Supporting information

Evaluation of electrode and solution area-based resistances enables quantitative comparisons of factors impacting microbial fuel cell performance

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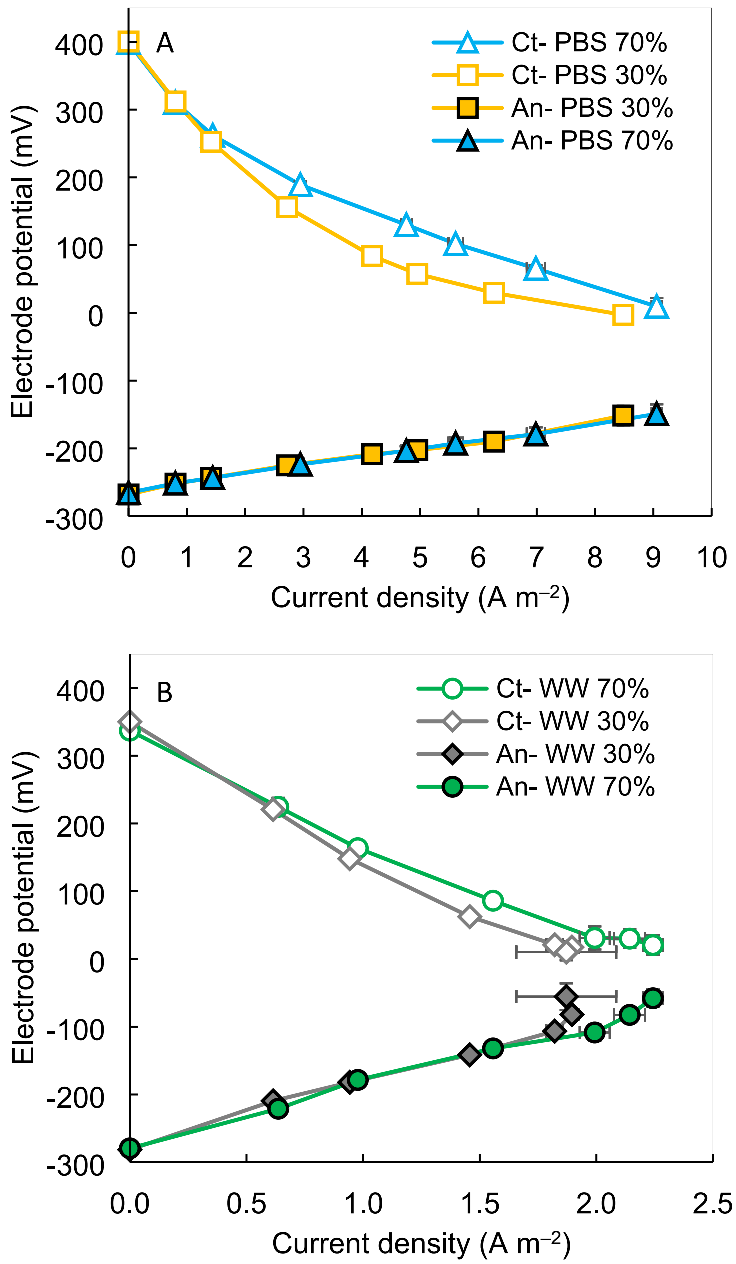

Figure S1. Anode (An) and cathode (Ct) electrode potentials in (A) PBS and (B) wastewater using cathodes with 70% or 30% DL porosities. We can see in the plots A and B that the anode potentials are similar for both cathodes, in either PBS and wastewater (WW). This shows that the anode potentials were not affected by the porosity of the cathode, which would allow more oxygen transfer into the solution. However, the cathode potentials are higher for the 70% cathodes than the 30% cathodes, reflecting that the higher porosity cathodes allow more oxygen transfer into the cathode, and thus increase slightly the potentials.

EPS analysis and current density. The ORR usually shows a large activation loss at low current densities due to the sluggish kinetic. Applying the EPS analysis in low current densities range could result in the inclusion of the activation losses in the cathode specific resistance. Thus, the current density range used for the EPS analysis should be kept similar during the comparison of different studies. For example, in current density range comprised between 2.7 A m^{-2} and 9.1 A m^{-2} the cathode specific resistance in PBS with the two different DL porosities were R_{cat} 14.8 ± 0.9 mΩ m^2 (70% DL) and R_{cat} = 12 ± 5 mΩ m^2 (30% DL) while the experimental cathode potentials were $E_{Cat,e0}$ = 271 ± 6 mV (70% DL) and $E_{Cat,e0}$ = 205 ± 27 mV (30% DL) (Figure 3A). In a current density range of 0 – 3 A m^{-2} the cathode specific resistance increased to R_{cat} = 54 ± 10 mΩ m^2 (70% DL) and R_{cat} = 75 ± 7 mΩ m^2 (30% DL) and the experimental cathode potentials were $E_{Cat,e0}$ = 379 ± 18 mV (70% DL) and $E_{Cat,e0}$ = 390 ± 10 mV (30% DL) (Figure S2). These results were similar to those obtained in wastewater (R_{cat} = 54 ± 7 mΩ m^2 (70% DL) and 78 ± 14 mΩ m^2 (30% DL); $E_{Cat,e0}$ = 308 ± 10 mV (70% DL) and 313 ± 18 mV (30% DL)) in a current density range of 0.61 A m^{-2} – 2 A m^{-2}. Thus, changing solution from PBS to wastewater did not affect the electrode specific resistance but decreased the experimental electrode potential $E_{Cat,e0}$ of ~20% (71 mV with 70% DL and 77 mV with 30% DL) probably due to the less favorable condition in an unbuffered solution in respect to PBS.

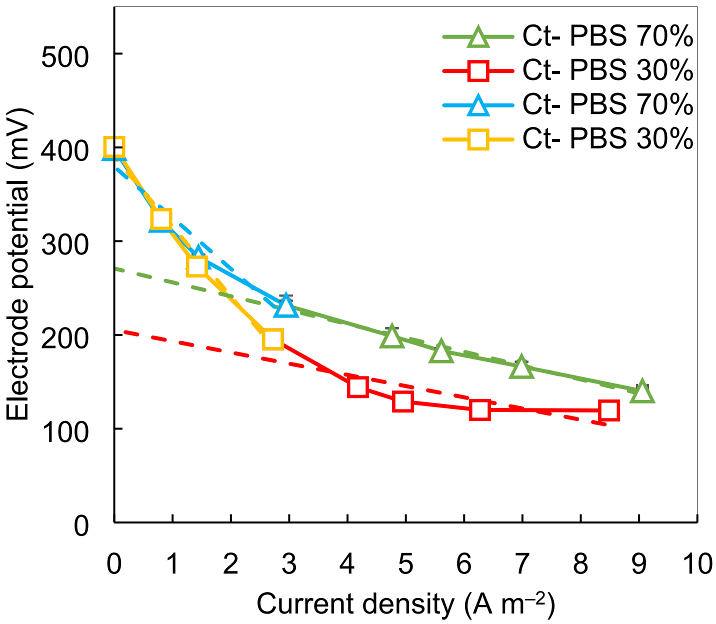

Figure S2. Cathode (Ct) potentials in PBS using cathodes with 70% or 30% DL porosities. The dashed lines represent the linearization of the data that would be obtained from polarization tests, while the thick solid lines show the linearized portion of the slopes that are used to calculate the cathode (R_{Cat}) resistances.

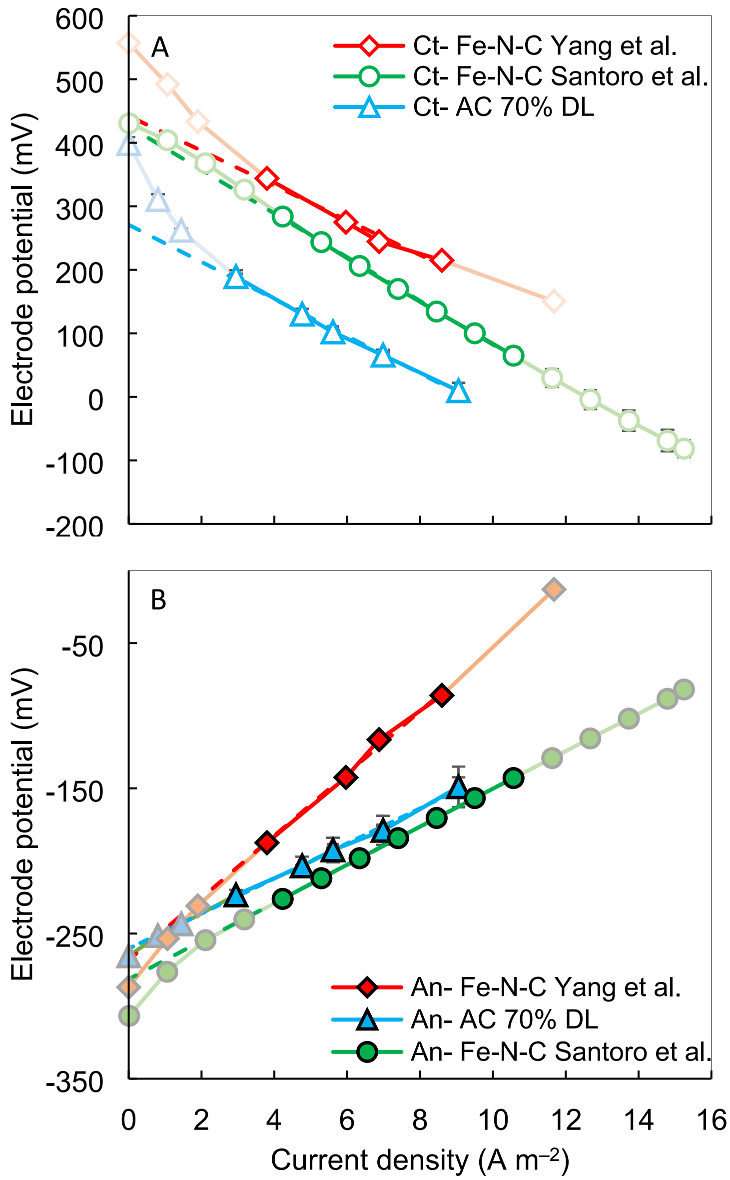

Figure S3. (A) Cathode (Ct) and (B) anode (An) potentials using Fe catalyst developed at the Pennsylvania State University (PSU) and at the University of New Mexico (UNM) compared to plain AC cathodes with 70% or 30% DL porosities. These figures show the linear portions of the lines used for the results on the electrode experimental potentials and resistances in the main section of the paper. The dashed lines represent the linearization of the data that would be obtained from polarization tests.

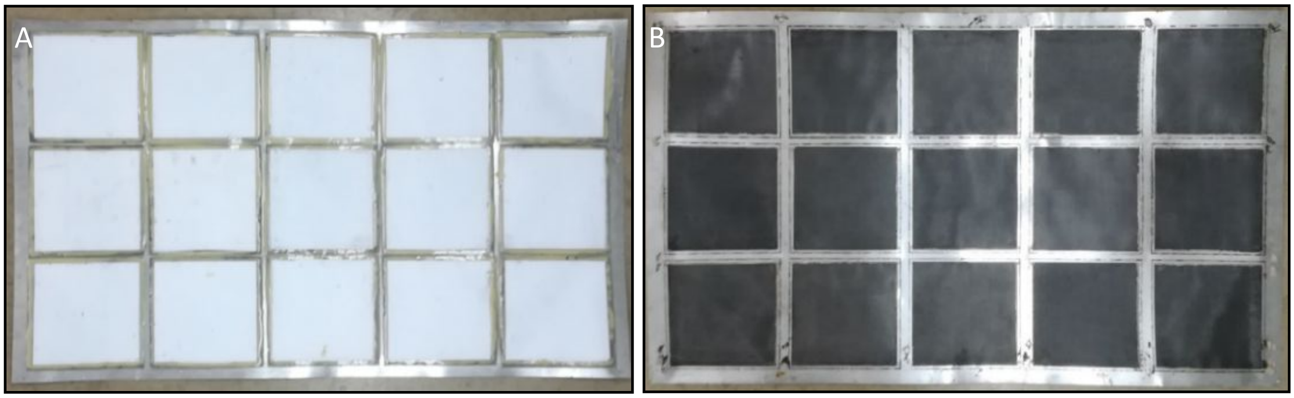

Figure S4. Photos of the (A) air and (B) solution side of the 0.68 m^2 cathode.

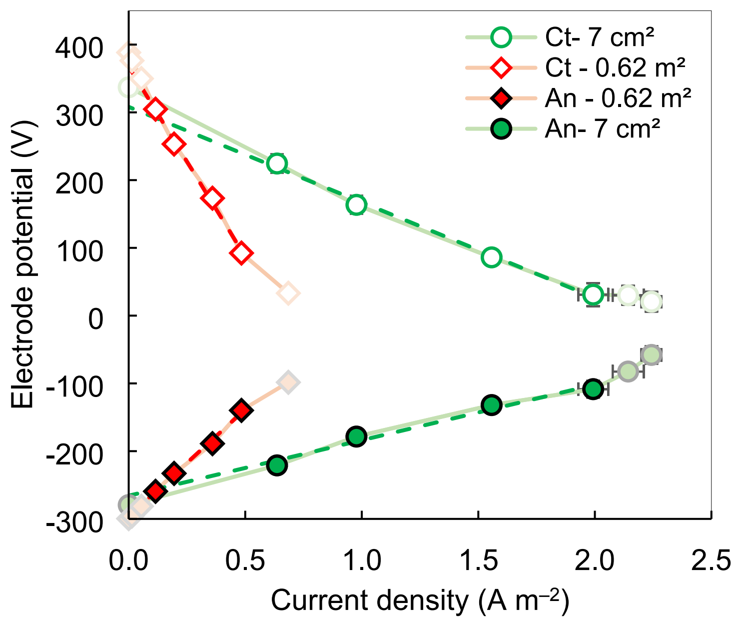

Figure S5. Comparison of 7 cm^2 and 0.62 m^2 electrode potentials in wastewater. This shows how the smaller cathodes have much lower overpotentials, and that they reach much higher current densities compared to the large cathodes. The dashed lines represent the linearization of the data that would be obtained from polarization tests, while the thick solid lines show the linearized portion of the slopes that are used to calculate the anode (R_{An}) and cathode (R_{Cat}) resistances.