高等学校化学学报 2008, 29(11) 2209-2212 DOI: ISSN: 0251-0790 CN: 22-1131/O6

论文

亚心形四片藻培养和产氢过程一体化平板光生物反应系统

郑阳[1,2], 陈赵[1], 傅赟彬[1,2], 陆洪斌[1], 张卫[1]

1. 中国科学院大连化学物理研究所海洋产品工程组, 大连116023;
2. 中国科学院研究生院, 北京100049

摘要:

利用整合了燃料电池的平板光生物反应器, 探讨了将亚心型四片藻高密度培养和产氢两段工艺一体化集成的可行性. 在培养阶段通入体积分数为2%~5%的CO_2可使藻细胞迅速增殖, 9 d内即可达到产氢要求的生物量(8.5×10^6 cell/mL). 通过叶绿素荧光参数分析, 选择2%的CO_2培养的藻进行后续的产氢实验. 结果表明, PSⅡ活性和光合电子传递速率均随时间的推移而逐渐下降. 通过对产氢动力学曲线的分析, 计算出最大产氢速率为1.1 mL/(h·L), 持续产氢时间为60 h.

关键词: 平板光生物反应器 一体化工艺 亚心形四片藻(*Tetraselmis subcordiformis*) 叶绿素荧光 燃料电池

Integrated Cultivation and Photohydrogen Production of *Tetraselmis Subcordiformis* in a Flat-plate Photobioreactor System

ZHENG Yang[1,2], CHEN Zhao-An[1], FU Yun-Bin[1,2], LU Hong-Bin[1], ZHANG Wei[1*]

1. Marine Bioproducts Engineering Group, Dalian Institute of Chemical and Physics, Chinese Academy of Sciences, Dalian 116023, China;
2. Graduate School of Chinese Academy of Sciences, Beijing 100049, China

Abstract:

This paper aimed to develop an integrated processes of microalgal cultivation and hydrogen photoproduction in a flat-plate photobioreactor system combined with alkaline fuel cell. The optimal high cell density of 8.5×10^6 cell/mL was achieved on 9 d when the cultivation of *Tetraselmis subcordiformis* was supplemented with CO2 of 2%—5%(volume fraction) in the flat-plate photobioreactor. When the bioreactor system was switched to the hydrogen production condition, hydrogen evolution was induced by the addition of carbonylcyanide(*m*-chlorophenylhydrazone, CCCP) and anaerobic condition, with a maximum hydrogen production rate of 1.1 mL/(h·L) for 60 h. The kinetics analysis of algal chlorophyll fluorescence was carried out to identify the limiting factors in both algal growth and hydrogen production at 2%CO_2 supplementation. At hydrogen production phase, algal PSⅡ activity and relative electron transfer rate(rETR) decreased with the increase of time, which caused the decline and eventual stop in hydrogen production. To sustain the hydrogen production, PSⅡ activity and rETR must be maintained. The results demonstrate the feasibility of process integration of algal cultivation and hydrogen production in one single system, which will significantly improve the process economics.

Keywords: Flat-plate photobioreactor Process integration *Tetraselmis subcordiformis* Chlorophyll fluorescence Fuel cell

收稿日期 2008-02-28 修回日期 1900-01-01 网络版发布日期

DOI:

基金项目:

通讯作者: 张卫

作者简介:

参考文献：

1. Gaffron H.. Nature[J], 1939, 143: 204—205
2. RAN Chun-Qiu(冉春秋), ZHANG Wei(张卫), YU Xing-Ju(虞星炬), *et al*.. Chem. J. Chinese Universities(高等学校化学学报)[J], 2006, 27(1): 62—66
3. Zhang Liping, Thomas Happe, Anastasios Melis. Planta[J], 2002, 214: 552—561
4. Guan Ying-Fu, Zhang Wei, Deng Mai-Cun, *et al*.. Biotechnology Letters[J], 2004, 26: 1031—1035
5. Ran Chun-Qiu, Yu Xing-Ju, Jin Mei-Fang, *et al*.. Biotechnology Progress[J], 2006, 22(2): 438—443
6. Ikuko Iwasaki. Journal of Photochemistry and Photobiology B: Biology[J], 1998, 44: 184—190
7. Ikuko Iwasaki. Journal of Photochemistry and Photobiology B: Biology[J], 1996, 36: 327—332
8. Hu Qiang, Norihide Kurano. Appl. Microbiol. Biotechnol.[J], 1998, 49: 655—662
9. Nils G. A., Ekelund K., Andreas Aronsson.. Environmental and Experimental Botany[J], 2007, 59: 92—98
10. Graham Peers, Neil M. Price. Nature[J], 2006, 441(7091): 341—344
11. Peter J. Ralph, Rolf Gademann. Aquatic Botany[J], 2005, 82: 222—237
12. Melis A.. Planta[J], 2007, 226: 1075—1086
13. Du Hai. Study of the Process Characterizations of H2 Photoproduction from Platymonas Subcordiformis at High Cell Density[D], Dalian: Dalian Institute of Chemical Physics, Chinese Academy of Sciences, 2005

本刊中的类似文章

1． 潘海燕, 梁勇芳, 朱秀玲, 张守海, 蹇锡高 .用于燃料电池质子交换膜的含萘及氮杂环结构的新型磺化聚酰亚胺的合成及性能[J]. 高等学校化学学报, 2007,28(1): 173-176
2．孔令环,,肖敏,王雷,,孟跃中 .燃料电池质子交换膜用新型磺化聚芳醚酮的合成和性能表征[J]. 高等学校化学学报, 2006,27(6): 1141-1144
3．井丽巍, 刘佰军, 关绍巍, 姜振华.侧基磺酸型含氟聚芳醚的合成[J]. 高等学校化学学报, 2008,29(5): 1074-1076
4．庞金辉, 张海博, 刘佰军, 李雪峰, 姜振华.侧链型磺化聚芳醚酮质子交换膜材料的制备[J]. 高等学校化学学报, 2009,30(2): 430-432
5．王爱琴, 任奇志, 刘双艳, 麻晓霞, 谢先宇.热处理温度对钴卟啉负载碳黑电催化剂的结构及氧还原性能的影响[J]. 高等学校化学学报, 2009,30(4): 752-756

文章评论

序号	时间	反馈人	邮箱	标题	内容