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Electronic Supplementary Information

Cyanobacteria-based double-mediated photo-microbial electrochemical cells are promising future energy sources for electricity generation and hydrogen production

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Supplementary figures

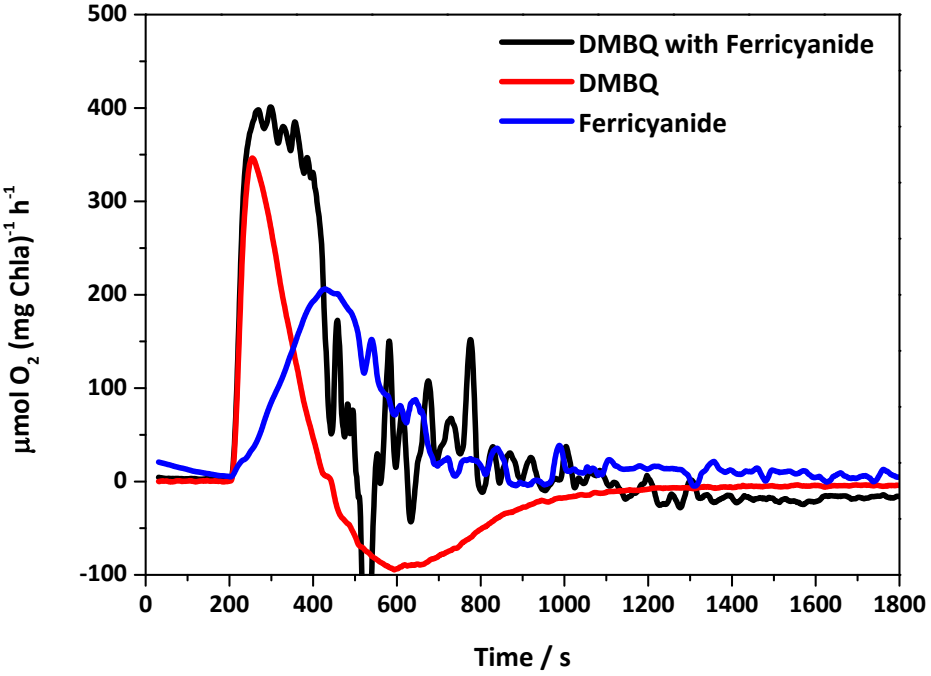

Figure S1. Comparison of oxygen evolution rates from *A. variabilis* depending on single and double mediator. The solution contained 1X BG11 medium and 50 mM HEPES buffer (pH 7.5) and was stirred at 750 rpm. Temperature = 28 ^{o}C.

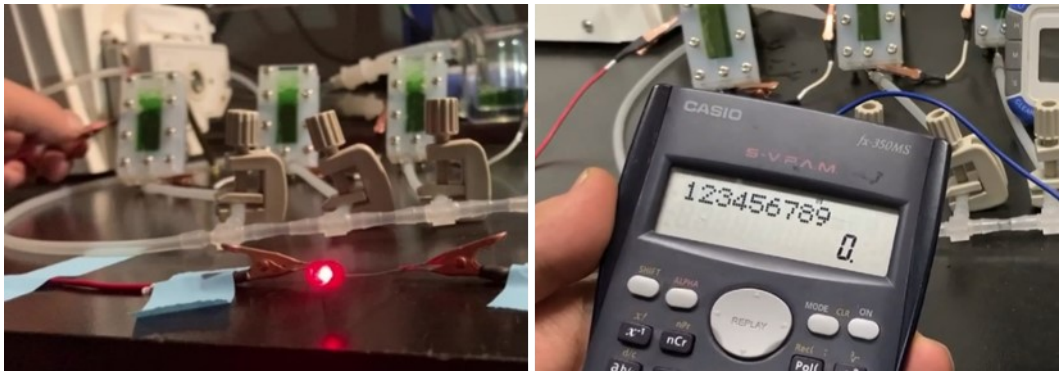

Figure S2. Lighting an LED and operating an electronic calculator using five series-connected DM-PMECs.

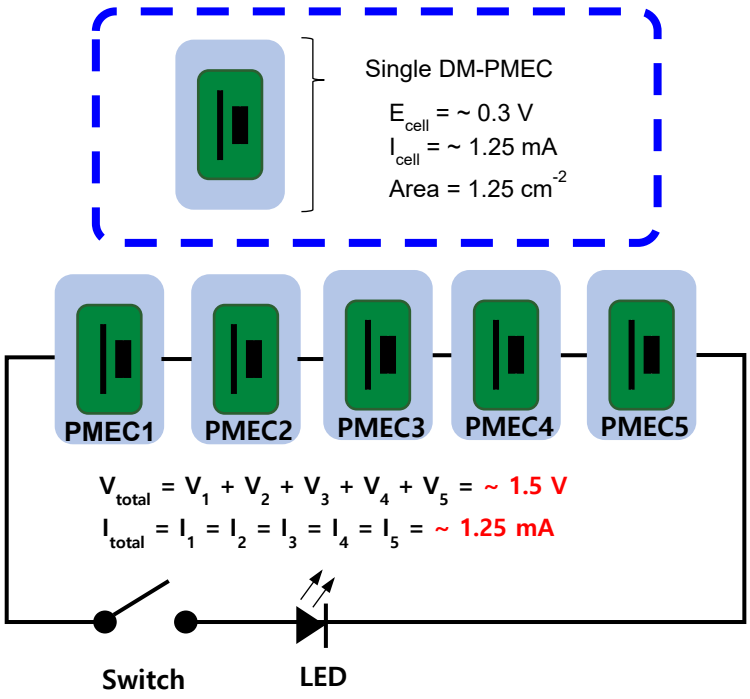

Figure S3. Series connection of five DM-PMECs for lighting a light-emitting diode.

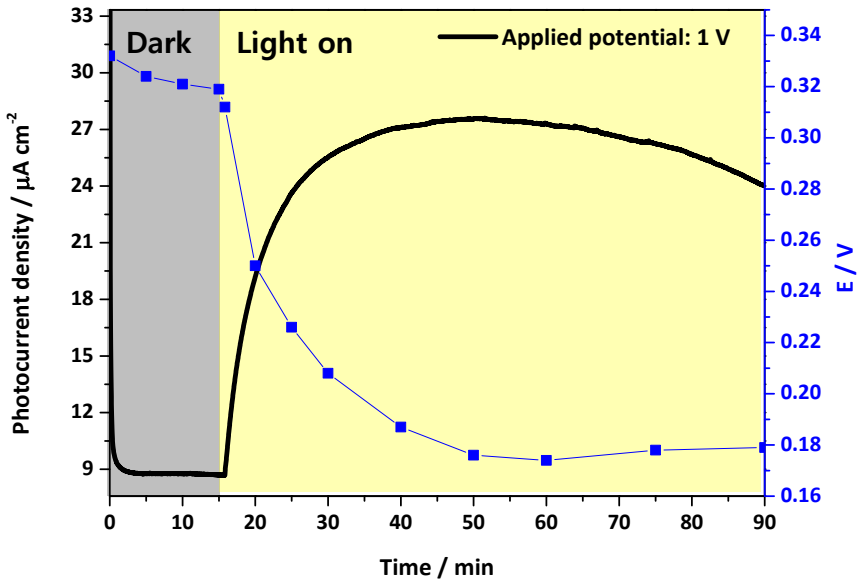

Figure S4. Photocurrent and anode potential change with time in a DM-PMEC operated in a two-electrode system when external voltage of 1 V was applied. Anodic chamber (12 mL) and cathodic chamber (14 mL) were separated by a Nafion membrane. Anolyte composition: 30 μg Chl*a* mL^{-1} of *A. variabilis*, 2 mM DMBQ, and 15 mM ferricyanide in 100 mM HEPES buffer (pH 7.5). Anode area: 32 cm^2. Cathode area: 4.85 cm^2. Light source: LED lamp (model: PS102, LANICS. CO. Ltd). Light intensity: ~719.3 μmol s^{-1} m^{-2} (ca. 35.9 mW cm^{-2}). The anolyte was purged by high-purity argon gas. The anode potential was measured by an Ag/AgCl electrode.

Calculation of total input energy (W_{in})

W_{in} is calculated from the photocurrent density vs. time curve as follows.

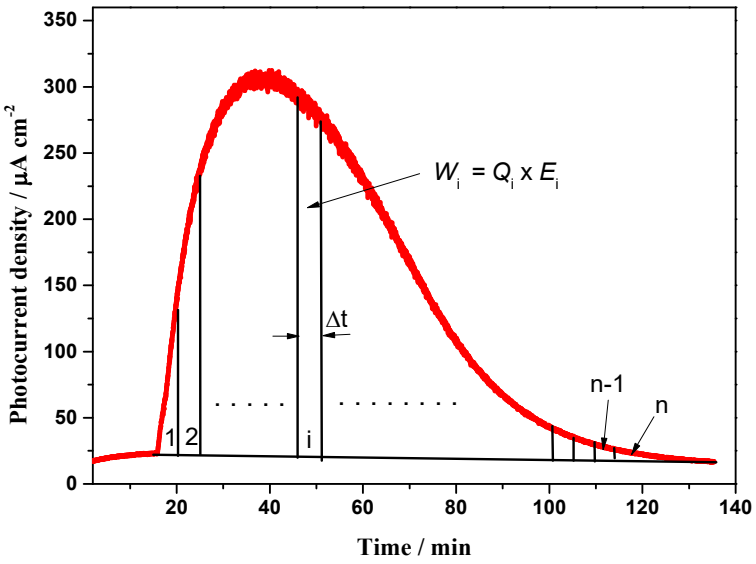

Figure S5. The curve is divided into n sections with an equal time interval Δt. The area of each section represents charge Q_i. Energy is given by Q_i x E_i where E_i is the potential measured for each section. It is assumed that E_i is constant in the time interval Δt. Total input energy (W_{in}) is then the sum of the energy at each section.

$$W_{in} = \sum_{i=1}^{n} W_i = \sum_{i=1}^{n} Q_i E_i$$

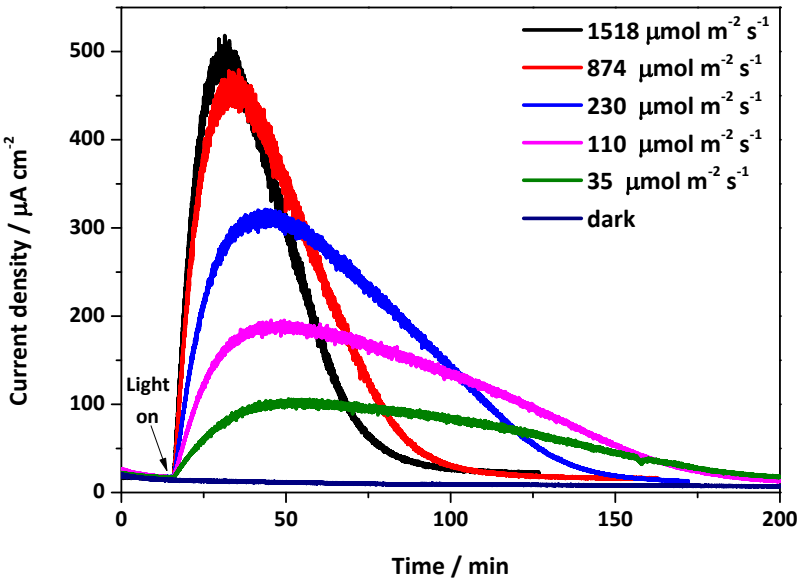

Figure S6. Photocurrent dependence on the light intensity in a DM-PMEC containing *A. variabilis* (30 mg Chl*a* mL^{-1}). Current was measured in a chronoamperometric mode at 0.4 V vs. Ag/AgCl. Electrode area = 16.6 cm^2.

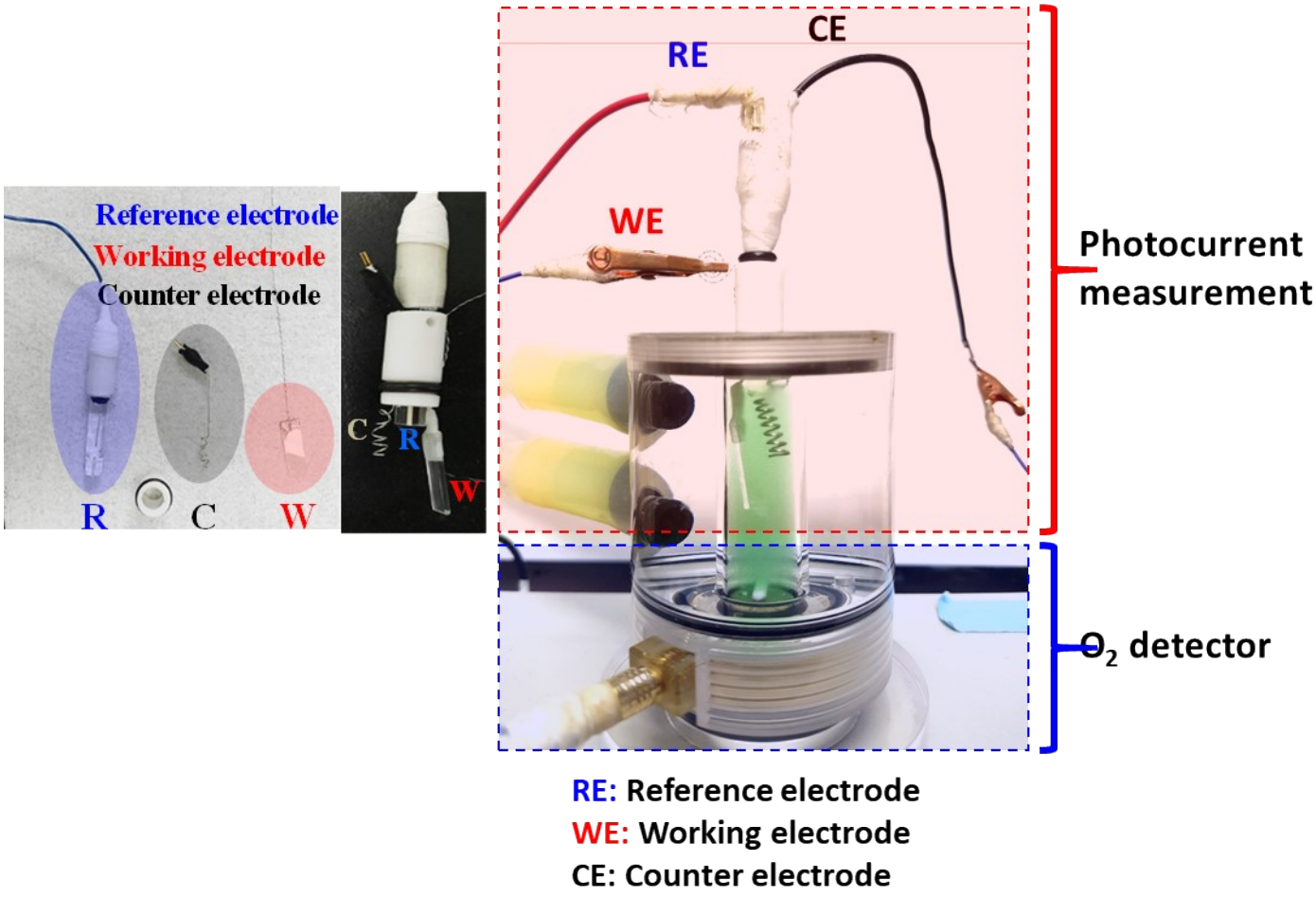

Figure S7. The dual-functioning electrochemical cell that measures oxygen evolution and photocurrent simultaneously. Light illuminates the cell from the top.