Electronic Supplementary Information

Understanding Long-Distance Extracellular Electron Transport in a Mixed Community Electroautotrophic Microbial Biocathode

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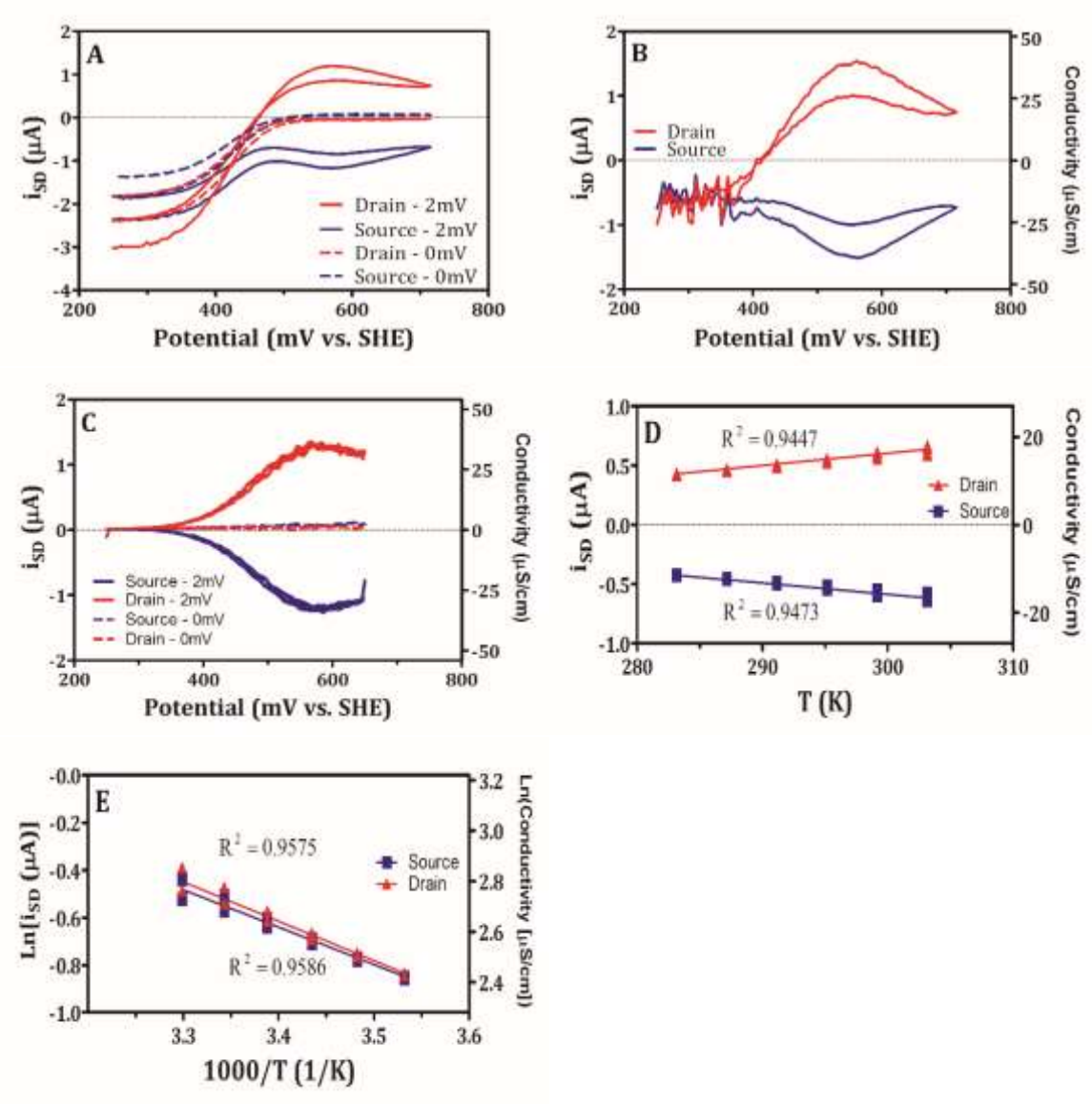

Figure S1. Electrochemical gating experiments of MCL biofilms grown on an IDA. **(A-B)** Electrochemical gating measurements of replicate IDAs performed under turnover condition. **(A)** Raw source and drain currents at V_{SD} = 2 mV and V_{SD} = 0 mV. **(B)** Baseline subtracted source and drain current curves under turnover conditions. **(C)** Electrochemical gating measurements of a replicate IDA under non-turnover condition depicting raw source and drain currents with V_{SD} = 2 mV or 0 mV. The lack of turnover current eliminates the need to background subtract. The conducted current curve depicted in Figure 1A is baseline subtracted (source and drain curves at V_{SD} = 0 mV subtracted from those at V_{SD} = 2 mV). **(D-E)** Replicate temperature dependent gating measurements and fit to the Arrhenius equation, as in Fig. 1 in the main text.

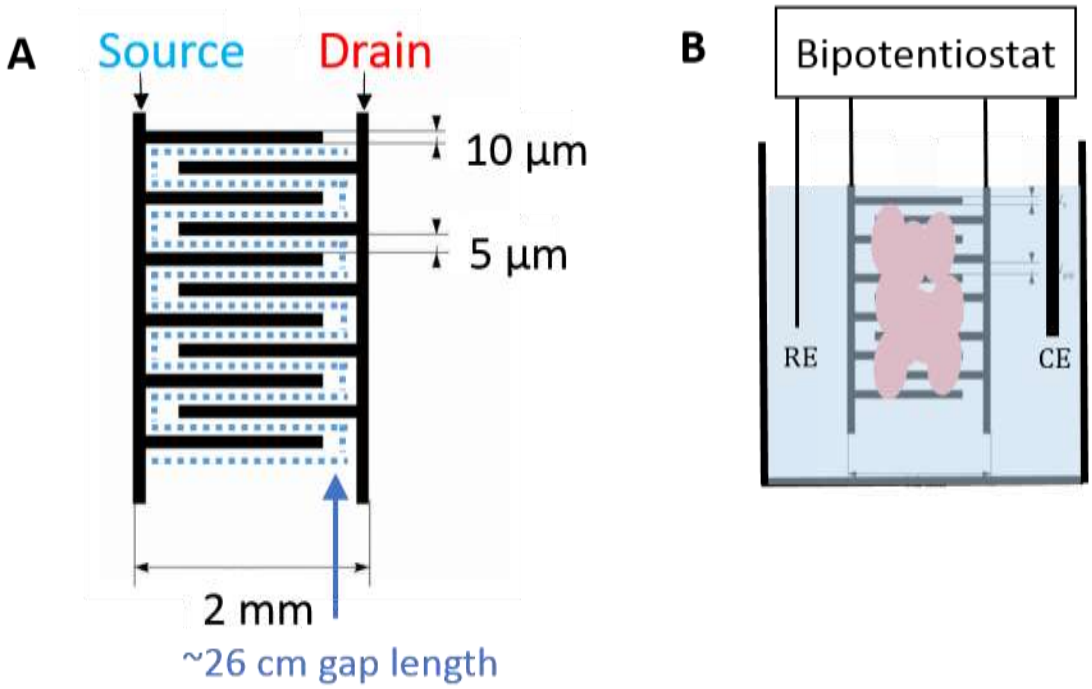

Figure S2. Schematic of the interdigitated microelectrode array geometry. **(A)** Top-down view of the IDA showing the alternating electrode pairs separated by a nonconductive gap and connected at opposite ends of the array, forming electrode 1 and electrode 2. The long gap length and small electrode surface area are key featured of this geometry that gives this configuration its high signal to noise ratio. **(B)** Schematic of the system setup showing that the source and drain electrodes are controlled separately using a bipotentiostat. A reference electrode is used to set the potential of the source and drain and a counter electrode is used to source/ sink currents generated by the biofilm grown on the IDA.

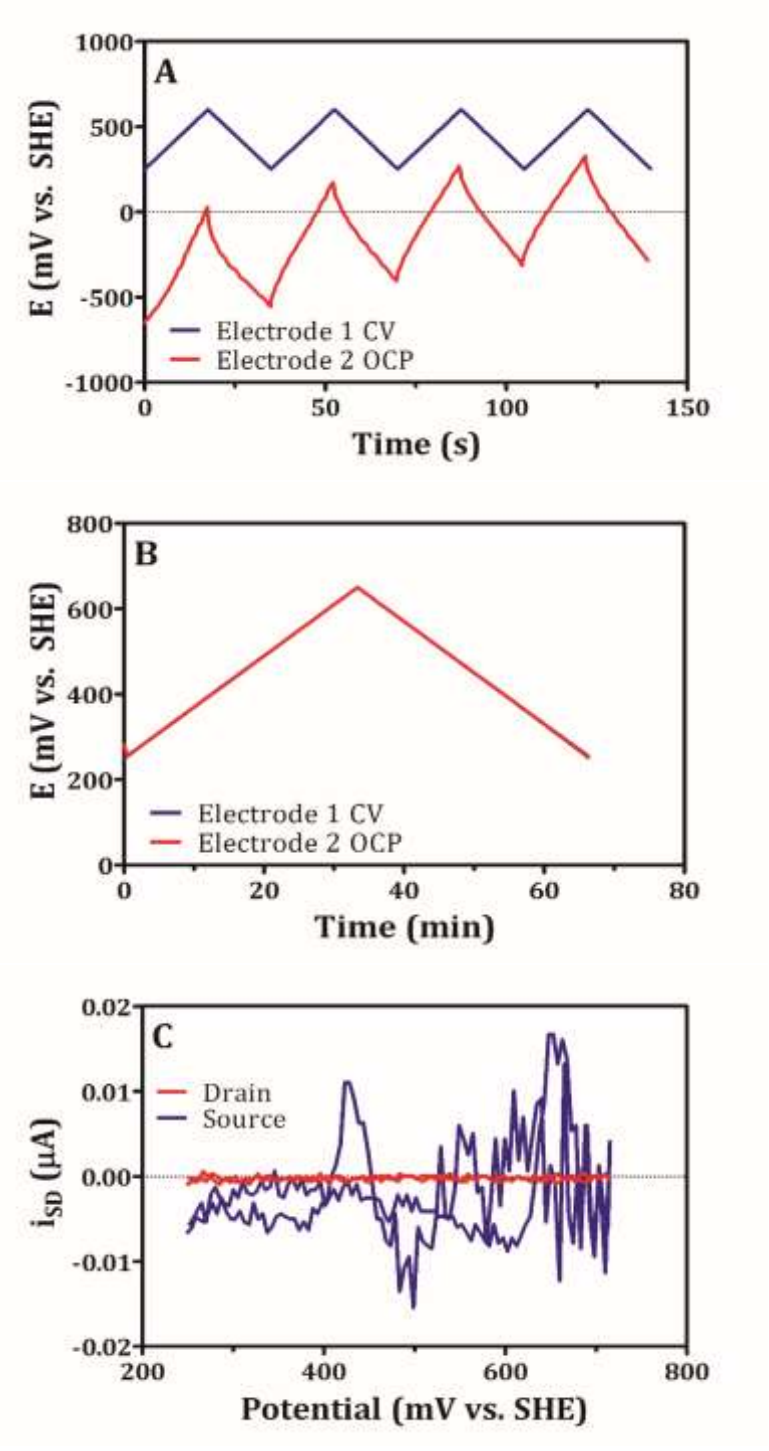

Figure S3. Cyclic voltammetry and gating measurements of abiotic control IDA in artificial seawater medium **(A)** Variation of OCP of electrode 2 during CV of electrode 1. The OCP of electrode 1 tracks the potential applied to electrode 2, attributed to ionic conductivity between the electrodes, but does not match the potential applied to electrode 1, attributed to relatively low conductivity between the electrodes. **(B)** The OCP of electrode 2 tracks the potential of electrode 1 exactly during non-turnover CV when a biofilm is grown on the IDA across the gaps (same

data as Fig. 4B), indicating high conductivity between the electrodes attributed to the biofilm. **(C)** Electrochemical gating measurements of the abiotic IDA indicate no current is conducted across the gap between the two electrodes.

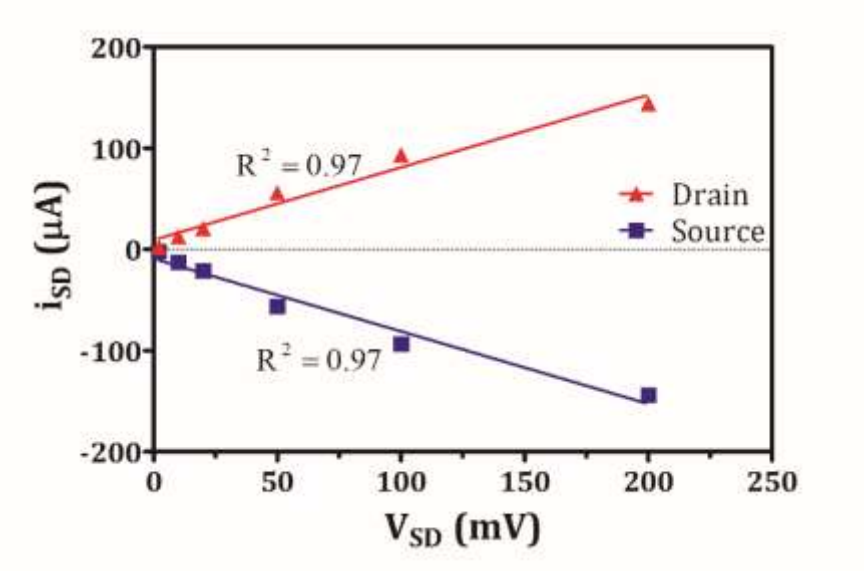

Figure S4. Dependence of source-drain current (i_{SD}) on voltage offset (V_{SD}) at E_G = 570 mV vs. SHE. The V_{SD} used here is within the linear region of the i-V curve, indicating that the conductance can be linearly approximated using Ohm's Law.

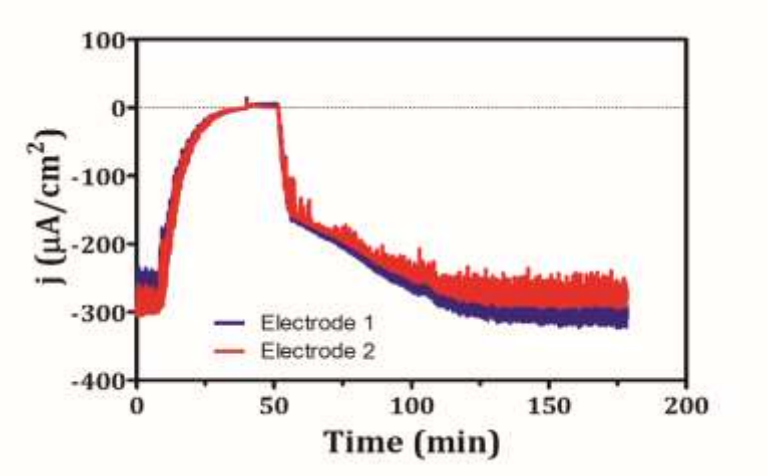

Figure S5. Representative turnover current density vs. time record showing that turnover current recovers under turnover condition after experiments are performed under non-turnover condition. The biofilm takes ~ 2 h to fully recover once oxygen is reintroduced into the system.

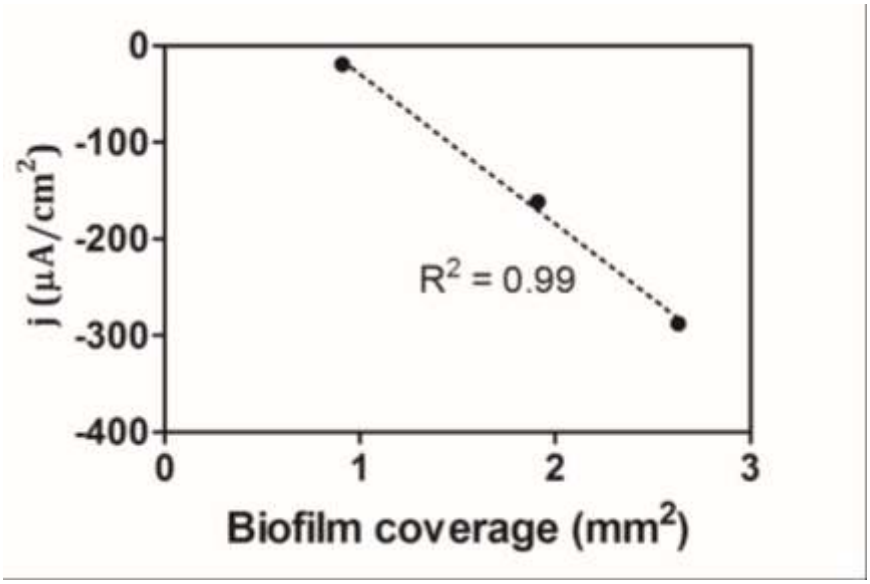

Figure S6. Biofilm coverage vs. turnover current density. We observed a strong correlation between turnover current density and biofilm coverage for three samples that were examined microscopically in an unfixed state. While more replicates are needed to quantify this relationship, the results from these three data-points strongly suggest a significant relationship.

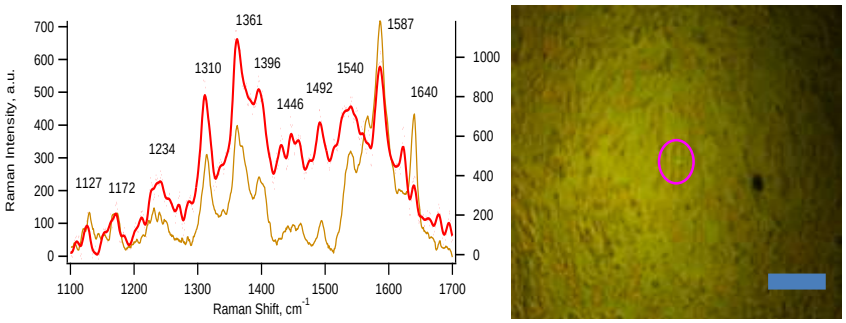

Figure S7. Characteristic CRRM spectra of (Red line) a fully grown phase MCL biofilm obtained on the biofilm outer surface. (Brown line) Experimental Raman spectra of a *Geobacter sulfurreducens* bioanode indicative of *c*-type cytochromes. The blue dot inside circle in the center of the microscope image indicates the 1 µm diameter area where the Raman spectrum of MCL was obtained. Scale bar = 10 µm.

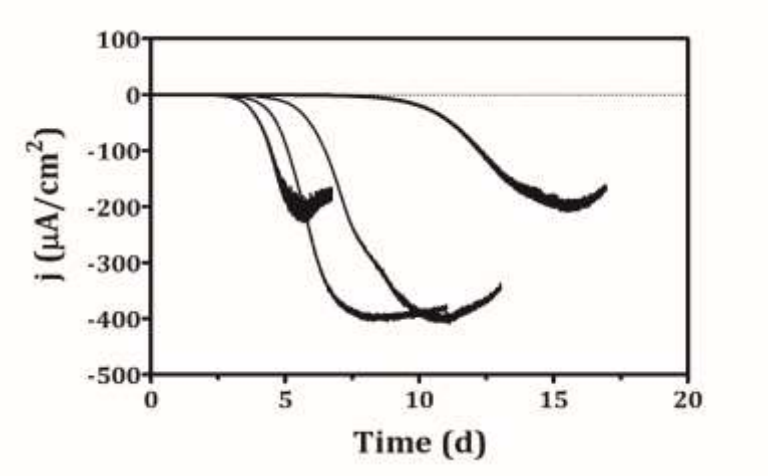

Figure S8. Current density profile of replicate reactors during growth of MCL when the electrode potentials were fixed at 0.310 V vs. SHE. The source of variability in maximum current density and the incubation time to reach maximum current density is unclear at this time. Such inconsistent electrode performance his in line with what has been observed previously.

References

1. Y. Liu and D. R. Bond, *ChemSusChem*, 2012, **5**, 1047-1053.
2. L. Jourdin, T. Grieger, J. Monetti, V. Flexer, S. Freguia, Y. Lu, J. Chen, M. Romano, G. G. Wallace and J. Keller, *Environmental Science & Technology*, 2015, **49**, 13566-13574.