Supplementary Information

Fully Printed Prothrombin Time Sensor for Point-of-Care Testing

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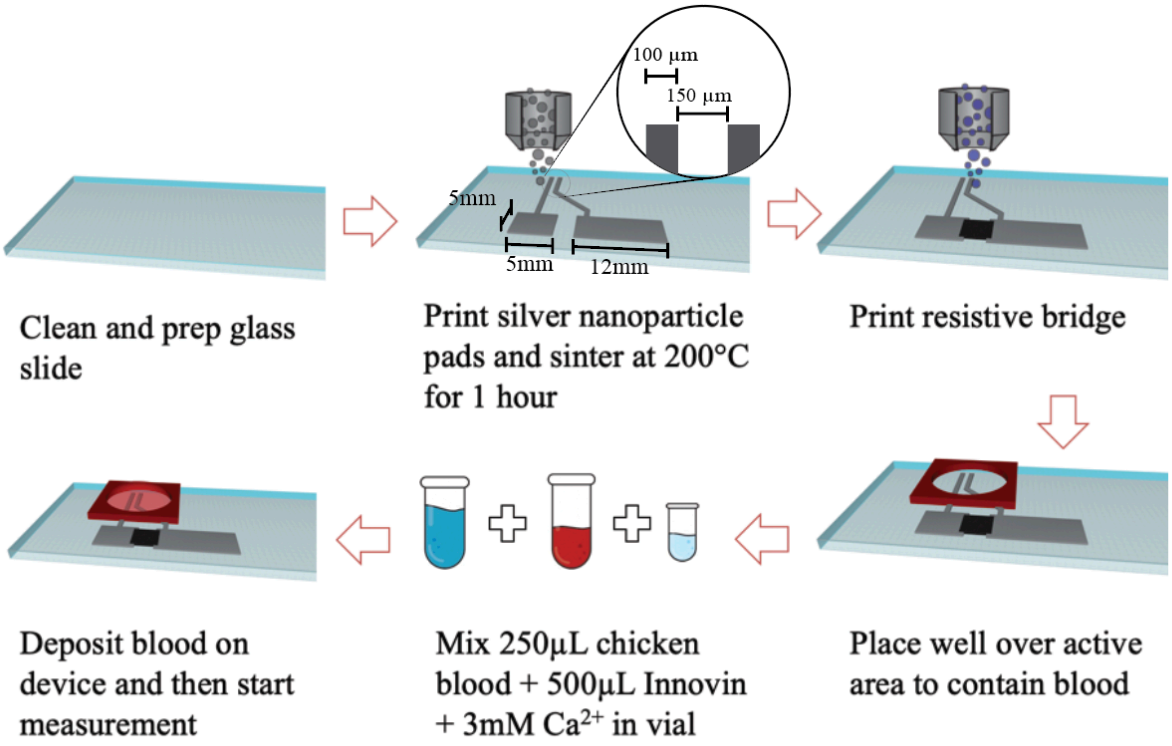

Figure S1: Schematic process flow for printing PT sensors and testing coagulation of chicken blood. Silver nanoparticles printed onto a glass slide and sintered in an oven at 200°C. A resistive bridge of silver nanowires or unsorted carbon nanotubes is then printed. Next, a well to encapsulate the blood is placed over the testing area. 250 µL whole blood is mixed with 500 µL Innovin and 3 mM Ca^{2+} and, immediately after mixing, a 100 µL aliquot is deposited onto device testing area.

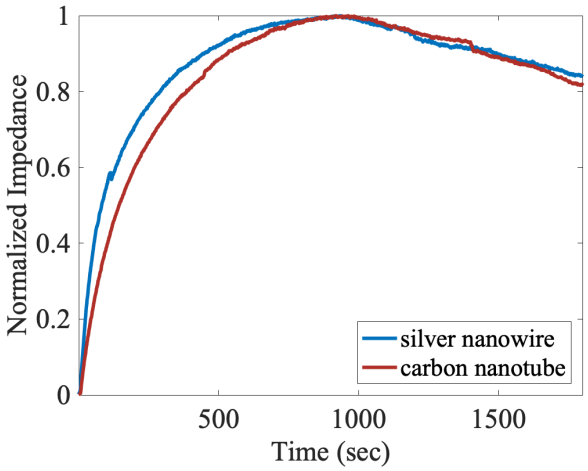

Figure S2. Resistor bridge test. Prothrombin time measurement with a printed resistor fabricated from silver nanowires (red) and unsorted carbon nanotubes (blue) demonstrating nearly identical clotting times.

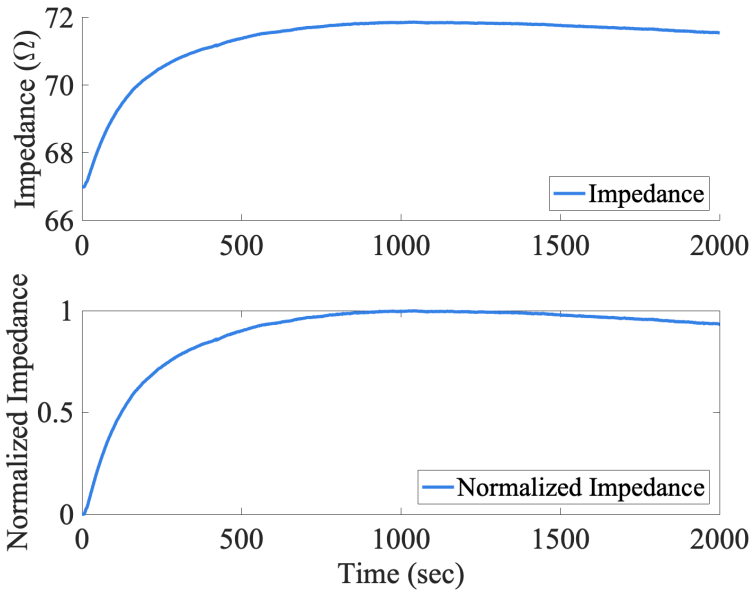

Figure S3. Impedance Normalization. To better compare and assess data, all impedance tests are normalized between 0 and 1. (top) As measured impedance for a clotting test. (bottom) normalized impedance.

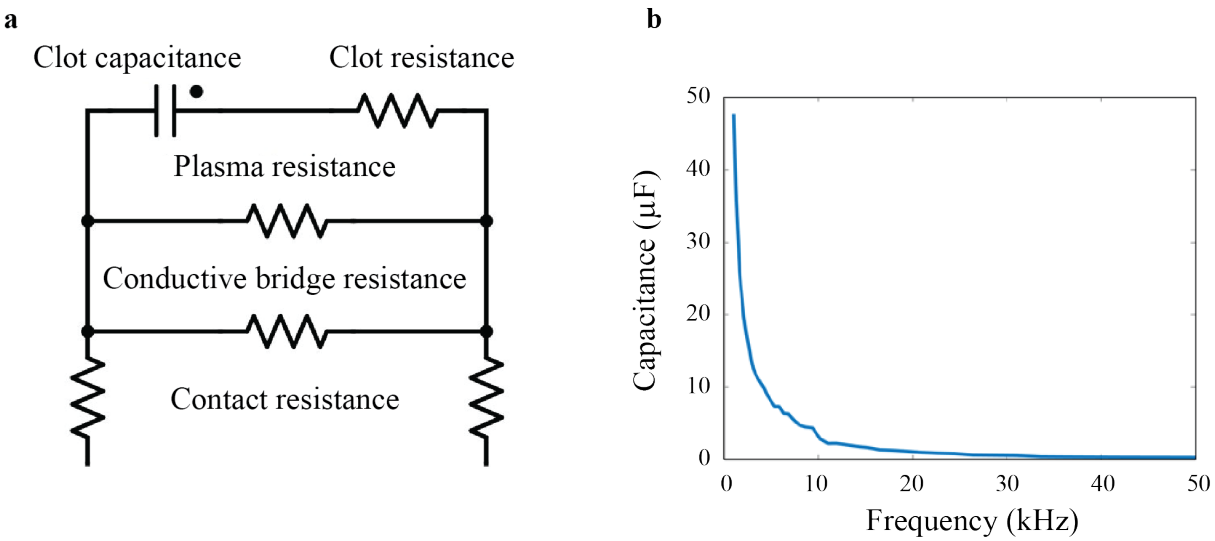

Figure S4. Electrical properties of blood. a) Circuit diagram representation of blood clot on device. b) Capacitance of unclotted blood as a function of frequency.

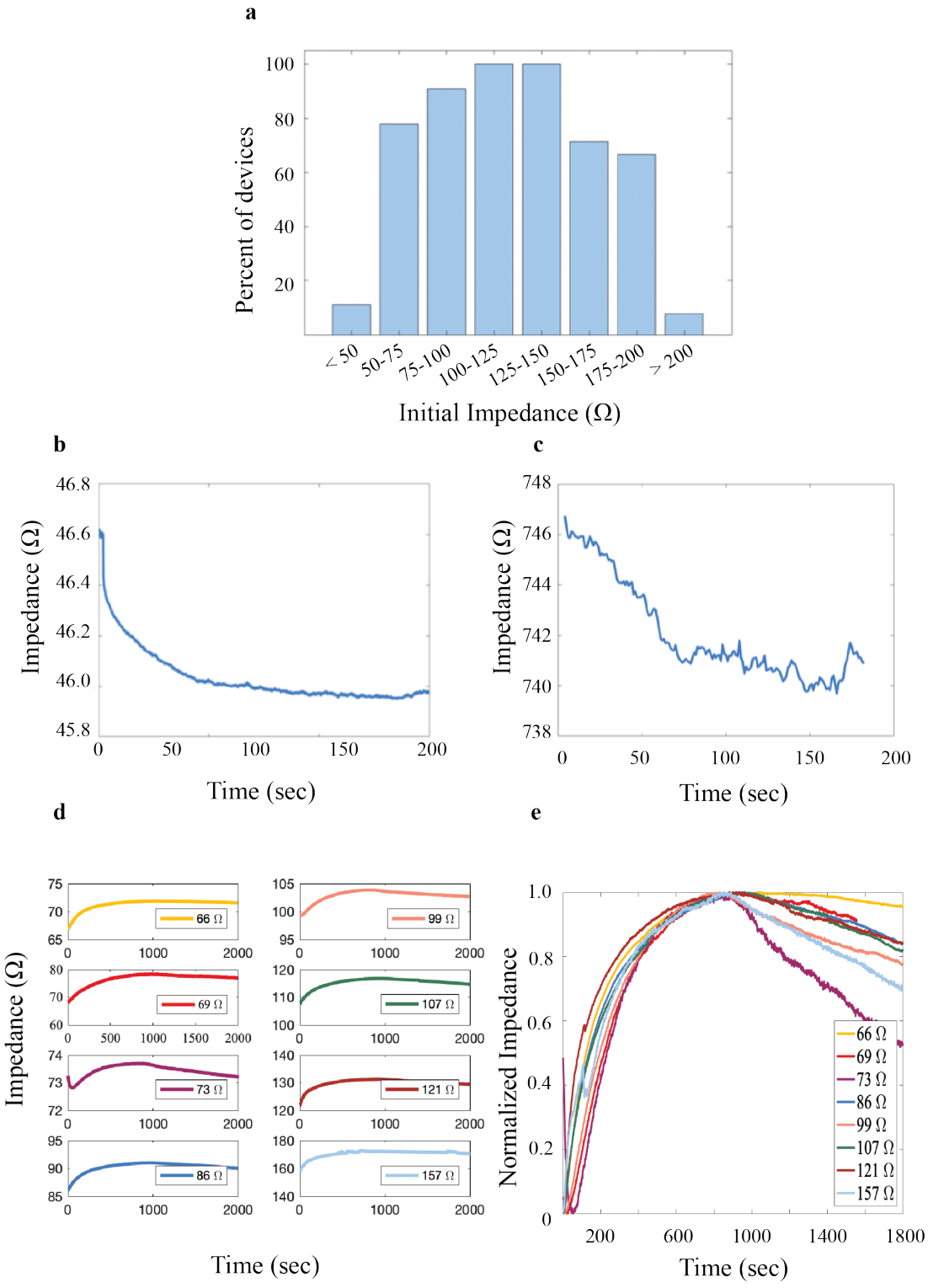

Figure S5. Initial impedance device functionality. a) Percent of devices that were capable of measuring a clotting event as a function of initial impedance of the PT sensors. PT impedance tests in chicken blood with initial impedance values b) below 50 Ω and c) above 200 Ω, demonstrating the inability of detecting the clotting event in both cases. d) Multiple PT/INR tests with initial impedance values between 66 and 157 Ω. e) Normalized and overlaid PT/INR tests.

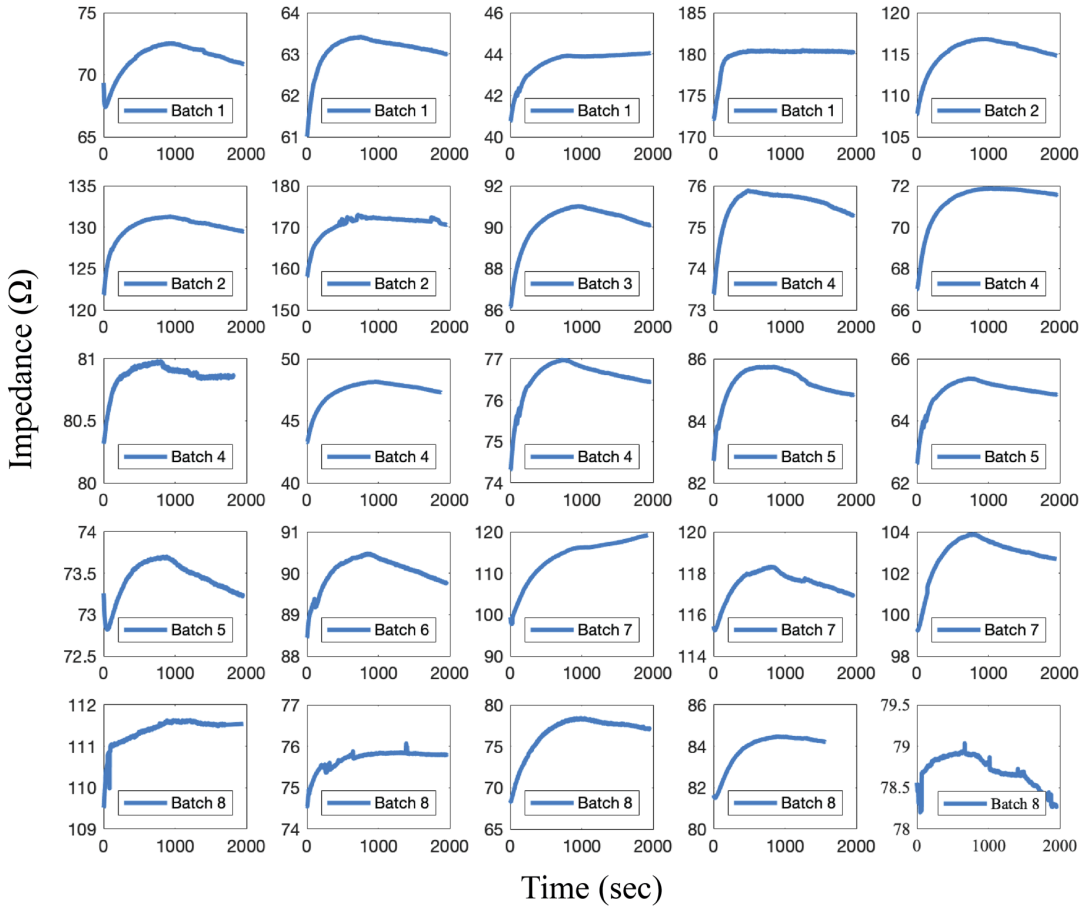

Figure S6. Batch-to-batch similarity in clotting response. Impedance response for 25 different chips fabricated over 8 printing batches demonstrating impedimetric and clotting time consistency over multiple devices and multiple batches.

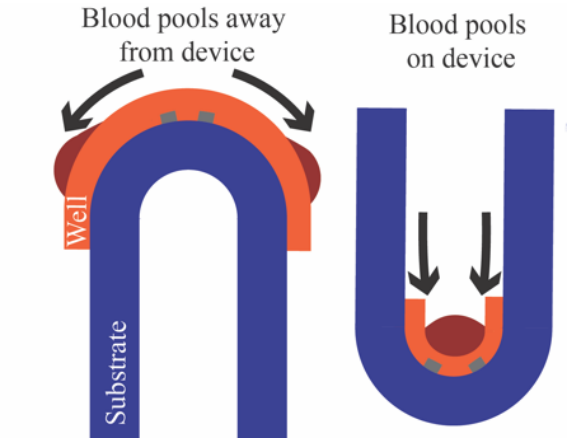

Figure S7. Blood pooling with bend radius. Blood pooling away from the electrodes when the underlying substrate is bent away from the device (left). Blood pooling over electrodes when the underlying substrate is bend towards the device (right).

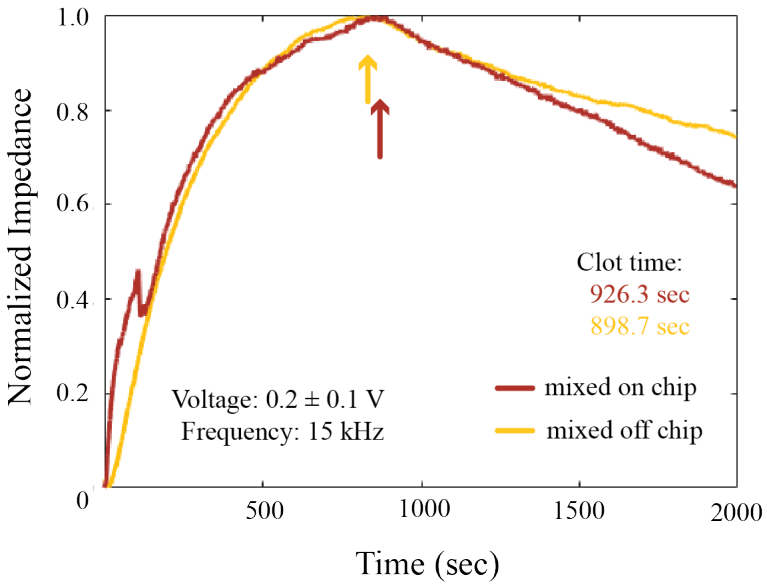

Figure S8. On vs off chip mixing. Prothrombin time with chicken blood mixed on chip (red) and off chip (yellow) demonstrating slightly longer clotting times with on chip mixing due to initiation of testing at instigation of coagulation as opposed to a few seconds after coagulation pathway is instigated.