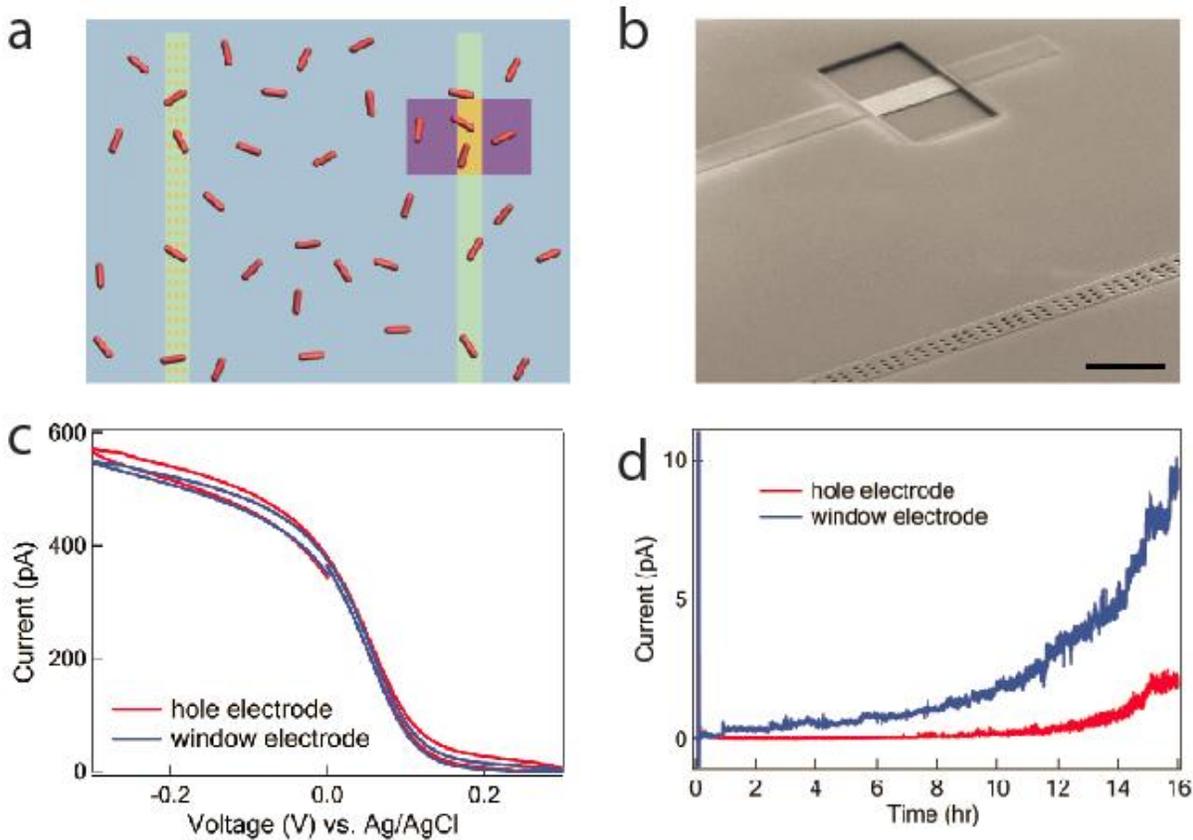
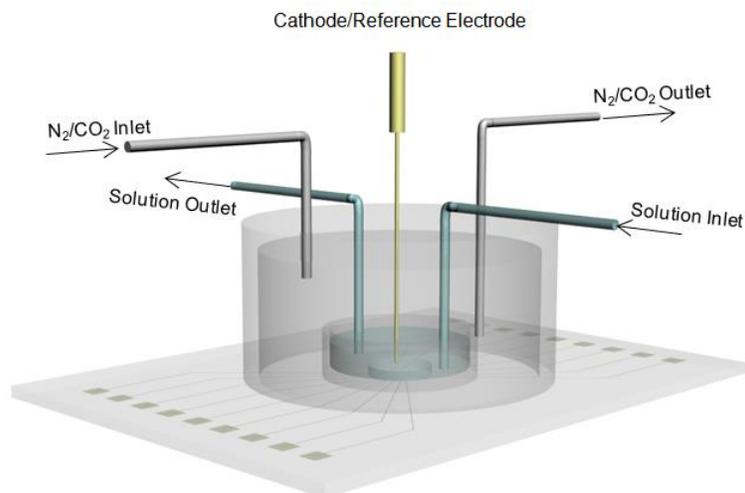


Supplementary Figure S1 | Control experiments for using *Geobacter* in the nanoelectrode system. Short-circuit current recording on microelectrode when dead *G. sulfurreducens* DL-1 cells (a) or DL-1 cells without acetate (b) were injected into the measurement chamber. The *G. sulfurreducens* DL-1 cells were killed by autoclaving at 121 °C for 20 min. In order to remove the remaining acetate in culture solution, the culture tube was centrifuged to remove supernatant and washed twice with degassed media without acetate. The black, red and blue arrows indicate the addition of dead DL-1 cells, DL-1 cells without acetate, and 10 mM degassed acetate solution, respectively.



Supplementary Figure S2 | Characterization of nanoelectrodes and experimental setup.

(a) The schematic of electrode design. (b) SEM image of the window and nanohole electrodes. Scale bar: 5 μm . (c) Cyclic voltammetry measurement of window (blue) and hole (red) electrodes in 1 mM ferricyanide solution. (d) Short-circuit current recording on window and hole electrodes after injection of *G. sulfurreducens* DL-1 cells. Short-circuit current measurement on our first generation of nanostructured electrodes.³⁰ Photolithography and thermal evaporation were used to fabricate the array of transparent Ti/Au finger electrodes, and then plasma-enhanced chemical vapor deposition was used to deposit a 400nm-thick silicon nitride passivation layer, and electron-beam lithography was used to define either nanoholes (200nm x 400nm) or windows (6 μm x 10 μm) at alternating electrodes in the array. We designed the openings such that nanoholes and window exposed the same electrode area, 12 μm^2 , to solution.



Supplementary Figure S3 | Schematic of chip design. Transparent electrode array was fabricated on 0.17mm glass slide, enabling simultaneous current recording and optical imaging of cells on electrodes. The inner measurement chamber was mounted to the center of substrate using silicone glue. A PDMS housing was attached and sealed to the outside of inner chamber, allowing for continuous or batch solution exchange, and control of anaerobic atmosphere by continuously flowing 20 sccm N_2/CO_2 (80/20) gas mixture during measurement.