhai Quan-Guo WEI Ling-Ling LIU Zhi-Hong HU Man-Cheng GAO Sheng-Li (29)

## Experiment Teaching

- Teaching Experiment from Scientific Research Achievements of Aerospace Lunar Exploration Project: Bionic Lotus Leaf Aluminum-Doped Zinc Oxide Film for Moon Dust Protection ..... LI Yang REN Hui-Wen GUO Bao WANG Qun WU Xiao-Hong (36)

- Reconstruction and Practice of Experimental Teaching Mode of Inorganic Chemical Element Properties Under the Background of Information Teaching ..... WANG Jing LI Hui-Ping YU Le WANG Xiao-Yan LUO Shi-Zhong GAO Hong-Tao WANG Shu-Wen (41)

- Implementation Path of Safety Management of University Laboratory and Training Room of Chemistry and Chemical Engineering Based on Dual Prevention Mechanism ..... FAN Jian-Ming WU Xin-Gang (47)

- Exploratory Experimental Design of Computational Chemistry: Adsorption of Gas on Solid Surface and Its Influence on Catalysis ..... ZHANG Xin WANG Si FENG Hai-Song (53)

## Teacher Education

- Research on Evaluation of Interdisciplinary Thinking in STEAM Education: Empirical Analysis Based on Chemistry Normal Students ..... QUE Rong-Hui ZHOU Li-Fang (59)

## Vocational Education

- Exploration and Practice of Curriculum Ideological and Political Education in Pharmaceutical Analysis for Higher Vocational Colleges ..... KONG Xing-Xin TIAN Qing-Qing ZHANG Ping WANG Qing-Xi (67)

## Chemical Education for Non-Chemistry Majors

- Teaching Research of Chemical Changes During Anaerobic Digestion ..... CHEN Chang SONG Chao (76)

- Construction of Course of Safety and Environmental Protection for Pharmaceutical Process Based on OBE and EHS Concepts ..... YIN Hong-Quan CHEN Fu-Xue (84)

- Inquiry Experimental Teaching of Chinese Medicine Pharmaceutical Chemistry for Cultivating First-Class Major Talents: Association State of Glycyrrhizic Acid ..... LI Cun-Yu ZHENG Yun-Feng PENG Guo-Ping (90)

## Postgraduate Education

- Construction of an Evaluation Index System for Educational Internship for Master of Chemistry Education Under the Concept of OBE ..... SHEN Ming-Wu LIU Bao (95)

## Discussion and Thinking of Questions

- Theoretical Basis and Governing Factors of Halogenophilic Substitutions of Haloalkanes ..... YANG Zhan-Hui CHEN Ning (103)

- Understanding Important Thermodynamic Concepts from the Perspective of Statistical Thermodynamics ..... ZHANG Qi DU Jun LI Jun (109)

## History of Chemistry and Chemical History Education

- Exploration on Ideological and Political Elements in Chemistry Course: Chemists of "Fischer" with Same Abbreviation in the History of Chemistry ..... ZHANG Da-Wei CHENG Yi-Lun WANG Chuan-Qi WANG Song REN Shu-Le LIU Mei-Han WANG Shao-Bin (114)

# 化学教育(中英文)

(半月刊·1980年创中文刊·2017年变更为中英文刊)  
2023年第44卷第6期 3月18日出版

主管单位	中国科学技术协会
主办单位	中国化学会 北京师范大学
编辑出版	《化学教育(中英文)》编辑部
编辑部地址	北京师范大学化学楼217室
邮政编码	100875
电话(传真)	010-58807875
咨询信箱	hxjy-jce@263.net
投稿网址	http://www.hxjy.chemsoc.org.cn

顾 师	刘知新	编 部 主任	朱玉军
主 编	刘正平	副 主 编	孙世刚 王 磊
副 主 编	姜雪峰	施 展	郑长龙 朱玉军(专职)
刊名题字	王祖浩	印 刷 装 订	戴安邦
总发行处	杨 昀	订 阅	保定市海天印务有限公司
订 阅	郑长龙		中国邮政集团公司北京市报刊发行局
			全国各地邮局

刊号 ISSN 1003 - 3807  
CN 10 - 1515/O6

国内邮发代号 2-106

国外发行代号 M3070

定价 36.00 元

# CHINESE JOURNAL OF CHEMICAL EDUCATION

2023 Vol. 44 No. 6

Sponsored by Chinese Chemical Society and Beijing Normal University

## Chemistry-Life-Society

- Application of Quantum Dot Micro-Spectral Sensing Technology in Real-Time Water Quality Monitoring ..... YANG Song-Ming LIU Sen-Yang ZHANG Da-Wei YUAN Jin-Ying (1)

## Curriculum-Teaching Materials-Assessment

- Investigation on Teaching the International English Course of Process Intensification for Undergraduates of Chemical Engineering ..... WANG Dan PU Yuan WANG Jie-Xin CHEN Jian-Feng (7)

- Teaching Reform of Membrane Science and Technology Under the Goal of Carbon Peak and Carbon Neutralization ..... ZHAO Song WANG Zhi (12)

## Theory Teaching

- Systematic Construction of Course Ideological and Political Education and Teaching Practice of Inorganic Chemistry Based on OBE ..... LIU Xiao-Tang YU Lin-Liang CHEN Jie (17)

- Dilemma and Effective Teaching Strategies of Exercise Courses for College Chemistry ..... XING Shuang-Xi ZHENG Long (24)

- Teaching Content Design of "Elements in ds-Block" Embodying the Internal Integration of Knowledge, Ability and Quality ..... JIANG Yu-Cheng LI Shu-Ni ZHAI Quan-Guo WEI Ling-Ling LIU Zhi-Hong HU Man-Cheng GAO Sheng-Li (29)

## Experiment Teaching

- Teaching Experiment from Scientific Research Achievements of Aerospace Lunar Exploration Project: Bionic Lotus Leaf Aluminum-Doped Zinc Oxide Film for Moon Dust Protection ..... LI Yang REN Hui-Wen GUO Bao WANG Qun WU Xiao-Hong (36)

- Reconstruction and Practice of Experimental Teaching Mode of Inorganic Chemical Element Properties Under the Background of Information Teaching ..... WANG Jing LI Hui-Ping YU Le WANG Xiao-Yan LUO Shi-Zhong GAO Hong-Tao WANG Shu-Wen (41)

- Implementation Path of Safety Management of University Laboratory and Training Room of Chemistry and Chemical Engineering Based on Dual Prevention Mechanism ..... FAN Jian-Ming WU Xin-Gang (47)

- Exploratory Experimental Design of Computational Chemistry: Adsorption of Gas on Solid Surface and Its Influence on Catalysis ..... ZHANG Xin WANG Si FENG Hai-Song (53)

## Teacher Education

- Research on Evaluation of Interdisciplinary Thinking in STEAM Education: Empirical Analysis Based on Chemistry Normal Students ..... QUE Rong-Hui ZHOU Li-Fang (59)

## Vocational Education

- Exploration and Practice of Curriculum Ideological and Political Education in Pharmaceutical Analysis for Higher Vocational Colleges ..... KONG Xing-Xin TIAN Qing-Qing ZHANG Ping WANG Qing-Xi (67)

## Chemical Education for Non-Chemistry Majors

- Teaching Research of Chemical Changes During Anaerobic Digestion ..... CHEN Chang SONG Chao (76)

- Construction of Course of Safety and Environmental Protection for Pharmaceutical Process Based on OBE and EHS Concepts ..... YIN Hong-Quan CHEN Fu-Xue (84)

- Inquiry Experimental Teaching of Chinese Medicine Pharmaceutical Chemistry for Cultivating First-Class Major Talents: Association State of Glycyrrhizic Acid ..... LI Cun-Yu ZHENG Yun-Feng PENG Guo-Ping (90)

## Postgraduate Education

- Construction of an Evaluation Index System for Educational Internship for Master of Chemistry Education Under the Concept of OBE ..... SHEN Ming-Wu LIU Bao (95)

## Discussion and Thinking of Questions

- Theoretical Basis and Governing Factors of Halogenophilic Substitutions of Haloalkanes ..... YANG Zhan-Hui CHEN Ning (103)

- Understanding Important Thermodynamic Concepts from the Perspective of Statistical Thermodynamics ..... ZHANG Qi DU Jun LI Jun (109)

## History of Chemistry and Chemical History Education

- Exploration on Ideological and Political Elements in Chemistry Course: Chemists of "Fischer" with Same Abbreviation in the History of Chemistry ..... ZHANG Da-Wei CHENG Yi-Lun WANG Chuan-Qi WANG Song REN Shu-Le LIU Mei-Han WANG Shao-Bin (114)

# 化学教育(中英文)

(半月刊·1980年创中文刊·2017年变更为中英文刊)  
2023年第44卷第6期 3月18日出版

主管单位	中国科学技术协会
主办单位	中国化学会 北京师范大学
编辑出版	《化学教育(中英文)》编辑部
编辑部地址	北京师范大学化学楼217室
邮政编码	100875
电话(传真)	010-58807875
咨询信箱	hxjy-jce@263.net
投稿网址	http://www.hxjy.chemsoc.org.cn

顾 师	刘知新	编 部 主任	朱玉军
主 编	刘正平	副 主 编	孙世刚 王 磊
副 主 编	姜雪峰	施 展	郑长龙 朱玉军(专职)
刊名题字	王祖浩	印 刷 装 订	戴安邦
总发行处	杨 昀	订 阅	保定市海天印务有限公司
订 阅	郑长龙		中国邮政集团公司北京市报刊发行局
			全国各地邮局

刊号 ISSN 1003 - 3807  
CN 10 - 1515/O6

国内邮发代号 2-106

国外发行代号 M3070

定价 36.00 元