# Supporting Information

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### SI Materials and Methods

**Cultivation.** *Geobacter sulfurreducens* strain DL1 (51573; ATCC) was maintained under anaerobic condition (80:20 N2:$CO_2$) in freshwater media containing 40 mM fumarate and 10 mM sodium acetate as described previously (1–4). Cysteine (10 μM) was added as a reductant.

**Interdigitated Microelectrode Arrays Fabrication.** Interdigitated microelectrode arrays (IDAs) (5) were fabricated in house photolithographically using a sacrificial resist (NR 71–1000PY; Futurex) by deposition of 100 Å titanium and 1,000 Å gold onto piranha etch-cleaned microscope slides using a Temescal e-beam metal evaporator. The photoresist (NR7-3000P) was used as a blocking layer to ensure that only the microelectrode bands of the array were exposed. Masks were designed in house using L-Edit software. Blanks of a layer of low reflective chrome covered with AZ photoresist were exposed in a Heidleberg DWL-66 laser pattern generator. The patterned gold electrode was connected to a copper-coated circuit board and shielded cable before packaging in water-insulating epoxy (Scotchcast; 3M). The IDAs were tested by cyclic voltammetry in (ferrocenylmethyl)trimethylammoniumhexafluorophosphate (6) in phosphate buffer with 100 mM potassium chloride to ensure that IDAs functioned electrochemically as expected. Before use in *Geobacter* culture, IDAs were autoclaved for sterility. The biofilm was grown using established methods (4) by poising both electrodes as anodes at +0.300 V vs. Ag/AgCl [approximately +0.500 V vs. standard hydrogen electrode (SHE)] in media containing excess acetate (10 mM) until a self-determined limiting catalytic current of 50 μA (25 μA for each electrode) was achieved, corresponding to a biofilm thickness of 18 μm (on average) that was sufficiently thick to span the gap between adjacent interdigitated microelectrode bands (Fig. S1).

**Electrochemical Measurements.** All electrochemical experiments were performed in a 250-mL water-jacketed single-chamber electrochemical cell (AFCELL3; Pine Research Instrumentation) maintained at 30 °C in a similar manner as pervious described (3, 4, 7) with the following exception. The two electrode experiments were performed using a biopotentiostat (AFCBP1; Pine Instruments), a counter electrode (graphite rod), and a reference electrode (Ag/AgCl, 3 M KCl; CH Instruments).

**Microscopy.** Representative biofilm-modified IDAs were prepared for SEM using the method in the work by Rollefson et al. (8) in which samples were fixed in 2% (vol/vol) gluteraldehyde in 0.15 M sodium cacodylate at pH 7.4 with 0.15% safranin O, post-fixed for 2 hr in 1.5% (vol/vol) osmium tetroxide, dehydrated using serial dehydration in ethanol, treated with hexamethyldisilazane (HMDS), affixed to standard SEM mounts, sputter coated with a thin layer of platinum, and imaged using a Carl Zeiss SMT Supra 55 scanning electron microscope at 5 kV. Representative biofilm-modified IDAs were imaged using confocal laser scanning microscopy. The IDAs were removed from electrochemical reactors after completion of electrochemical measurements and rinsed two times in 1× PBS, pH 7.4 (10× PBS solution, EN7859CX; Excelleron). Biofilms were stained according to the manufacturer's instructions with the LIVE/DEAD BacLight Bacterial Viability Kit (L7012; Invitrogen). Staining was carried out in 1× PBS, pH 7.4, for 10 min at room temperature in the dark. After incubation with the stain, IDAs were rinsed one time with 1× PBS, pH 7.4, and allowed to destain in 1× PBS, pH 7.4, for 10 min. IDAs were broken off from the electrode housing unit and mounted into a single-welled chambered coverglass slide (155361; Lab Tek) with several microliters of mounting oil (Prolong Gold Antifade, P36930; Invitrogen). Biofilm imaging was carried out using a Nikon TE-2000e inverted confocal microscope (Nikon) with a Nikon CFI Apo TIRF 100× (n.a. 1.49) oil objective. Two wavelengths, 488 and 514 nm, were used to excite the fluorescent stains. A mininimum of eight fields were imaged and processed with ImageJ software program (http://imagej.nih.gov/ij/). Three random image stacks were used to determine the mean biofilm height by measuring the height at 18 random points for each stack using ImageJ.


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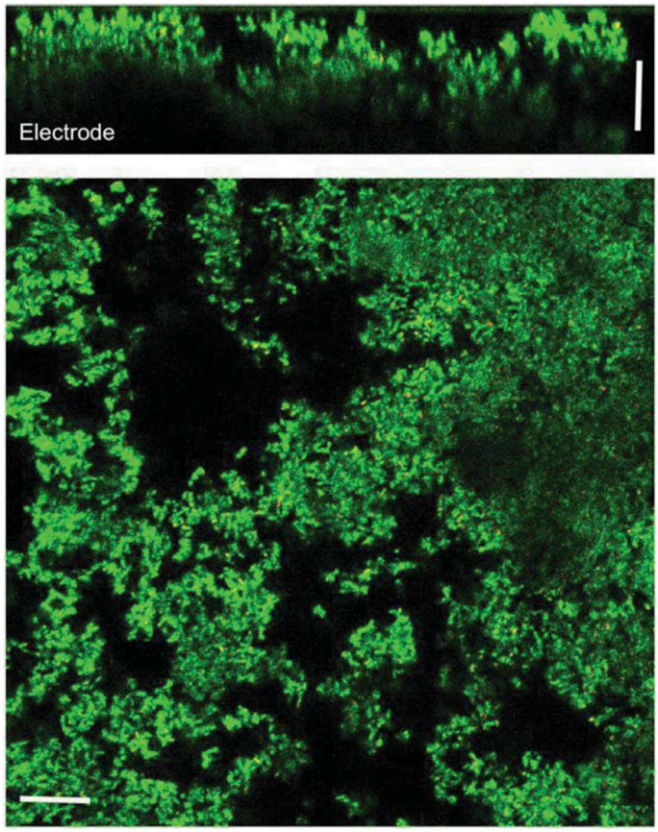


**Fig. S1.** Confocal laser scanning microscopy of a fully grown biofilm on an IDA. *Upper* is a representative slice of the biofilm perpendicular to the IDA surface. The mean biofilm height ($n$ = 17) was 18.0 μm. *Lower* is a representative slice of the biofilm parallel to the IDA surface. (Scale bar: 10 μm.)