Supporting Information

Magnetophoretic Separation of Microalgae: The Role of Nanoparticles and Polymer Binder in Harvesting Biofuel

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Table S1. Recorded cell separation efficiency of *Chlorella* sp. ($3x10^7$ cells mL^{-1}) at 300 mg L^{-1} of naked-IONPs and SF-IONPs for 1 minutes and 2 hours. Cells are collected by LGMS with collection duration of 10 minutes.

Mixing duration before LGMS collection	Cell separation efficiency (%)	
	Chlorella sp. + naked-IONPs	*Chlorella* sp. + SF-IONPs
1 minutes	6.20 ± 0.60	95.61 ± 0.63
2 hours	7.96 ± 0.20	96.32 ± 0.35

Table S2. Electrophoretic mobility of *Chlorella* sp. cells, IONPs, SF-IONPs and SF-IONPs-attached-cells.

	Electrophoretic Mobility (μm cm V^{-1} s^{-1})
Chlorella sp.	-2.353 ± 0.562
Naked-IONPs	-2.041 ± 0.477
SF-IONPs	3.533 ± 0.333
SF-IONPs-attached-cells	1.752 ± 0.316

Table S3. Electrophoretic mobility of SF-IONPs and SF-IONPs-attached-cells when different dosage of chitosan has been coated onto the naked-IONPs.

Dosage of Chitosan (g/g naked-IONPs)	Electrophoretic Mobility (μm cm V^{-1} s^{-1})	
	SF-IONPs	SF-IONPs-attached-cells
5	2.980 ± 0.343	1.431 ± 0.342
10	3.533 ± 0.332	1.752 ± 0.316
50	5.597 ± 0.310	2.837 ± 0.360
100	5.894 ± 0.297	3.062 ± 0.395

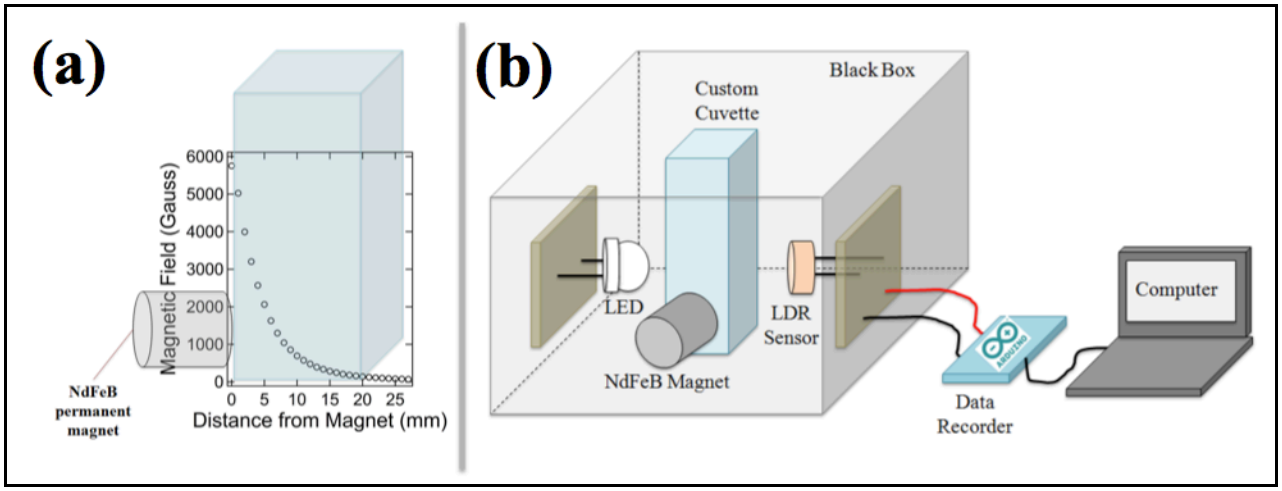


Figure S1. (a) Inhomogeneous magnetic field distribution across the medium contained in the custom cuvette for LGMS separation. (b) Schematic diagram of LGMS setup employed in this study. The setup is build in with optical light intensity sensing system (LDR setup) and connected with data recording system.

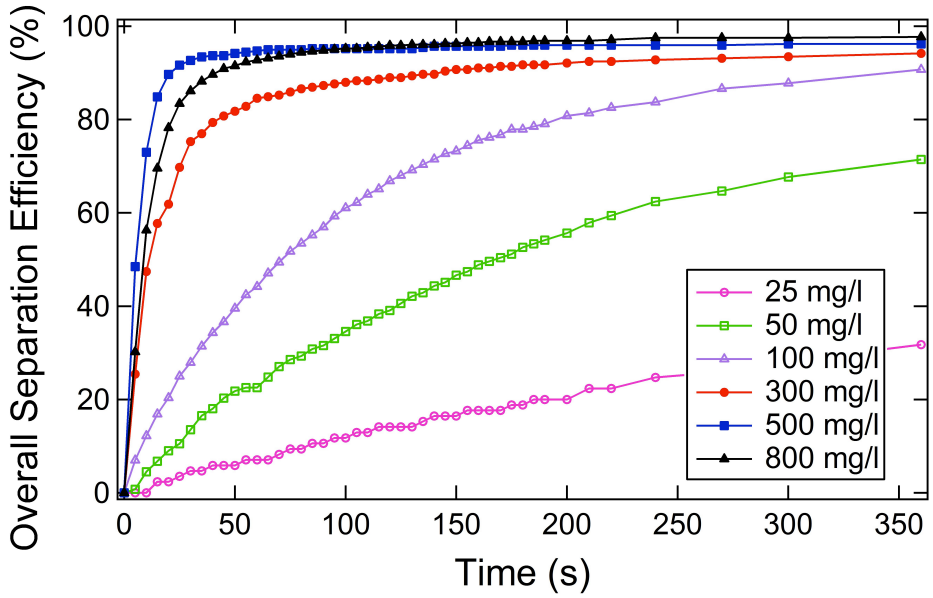


Figure S2. Overall separation efficiency of *Chlorella* sp. cells (3×10^7 cells mL^{-1}) in different concentration of SF-IONPs through the LGMS in function of time. The overall separation efficiencies are measured by LDR setup.

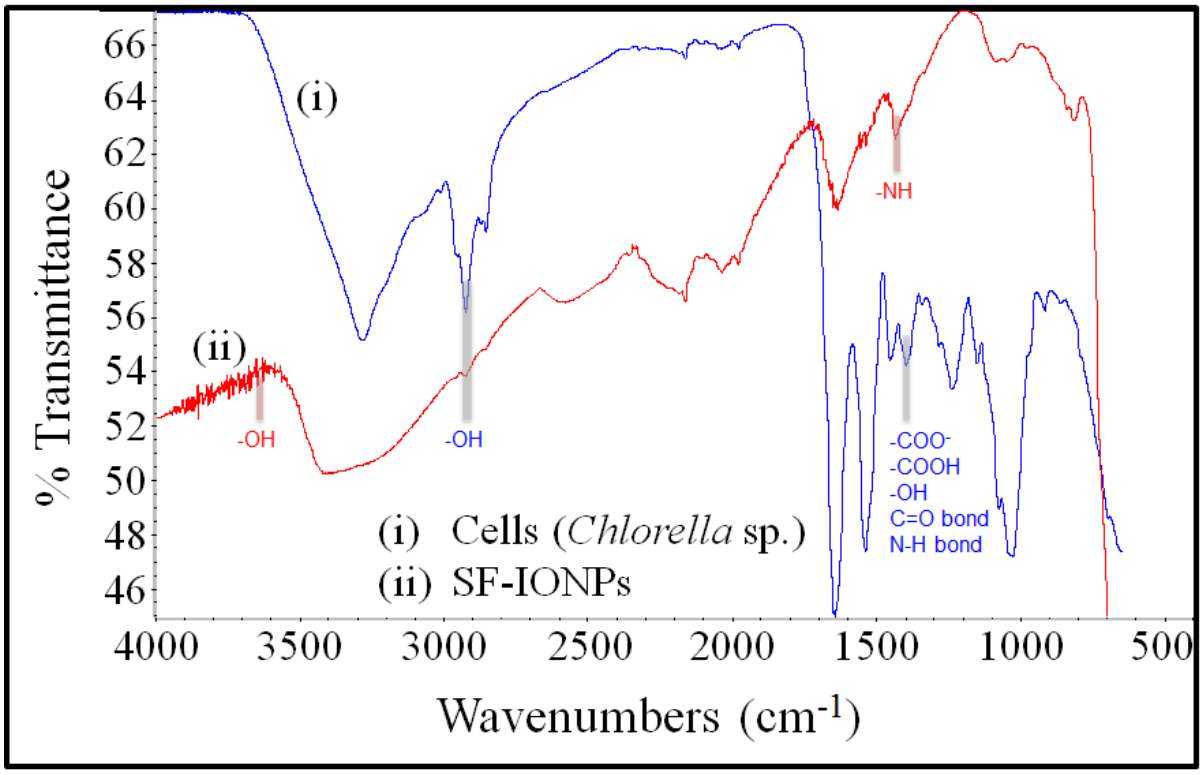
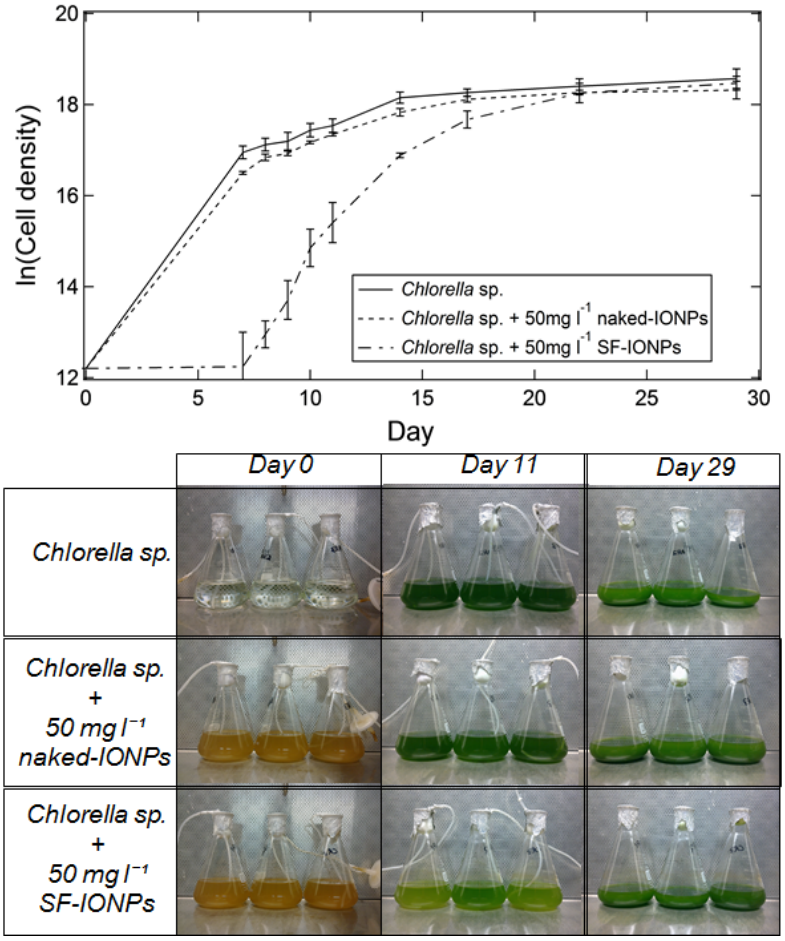


Figure S3. Fourier transforms infrared (FTIR) spectra of *Chlorella* sp. and SF-IONPs for functional groups and bonds determination.

(a)



(b)

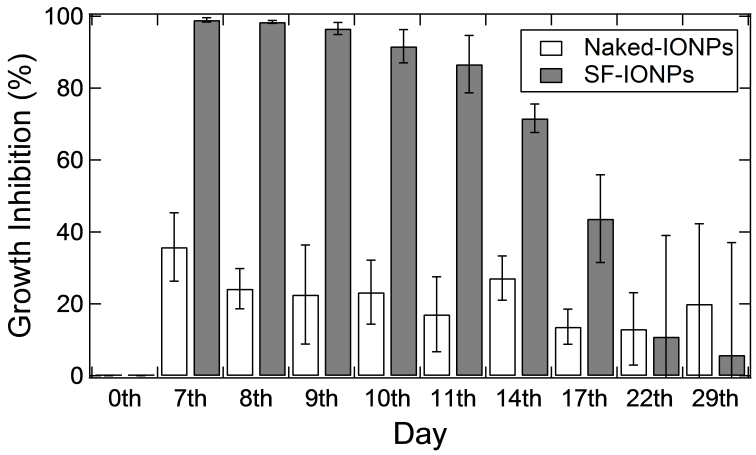


Figure S4. (a) Growth curve (ln (Cell density)) of the *Chlorella* sp. pure culture with the culture that have added in 50 mg L^{-1} of naked-IONPs and SF-IONPs respectively with initial cell density of $2x10^5$ cells mL^{-1}. Images are showed beneath the graph. (b) The inhibition effect on the growth of *Chlorella* sp. based on the cell density inhibition compared to the control with respect to the day of cultivation.

Definition of Growth Inhibition

The growth inhibition is used to define the different between the cell density (CD) of the microalgae with and without the addition of the iron oxide nanoparticles into the culture medium at the respective cultivation day. The formula is stated as below:

$$\text{Growth Inhibition}\,(\%) = \frac{\text{CD}_{\text{Control, i}} - \text{CD}_{\text{IONPs, i}}}{\text{CD}_{\text{Control, i}}} \times 100\% \qquad \text{Equation S1}$$

Where the CD represent the cell density in the unit of cells mL^{-1}, $CD_{Control}$ represents the cell density without adding in the nanoparticles while the CD_{IONPs} is the cell density of the sample after adding in the naked-IONPs/SF-IONPs, and the i represents the day of cultivation.

The high precentage of growth inhibition means the cell density of the sample added with the nanoparticles is far more lower than the control sample. The growth of cell has been suppresed by the nanoparticles. On the other hand, the low percentage of growth inhibition shows that the cells of the sample added with nanoparticles are experience the comparable growth as the control sample. The nanoparticles do not cause significant effect on the growth of microalgal cell.