Appendices

Effect of algal species and light intensity on the performance of an air-lift-type microbial carbon capture cell with an algae-assisted cathode

Xia Hu, Jiti Zhou, Baojun Liu*

Key Laboratory of Industrial Ecology and Environmental Engineering, Ministry of Education, School of Environmental Science and Technology, Dalian University of Technology, Linggong Road 2, Dalian 116024, China.

*Corresponding author. Prof. Jiti Zhou, E-mail: jitizhou502@163.com.

Calculations

Determination of CO_2 fixation rate

The CO_2 fixation rate R_{CO_2} ($mg \cdot L^{-1} \cdot d^{-1}$) was calculated as [1]:

$$R_{CO_2} = C_c \times P(\frac{M_{CO_2}}{M_C})$$

Where C_c is the carbon content in the biomass (%, w/w), which was measured by elemental analyzer (Elementar vario EL III); P is the biomass productivity ($mg \cdot L^{-1} \cdot d^{-1}$); M_{CO_2} is the molar mass of CO_2; and M_C is the molar mass of carbon.

The biomass productivity (P, $mg \cdot L^{-1} \cdot d^{-1}$) was calculated using the following equation:

$$P = \frac{\Delta X}{\Delta t}$$

Where ΔX is the variation of biomass concentration ($mg \cdot L^{-1}$) with cultivation time; Δt is the cultivation time (d).

Determination of lipid content and productivity

The band around 3000-2800 cm^{-1} of FTIR spectroscopy could well characterize the lipid content changes and thus be used to detect quantitatively the lipid content and its accuracy has been validated by traditional methods.[2 3] For the determination of lipid content, egg phosphatidylcholine (egg-PC) was chose as an external standard. An infrared spectrometer (Bruker VERTEX 70, Germany) was used to record the characteristic peak areas of egg-PC at 2800-3000 cm^{-1}, yielding the calibration equation:

$$A = 32.598T + 1.9709 \ (R = 0.993).$$

Where A is the characteristic peak areas of lipid; T (mg) is the weight of lipid.

The lipid content L_c (%) was calculated by the following equation:

$$L_c = \frac{T}{M} \times 100\%$$

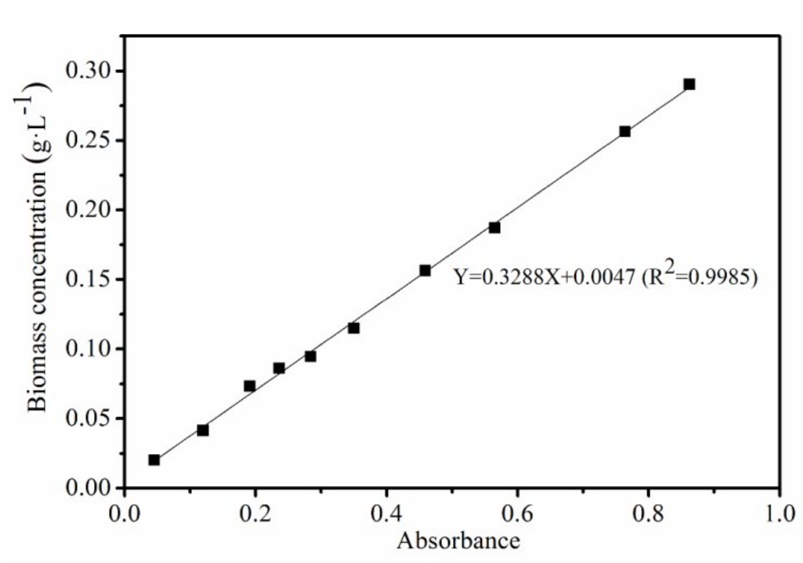
Where T (mg) is the weight of lipid; M (mg) is the dry weight of microalgae.

The lipid productivity L_P ($mg \cdot L^{-1} \cdot d^{-1}$) was calculated by the following equation:

$$L_p = P \times L_c$$

Where P ($mg \cdot L^{-1} \cdot d^{-1}$) is the biomass productivity; L_c (%) is the lipid content of microalgae.

A



B

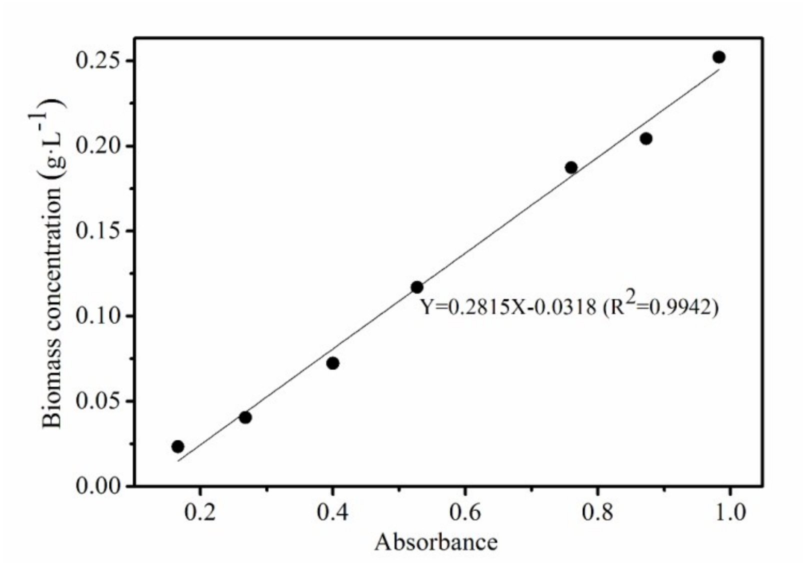


Figure A.1. The standard curves for biomass concentration of *Chlorella vulgaris* (A) and *Chlorella* sp. (B) against calibration of absorbance (690 nm)

Table A.1. Power densities and lipid productivities in different reactors

Reactor type	Microalgal species	Power densities ($mW \cdot m^{-2}$)	Lipid productivities ($mg \cdot L^{-1} \cdot d^{-1}$)	References
MCC	*Chlorella vulgaris*	24.4	NA	[4]
MCC	*Chlorella vulgaris*	14.4	NA	[5]
MCC	*Chlorella* sp.	3.35	NA	[6]
MCC	*Scenedismus obliquus*	30	NA	[7]
MCC	*Chlorella* + *Phormidium*	2.7	NA	[8]
ALMCC	*Chlorella vulgaris*	116.71	128.11	This study
ALP	*Chlorella* sp.	NA	121	[9]
ALP	*Chlorella vulgaris*	NA	94-146	[10]
ALP	*Chlorella sorokiniana*	NA	68-85	[10]
ALP	*Chlorella vulgaris*	NA	98	[11]
ALP	*Ankistrodesmus* sp.	NA	112	[12]

References

1. S. H. Ho, C. Y. Chen and J. S. Chang, Bioresour Technol., 2012, 113, 244-252.
2. Y. Meng, C. Yao, S. Xue and H. Yang, Bioresour Technol., 2014, 151, 347-354.
3. A. M. Pistorius, W. J. DeGrip and T. A. Egorova-Zachernyuk, Biotechnol Bioeng., 2009, 103, 123-129.
4. X. Y. Wu, T. S. Song, X. J. Zhu, P. Wei and C. C. Zhou, Appl Biochem Biotech., 2013, 171, 2082-2092.
5. A. González del Campo, P. Cañizares, M. A. Rodrigo, F. J. Fernández and J. Lobato, J Power Sources., 2013, 242, 638-645.
6. D. F. Juang, C. H. Lee and S. C. Hsueh, Bioresour Technol., 2012, 123, 23-29.
7. R. Kakarla and B. Min, Bioproc Biosyst Eng., 2014, 37, 2453-2461.
8. D. F. Juang, C. H. Lee, S. C. Hsueh and H. Y. Chou, Appl Biochem Biotech.,

2012, 167, 714-731.

9. A. B. Fulke, S. N. Mudliar, R. Yadav, A. Shekh, N. Srinivasan, R. Ramanan, K. Krishnamurthi, S. S. Devi and T. Chakrabarti, Bioresour Technol., 2010, 101, 8473-8476.

10. C. Adams, V. Godfrey, B. Wahlen, L. Seefeldt and B. Bugbee, Bioresour Technol., 2013, 131, 188-194.

11. F. Han, J. Huang, Y. Li, W. Wang, J. Wang, J. Fan and G. Shen, Bioresour Technol., 2012, 118, 431-437.

12. M. Do Nascimento, L. Dublan Mde, J. C. Ortiz-Marquez and L. Curatti, Bioresour Technol., 2013, 146, 400-407.