nature research

https://doi.org/10.1038/s41589-020-0623-9

Supplementary information

Electric field stimulates production of highly conductive microbial OmcZ nanowires

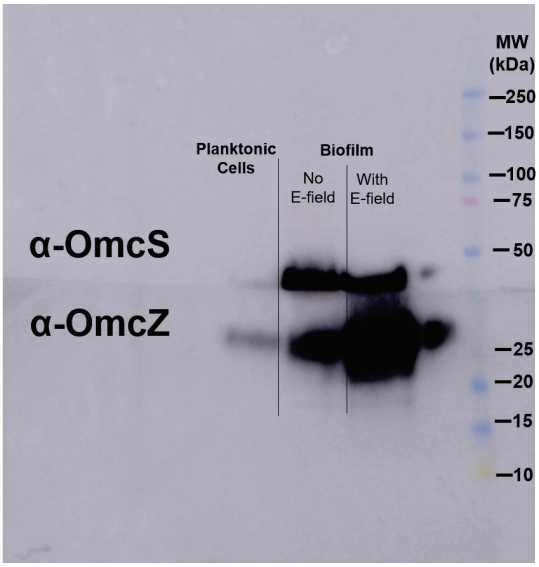
In the format provided by the authors and unedited

Supplementary Information

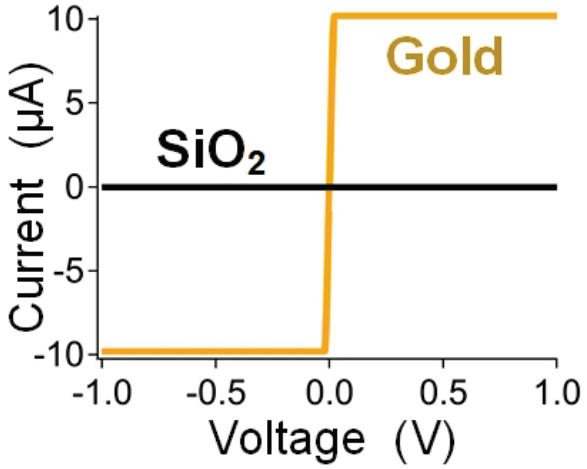
Electric field stimulates production of highly conductive microbial OmcZ nanowires

Sibel Ebru Yalcin[1,2,7*], J. Patrick O'Brien[1,2,7], Yangqi Gu[2,3], Krystle Reiss[4], Sophia M. Yi[1,2], Ruchi Jain[1,2], Vishok Srikanth[1,2], Peter Dahl[1,2], Winston Huynh[2,5], Dennis Vu[1,2], Atanu Acharya[4], Subhajyoti Chaudhuri[4], Tamas Varga[6], Victor S. Batista[4] & Nikhil S. Malvankar[1,2*]

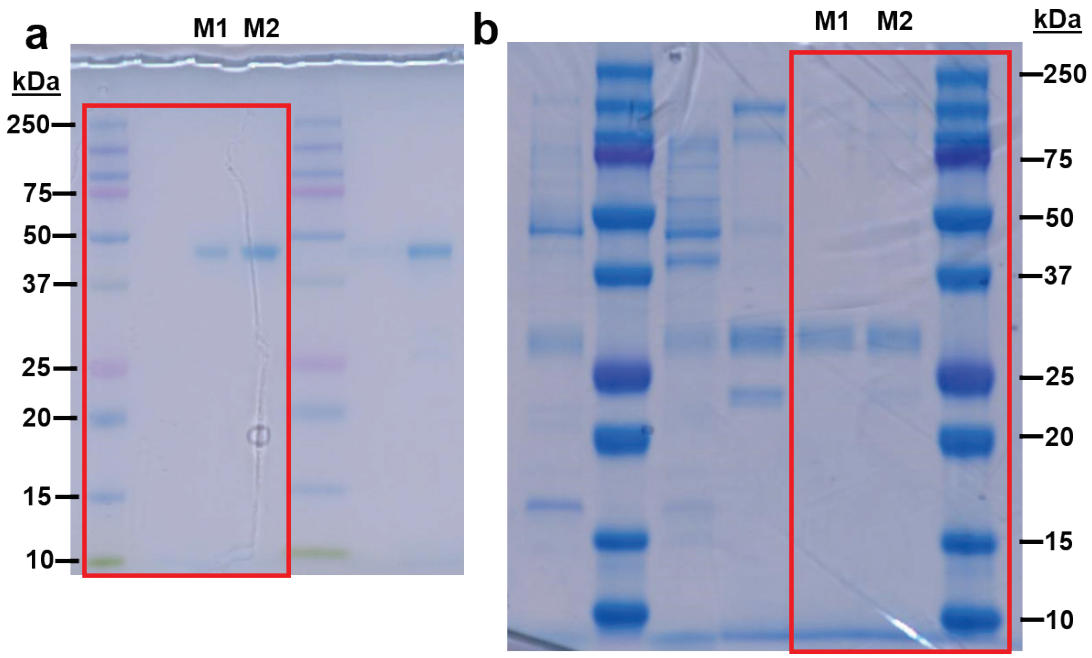
Supplementary Figures



Supplementary Figure 1. Electric field stimulates production of OmcZ nanowires. Immunoblotting showing comparison of OmcZ abundance in filament preparations of WT cells under three different growth conditions. Top part of the gels was blotted with OmcS-specific antibody. Both nanowires show expected molecular weight (OmcS ~45 kDa; OmcZ ~30 kDa).



Supplementary Figure 2. Positive (gold) and negative (SiO_2) controls for conducting probe AFM measurements. Current-voltage curves on gold and SiO_2 show expected results.



Supplementary Figure 3. Purified OmcS and OmcZ nanowires from Δ*omcZ* and KN400 strains respectively. SDS-PAGE gel of filament preparations showing a single band corresponding to **a,** OmcS purified from Δ*omcZ* strain and **b,** OmcZ from KN400 strain. M1 and M2 represent nanowires sheared from cells by two different methods – vortexing (M1) and blending (M2). Both nanowires show expected molecular weight (OmcS ~ 45 kDa; OmcZ ~ 30 kDa). Region in the red square for **a** and **b** is shown in Extended Data Fig. 10a and d respectively.

a

Secondary Structure	Bulk FTIR (%)	IR s-SNOM (%)
Alpha-Helix	58	56
Beta-Sheet	19	16.3
Loop	23	27.6

b

Secondary Structure	OmcS pH 7 (%)	OmcS pH 2 (%)
Alpha-Helix	69.1	26.3
Beta-Sheet	10.1	73.7
Loop	20.8	—
Secondary Structure	**OmcZ pH 7 (%)**	**OmcZ pH 2 (%)**
Alpha-Helix	70.4	29.2
Beta-Sheet	29.6	70.8
Loop	—	—

c

Secondary Structure	OmcS pH 7 (%)	OmcS pH 2 (%)
Alpha-Helix	65.55	38.6
Beta-Sheet	15.75	36.85
Loop	18.15	24.2
Secondary Structure	**OmcZ pH 7 (%)**	**OmcZ pH 2 (%)**
Alpha-Helix	38.7	20.25
Beta-Sheet	40.8	53.45
Loop	20.65	26.1

Supplementary Table 1. a, Composition of the secondary structure of lysozyme calculated from Extended Data Fig. 6. **b,** Composition of the secondary structure of individual OmcS (WT) and OmcZ (W51W57) nanowires at pH 7 and 2 from IR *s*-SNOM studies (Figures 2,5). **c,** Composition of the secondary structure of OmcS (WT) and OmcZ (W51W57) nanowire containing samples at pH 7 and pH 2 calculated from CD (Fig. 6c,d).

heme pair	8-heme proteins edge-to-edge distance (Å)	OmcS edge-to-edge distance (Å)
1 / 2	3.82	5.4
2 / 3	5.79	3.5
3 / 4	3.55	6.1
4 / 5	3.58	3.4
5 / 6	3.48	6.1
6 / 7	7.63	
7 / 8	5.63	
5 / 7	3.91	

Supplementary Table 2. Edge-to-edge distances between heme pairs in 8-heme proteins and OmcS nanowire. Distances within the π-stacking range (~3.5-4 Å) are highlighted in blue. Heme numbering is shown in Fig. 4c and d for the structures of OmcS and 8-heme proteins respectively.