Supporting Information

Combined Electrical-Electrochemical Phenotypic Profiling of Antibiotic Susceptibility of *In Vitro* Biofilm Models

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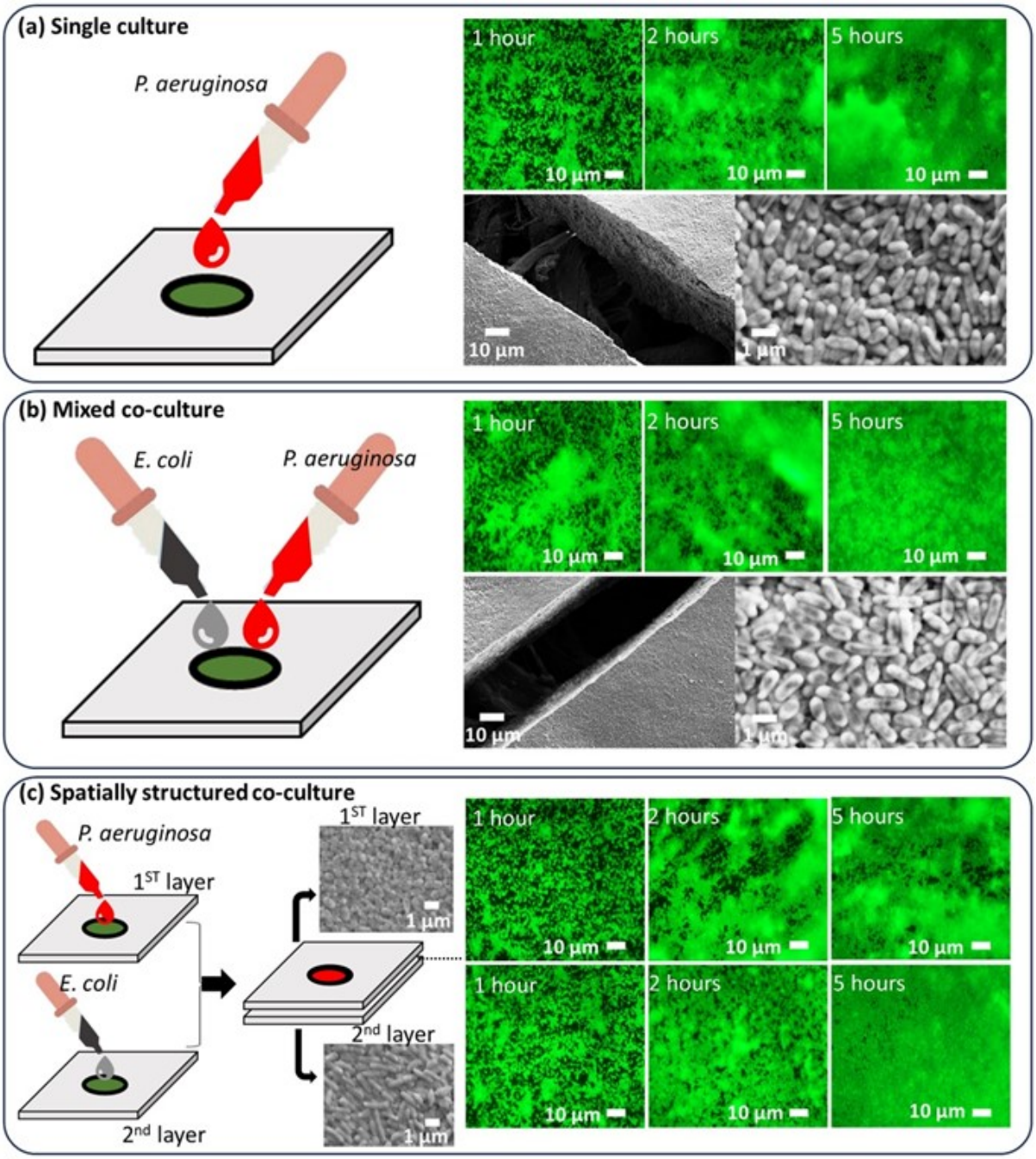

Figure S1. (a) Ilustration of the paper-based culture platform to form a *P. aeruginosa* biofilm, fluorescence microsopic images of the biofilm formed for 1 hour, 2 hours, and 5 hours, and SEM images of the biofilm at t = 5 hours with different magnitude. (b) Ilustration of the paper-based culture platform to form a mixed *P. aeruginosa* and *E. coli* biofilm, fluorescence microsopic images of the biofilm formed for 1 hour, 2 hours, and 5 hours, and SEM images of the biofilm at t = 5 hours with different magnitude. (c) Ilustration of the two-layer paper-based culture platform to form a spatially engineered *P. aeruginosa* and *E. coli* biofilm (*P. aeruginosa* on the top layer and *E. coli* on the bottom layer), fluorescence microsopic images of the biofilm formed for 1 hour, 2 hours, and 5 hours, and SEM images of the biofilm at t = 5 hours.

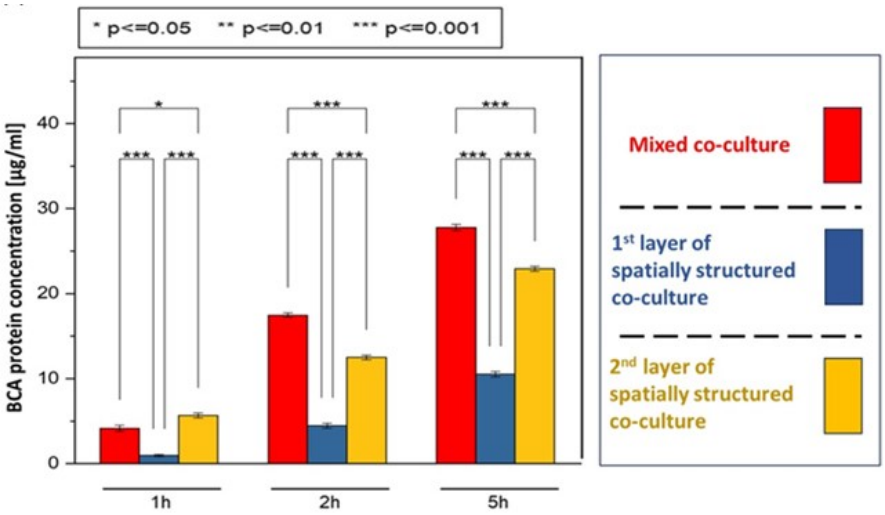

Figure S2. Quantification of bacterial biofilm formation over time by using a BCA protein assay kit. The mixed *P. aeruginosa* and *E. coli* biofilm, and the top and the bottom of the two-layered biofilm are characterized.

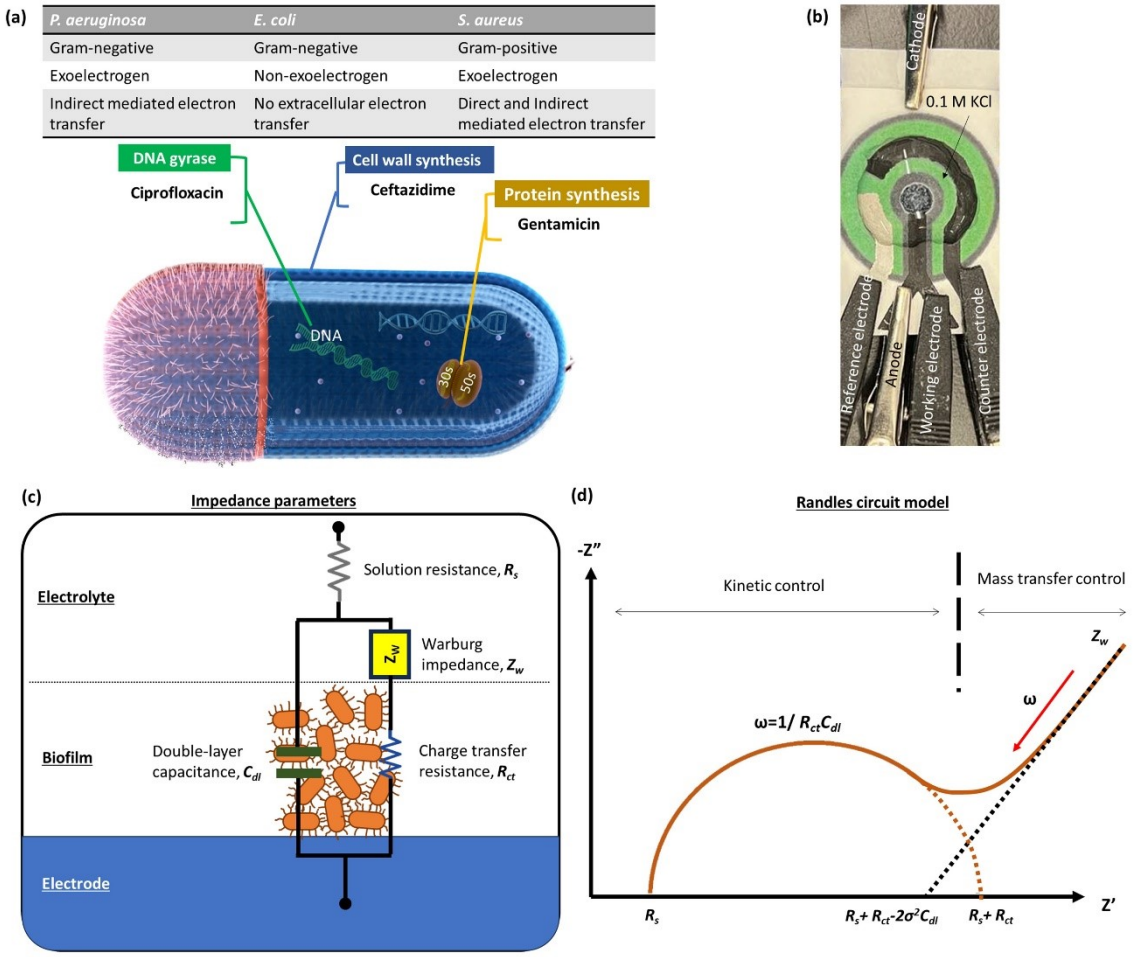

Figure S3. (a) Three pathogens against three frontline antibiotics tested in this work. (b) Test setup for the combined MFC-EIS measurements, (c) Schematic illustration demonstrating the impedance signature of a given microbe-electrode interface, and (d) the Randles' equivalent circuit model

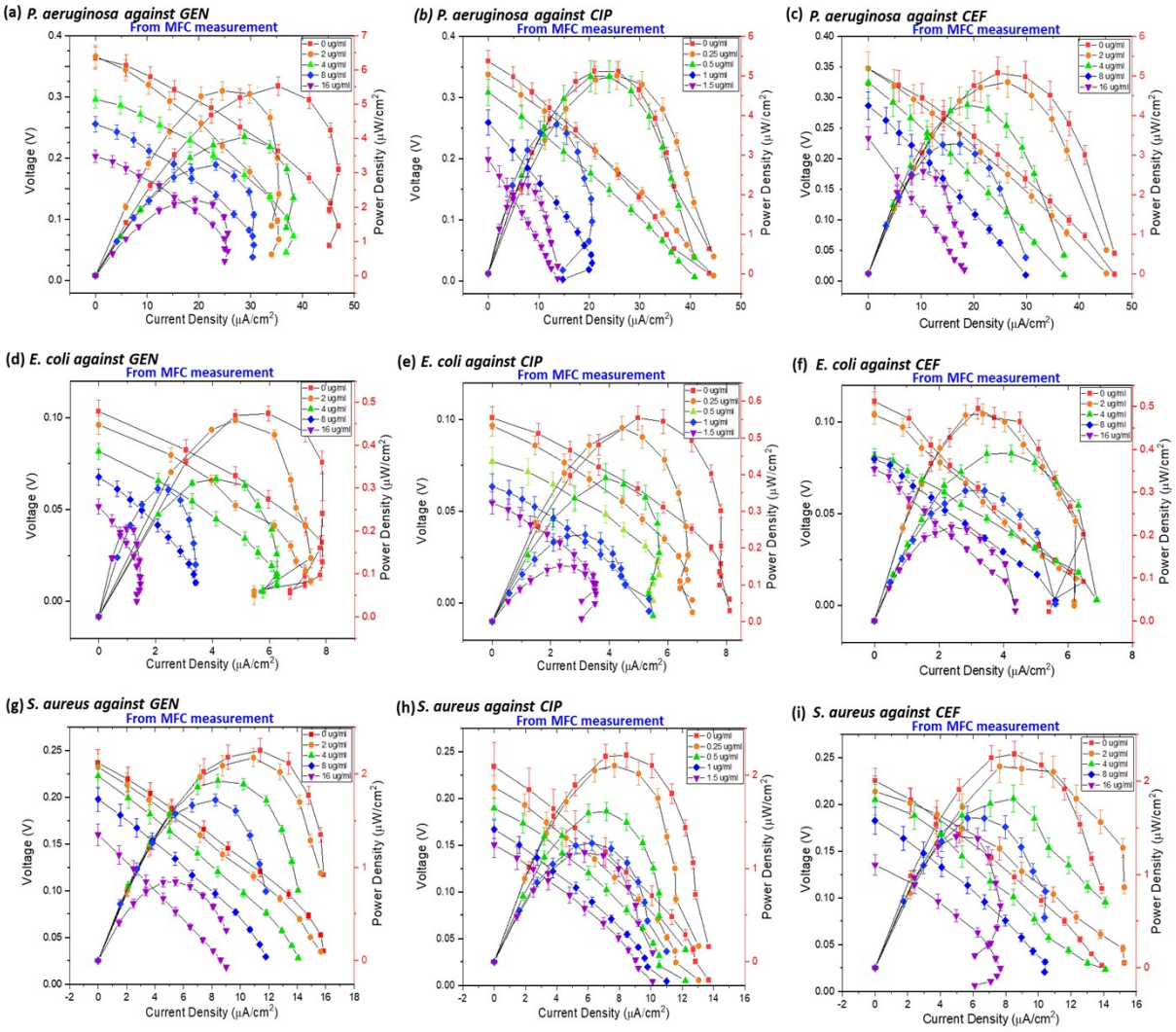

Figure S4. MFC measurements generating I-V and I-P curves for (a) *P. aeruginosa* biofilm against GEN, (b) *P. aeruginosa* biofilm against CIP, (c) *P. aeruginosa* biofilm against CEF, (d) *E. coli* against GEN, (e) *E. coli* against CIP, (f) *E. coli* against CEF, (g) *S. aureus* against GEN, (h) *S. aureus* against CIP, and (i) *S. aureus* against CEF.

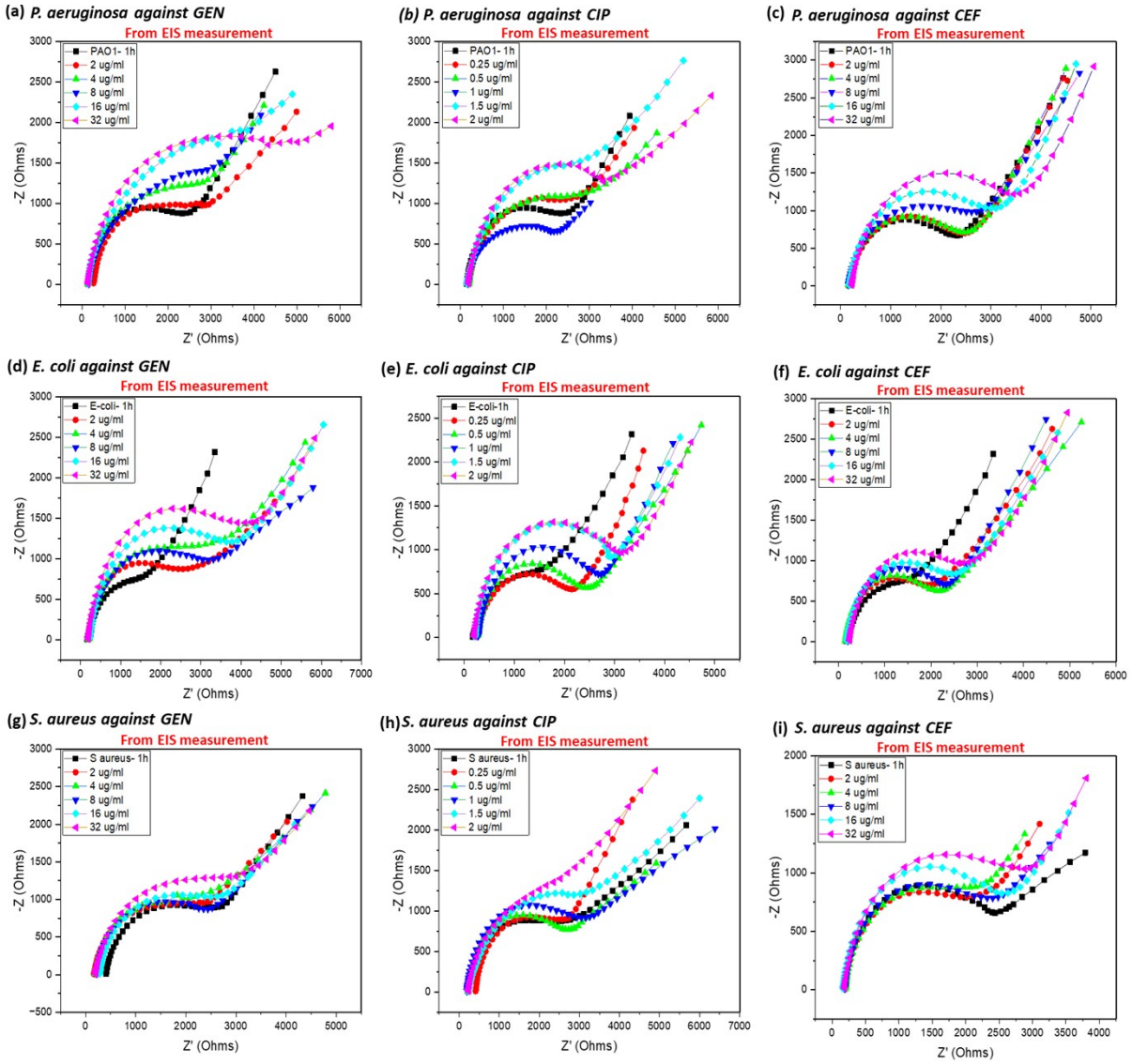

Figure S5. EIS measurements generating Nyquist impedance plots for (a) *P. aeruginosa* biofilm against GEN, (b) *P. aeruginosa* biofilm against CIP, (c) *P. aeruginosa* biofilm against CEF, (d) *E. coli* against GEN, (e) *E. coli* against CIP, (f) *E. coli* against CEF, (g) *S. aureus* against GEN, (h) *S. aureus* against CIP, and (i) *S. aureus* against CEF.

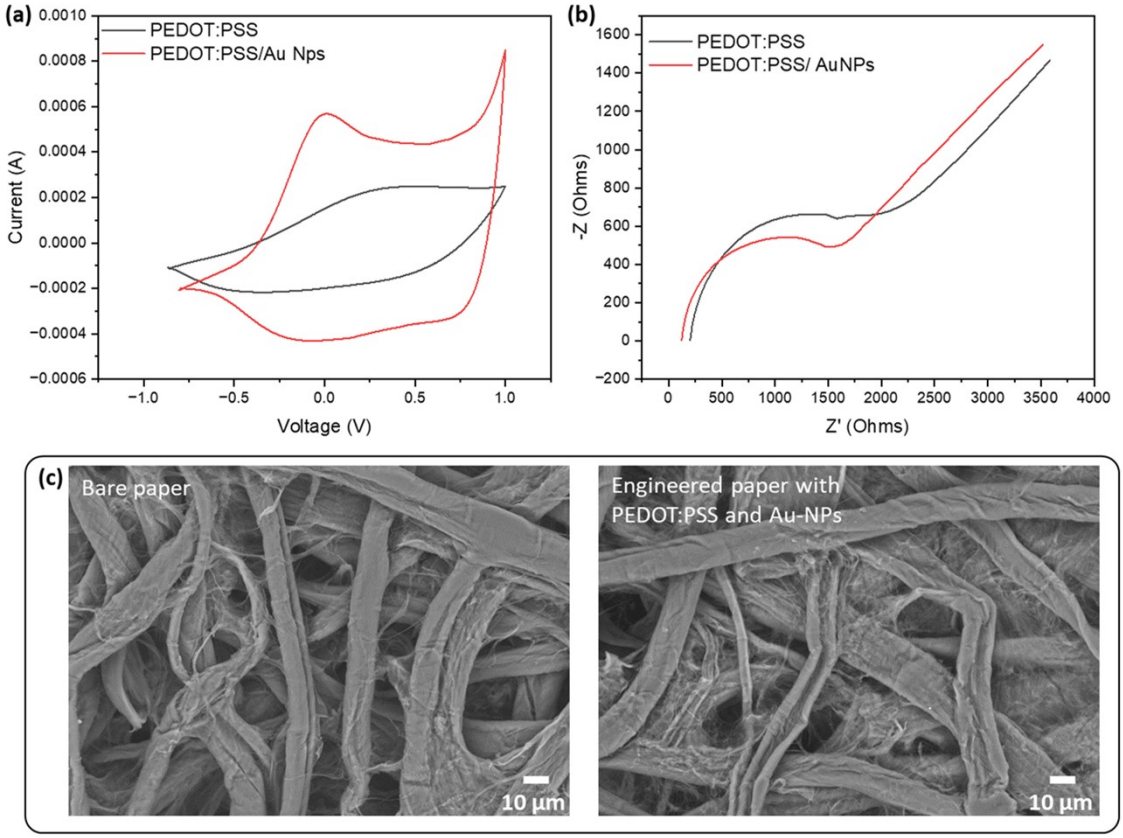

Figure S6. (a) Cyclic voltammetric profiles and (b) EIS spectra of the engineered paper with PEDOT:PSS only and a mixture of PEDOT:PSS and Au-NPs. (c) SEM images of the bare and engineered papers with PEDOT:PSS and Au-NPs.

Table S1. Acceptable MIC ranges given by the CLSI guidlines (https://clsi.org/)

	P. aeruginosa	***E. coli***	***S. aureus***
Gentamicin (GEN)	4 µg/ml	4 µg/ml	4 µg/ml
Ciprofloxacin (CIP)	0.5 µg/ml	0.5 µg/ml	1 µg/ml
Ceftazidime (CEF)	8 µg/ml	2 µg/ml	4 µg/ml