Supplementary Materials: Using Advanced Spectroscopy and Organic Matter Characterization to Evaluate the Impact of Oxidation on Cyanobacteria

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Table S1. First-order decay rates for chlorination and resulting CT.

Oxidant Dose and Contact Time		k (min^{-1})	R^2	CT (mg-min/L)
Chlorine	1 mg/L, 10 min	1.43×10^{-5}	0.98	5.2
	1 mg/L, 20 min	1.36×10^{-5}	0.99	6.9
	2 mg/L, 10 min	1.18×10^{-5}	0.95	11.7
	2 mg/L, 20 min	7.1×10^{-3}	0.98	21.4
	2 mg/L, 30 min	6.7×10^{-3}	0.99	21.7
	3 mg/L, 10 min	6.8×10^{-3}	0.92	25.9
	3 mg/L, 20 min	6.3×10^{-3}	0.98	35.9
	3 mg/L, 30 min	7.0×10^{-3}	0.94	37.5
Ozone	2 mg/L, 5 min	8.64×10^{-3}	0.84	2.94
	2 mg/L, 10 min	1.70×10^{-3}	0.94	2.15
$KMnO_4$	2 mg/L, 120 min	9.89×10^{-5}	0.98	172
	5 mg/L, 120 min	7.99×10^{-5}	0.98	456
H_2O_2	5 mg/L, 6 hr	8.29×10^{-5}	0.95	837
	10 mg/L, 6 hr	5.17×10^{-5}	0.99	2168

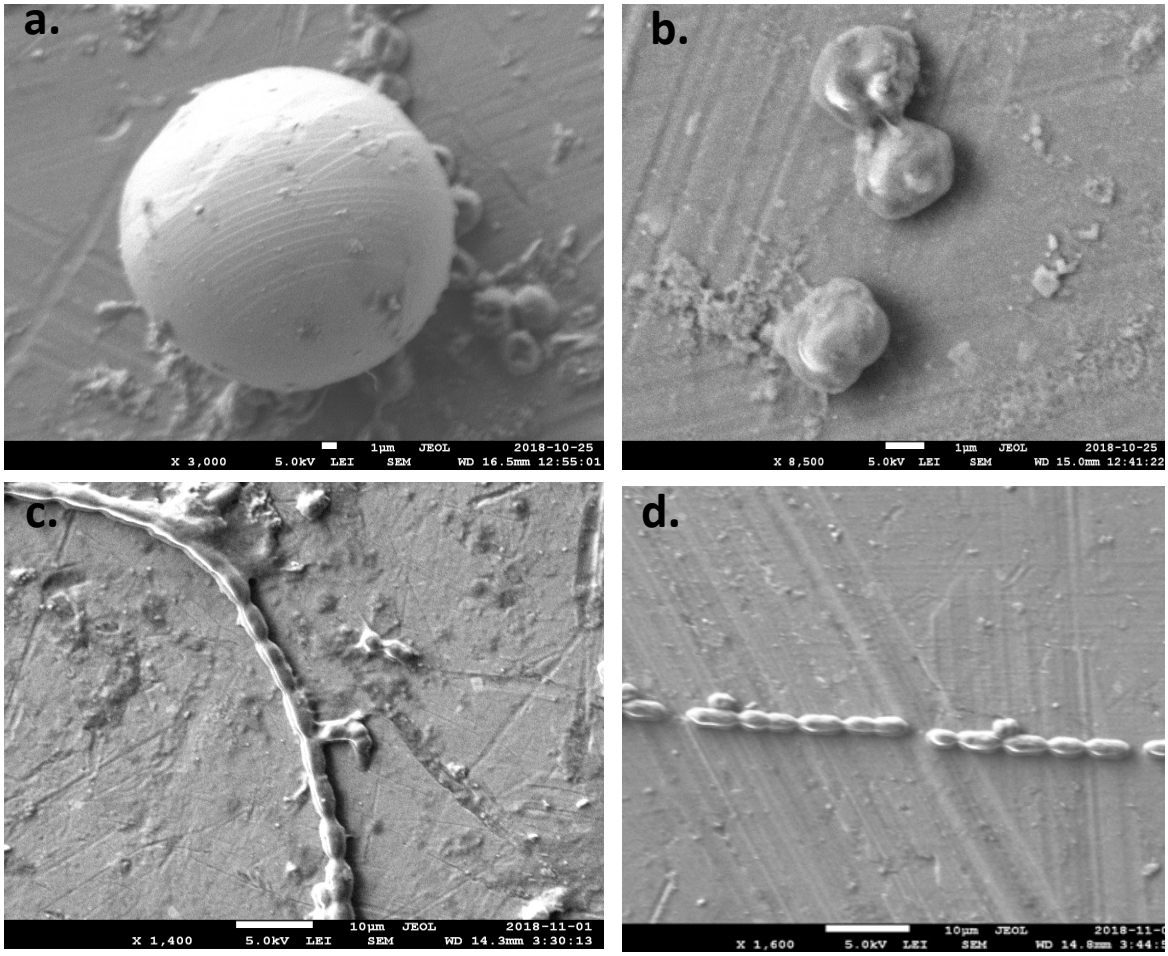

Figure S1. SEM images of the cyanobacteria morphology both before and after chlorination (CT of 37.5 mg-min/L): **a**) *Microcystis* in control (3000×) **b**) chlorinated *Microcystis* cells (8500×), **c**) *Dolichospermum* cells in control (1400×), and **d**) chlorinated *Dolichospermum* cell (1600×).

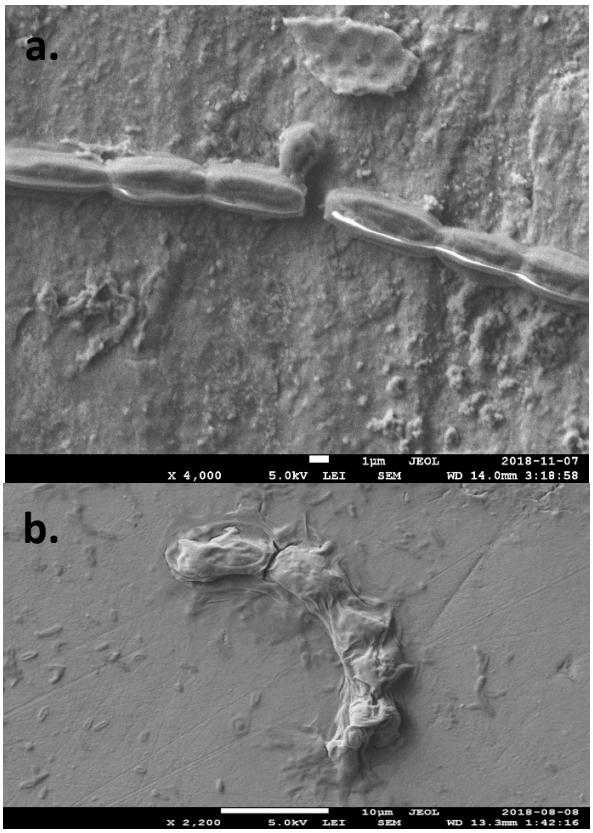

Figure S2. SEM image of cyanobacteria after **a**) ozonation of both *Microcystis* and *Dolichospermum* (0.5 mg/L, 5 min exposure at 4000×) and **b**) hydrogen peroxide application on *Dolichospermum* (837 mg-min/L at 2200×).

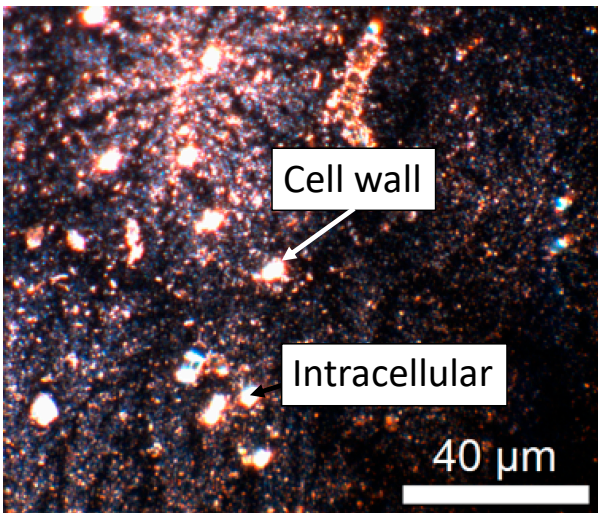

Figure S3. EDM image of un-oxidized *Microcystis* with cell wall and intracellular material identified.

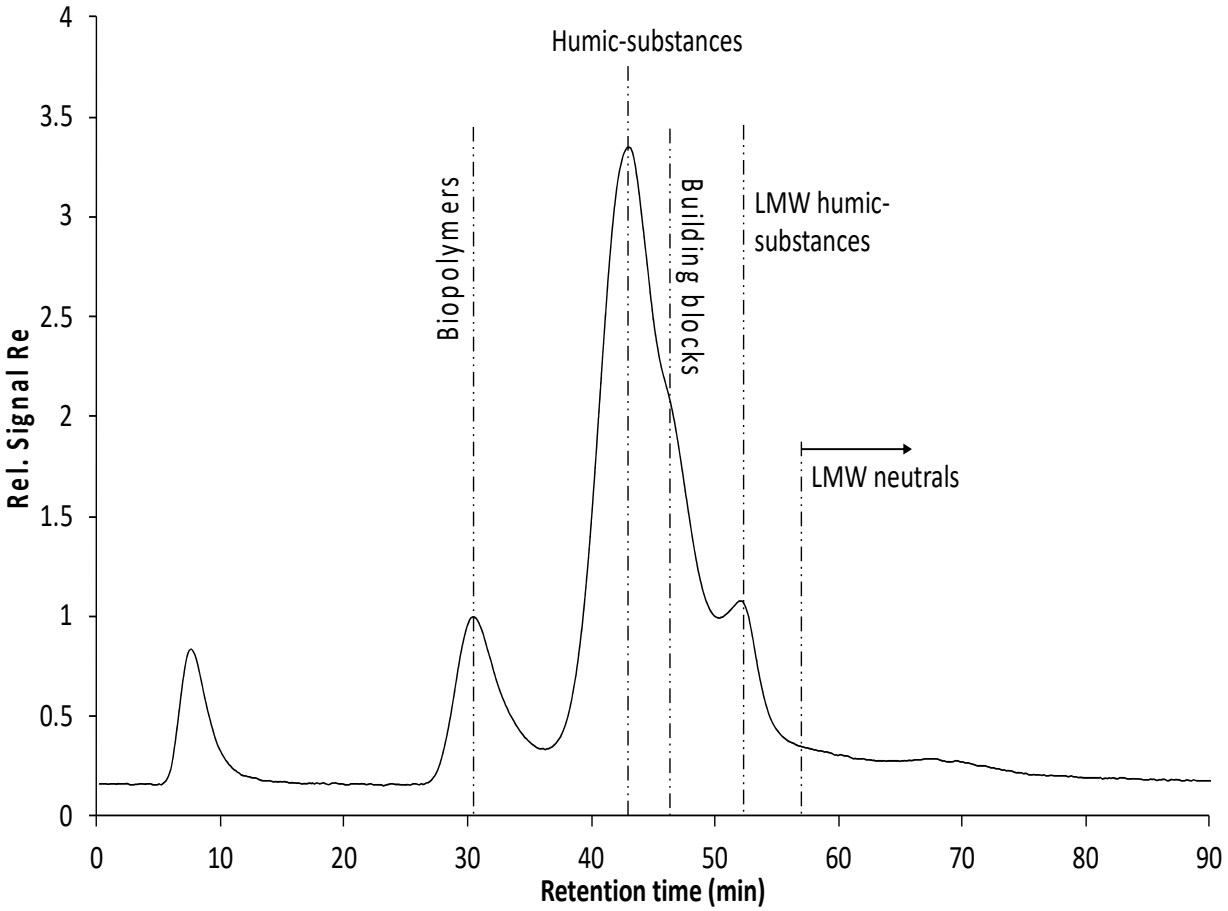

Figure S4. LC-OCD chromatogram of the un-oxidized control cyanobacteria sample. *Microcystis* and *Dolichospermum* were spiked into Lake Champlain water and filtered (0.45 µm).

Table S2. Impact of oxidation on organic carbon fractions with LC-OCD-OND-UVD.

	Concentration (µg C/L)					
Sample	**Total DOC**	**Bio-Polymer**	**Humic-Substances**	**Building Blocks**	**LMW Acids**	**LMW Neutrals**
Chlorine control	5184	556	2677	757	145	411
Chlorine (3 mg/L, 30 min)	5216	583	2583	866	145	496
Ozone control	5632	402	3335	706	131	481
Ozone (2 mg/L, 10 min)	6382	547	3440	810	167	630
$KMnO_4$ and H_2O_2 control	6134	383	3146	884	140	796
KMnO4 (5 mg/L, 120 min)	5533	271	3131	735	131	448
H_2O_2 (5 mg/L, 6 hr)	5913	380	3308	825	114	565

Sample	Bio-Polymer DON (µg N/L)	Bio-Polymer N/C (µg/µg)	Humic-Substances DON (µg N/L)	Humic-Substance N/C (µg/µg)	Humic-Substances SUVA (L $mg^{-1}m^{-1}$)	Humic-Substances Molecular Weight (M_n-g/mol)
Chlorine control	61	0.11	147	0.05	3.93	624
Chlorine (3 mg/L, 30 min)	47	0.08	133	0.05	3.25	626
Ozone control	56	0.14	136	0.04	3.99	626
Ozone (2 mg/L, 10 min)	216	0.40	140	0.04	2.84	583
$KMnO_4$ and H_2O_2 control	13	0.03	108	0.03	4.45	701
KMnO4 (5 mg/L, 120 min)	21	0.09	101	0.03	3.93	638
H_2O_2 (5 mg/L, 6 hr)	54	0.14	121	0.04	4.34	570

LMW = low molecular weight. Building blocks = low molecular weight humic-like substances. Biopolymer = high molecular weight (>10 kDa) polysaccharides, proteins, amino-acids, and other components in extracellular polymeric substances.

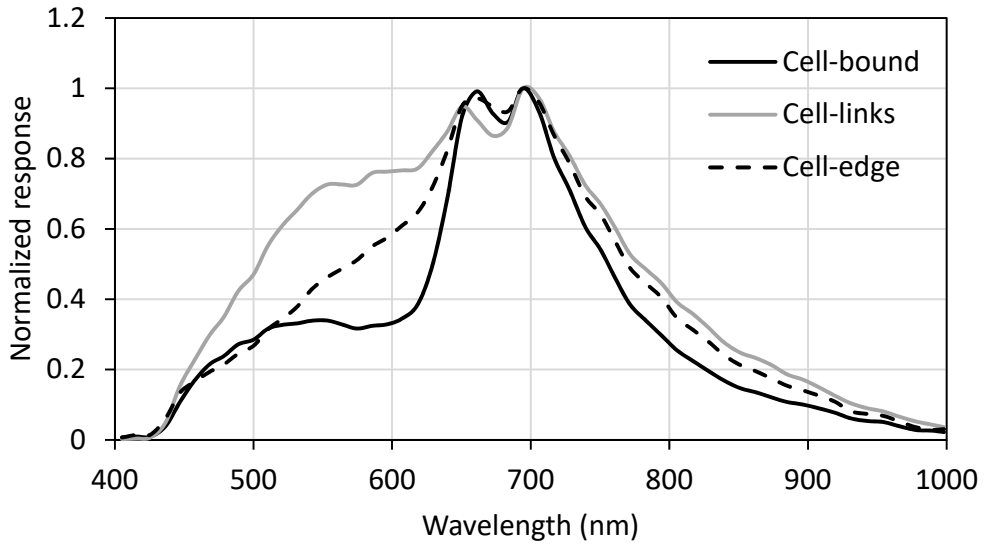

Figure S5. HSI responses of cell-bound, cell-wall, and cell-links for *Dolichospermum*. Instrument responses were normalized to the maximum value of each spectra for comparison.

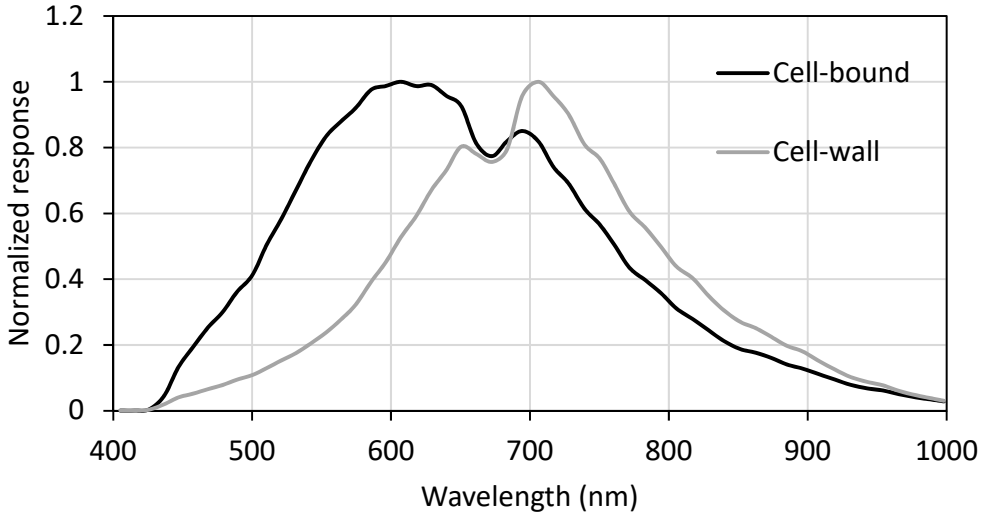

Figure S6. HSI responses of cell-bound and cell-wall for *Microcystis*. Instrument responses were normalized to the maximum value of each spectra for comparison