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SKINTRONICS: Wireless, Skin-Wearable Electronics for Monitoring of Electrocardiogram

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VCU

T_B-NE₊ Bio-interfaced NanoEngineering Group

Undergraduate Research Symposium

SKINTRONICS: Wireless, Skin-Wearable Electronics for Monitoring of Electrocardiogram

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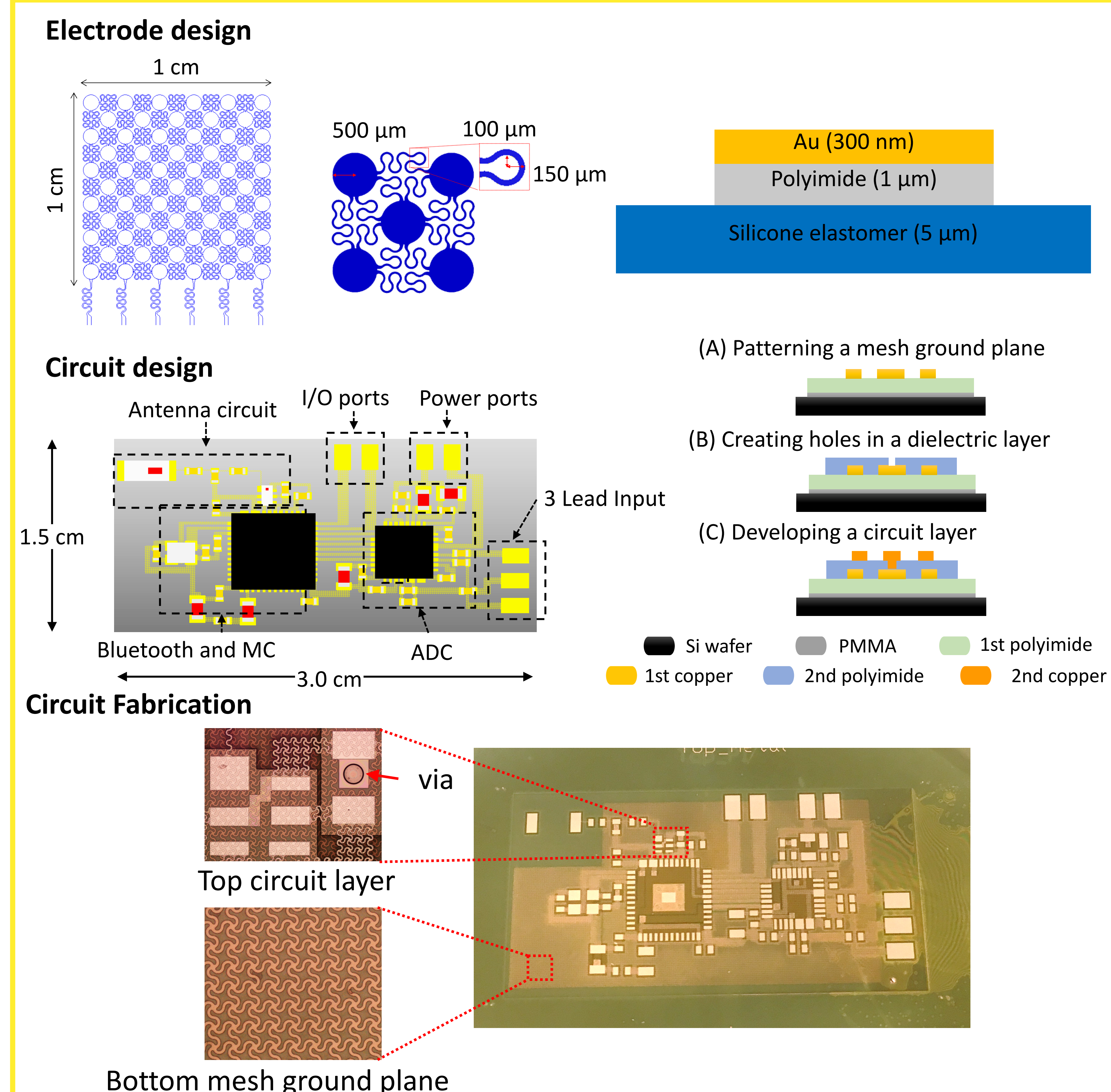
Background

- Current 12-lead ECGs are not easy to apply without experience with electrode placement
- Conventional electrodes are not comfortable nor do they conform to the skin well
- ECGs have multiple wires and must be directly connected to a monitor to view the data

Objectives

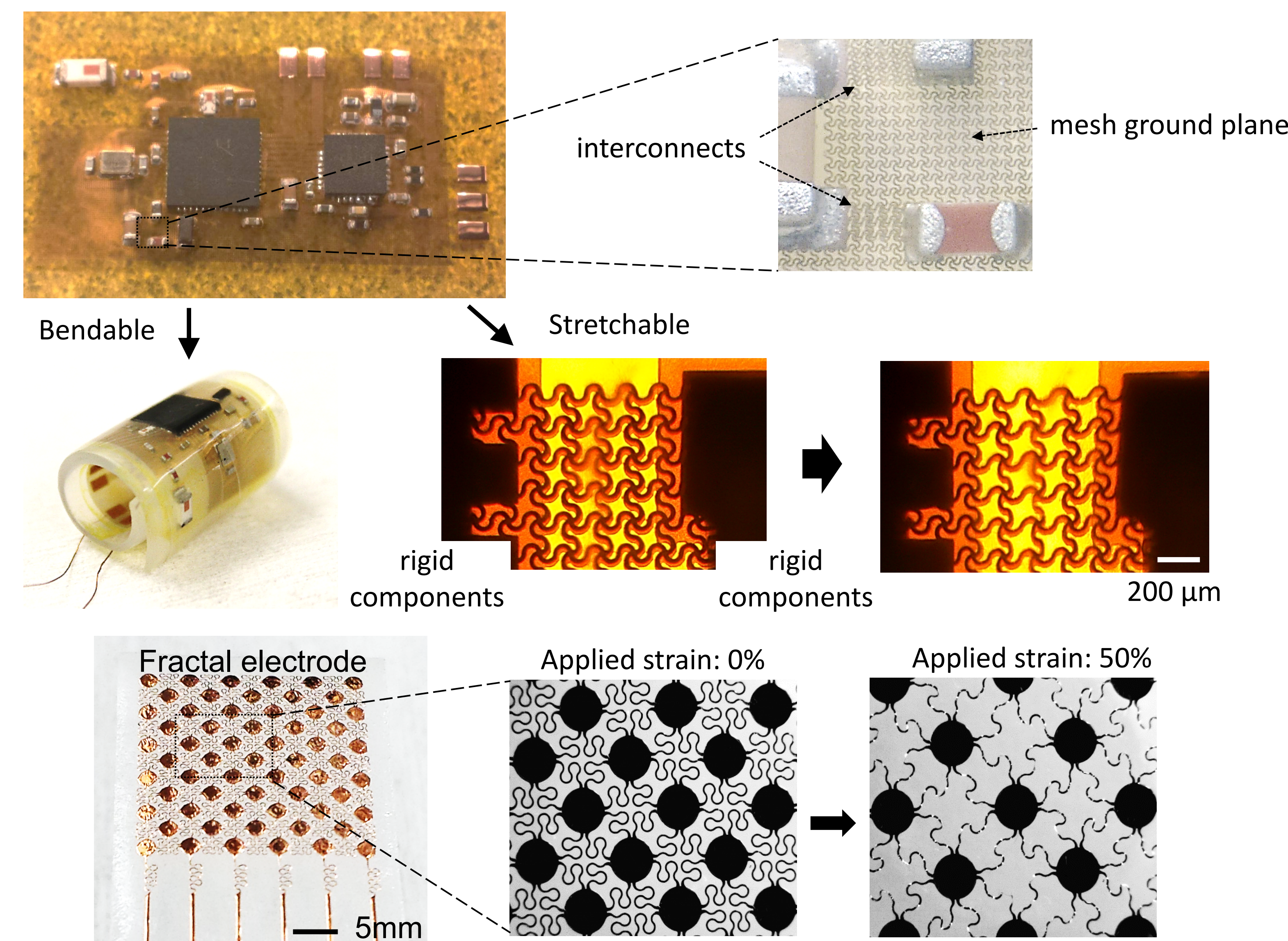
- Design a flexible, stretchable and wireless ECG device that is compact and conforms to the skin with preplaced electrodes
- Fabricate a prototype that contains electrodes and ECG device encased in a single silicon-like substrate that will allow it to be applied directly to the skin with conformal contact

Design and Device Preparation



Characterization

Mechanical behaviors



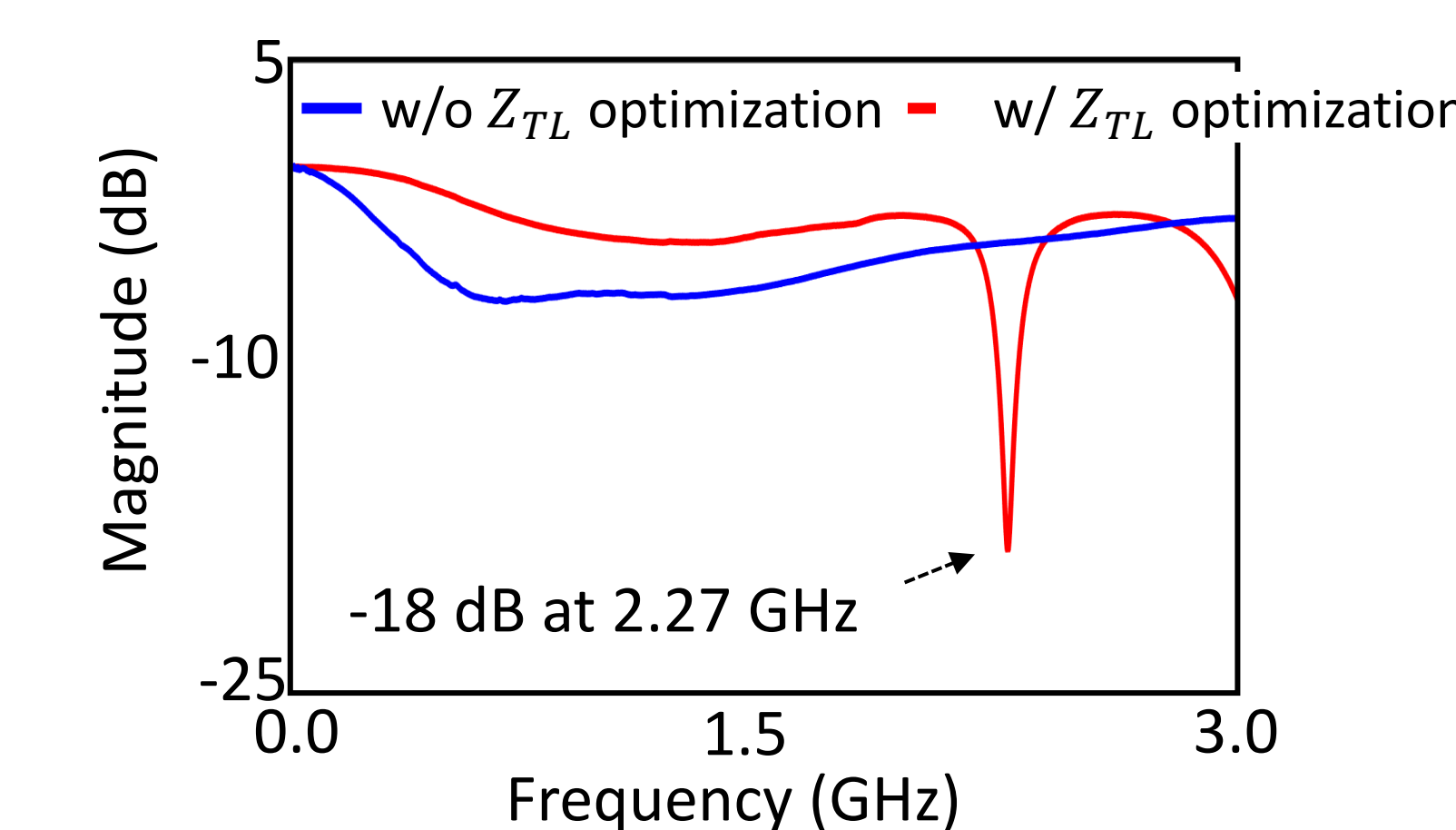
Antenna Design

1. Wheeler's equation for transmission line impedance

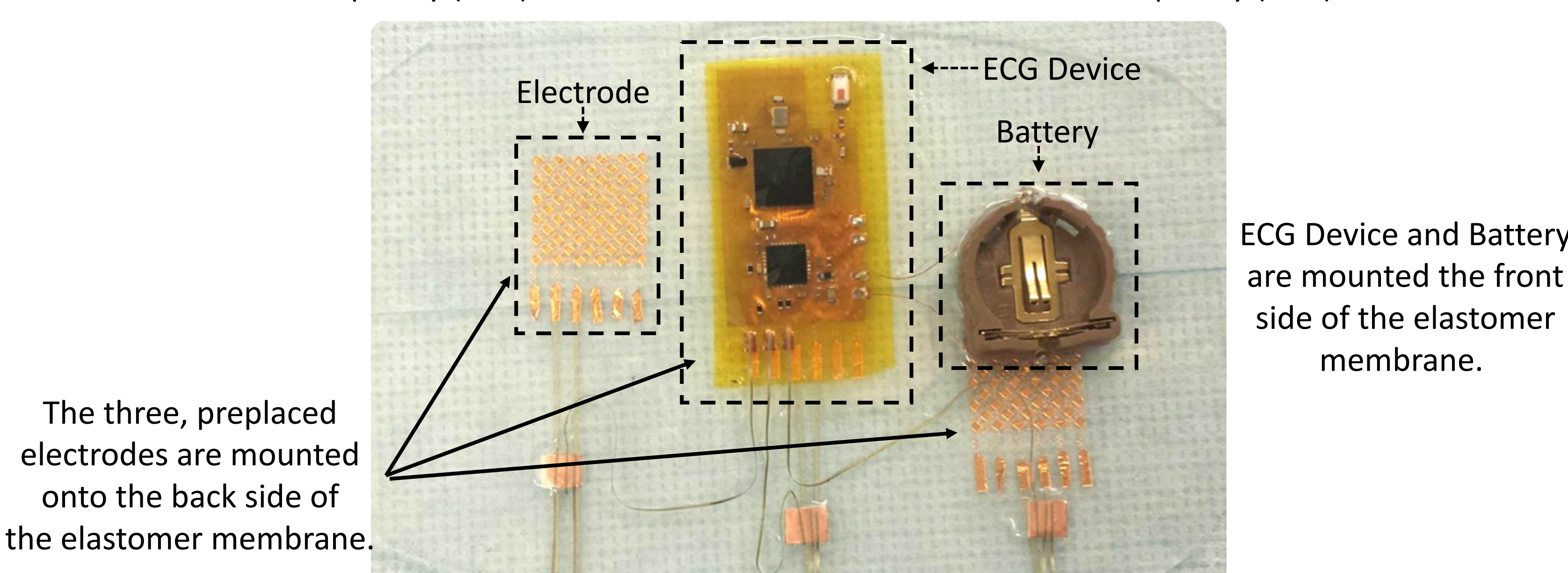
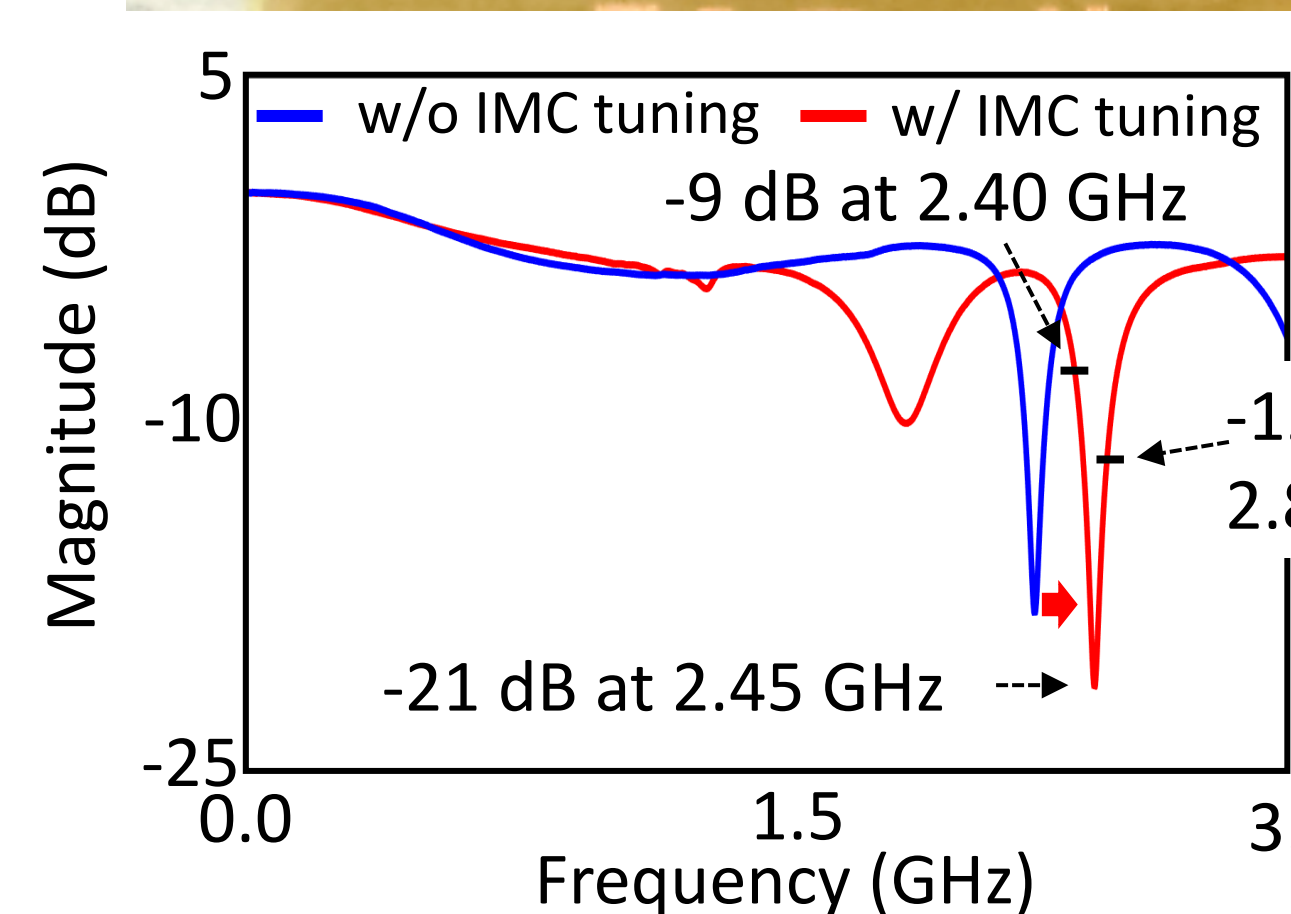
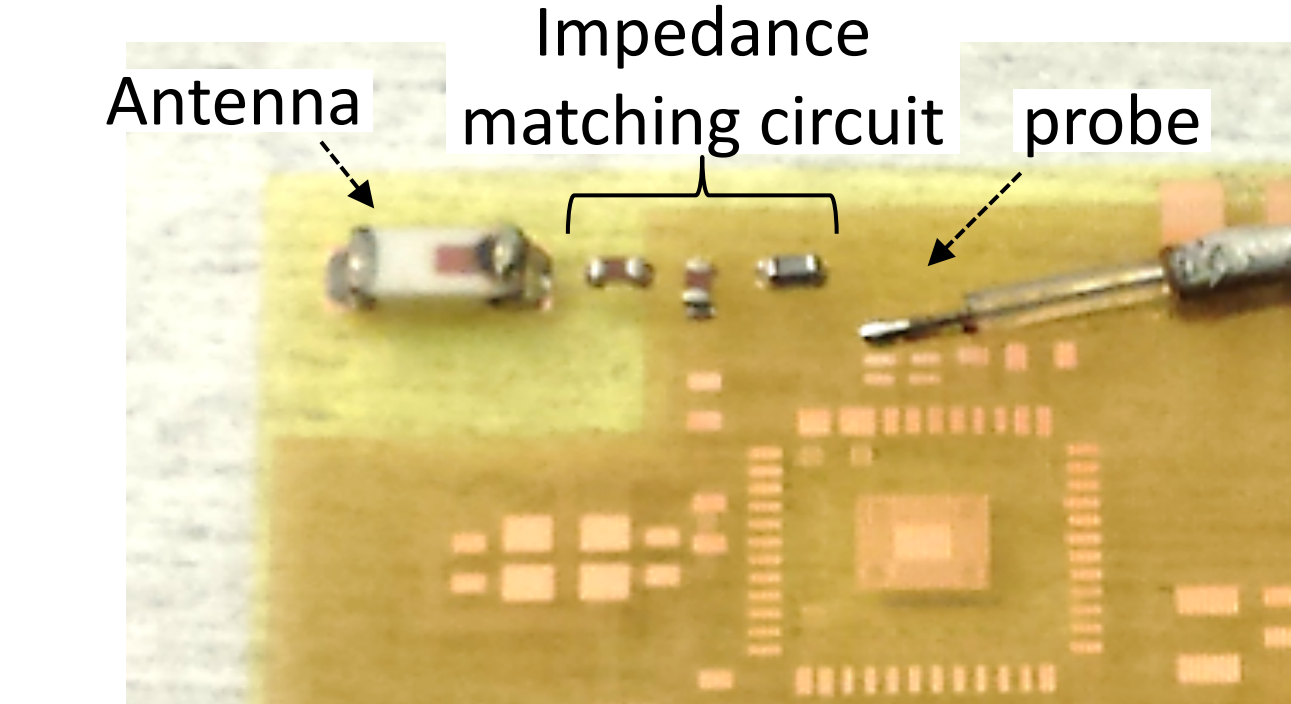
$$Z_{TL} = \frac{Z_0}{2\pi\sqrt{2}\sqrt{\epsilon_r + 1}} \ln \left(1 + 4 \left(\frac{h}{W_{eff}} \right) (X_1 + X_2) \right)$$

where $W_{eff} = W + \left(\frac{t}{\pi} \right) \ln \left(\frac{4e}{\left(\frac{t}{h} \right)^2 + \left(\frac{t}{W\pi + 1.1t\pi} \right)^2} \right) \frac{\epsilon_r + 1}{2\epsilon_r}$

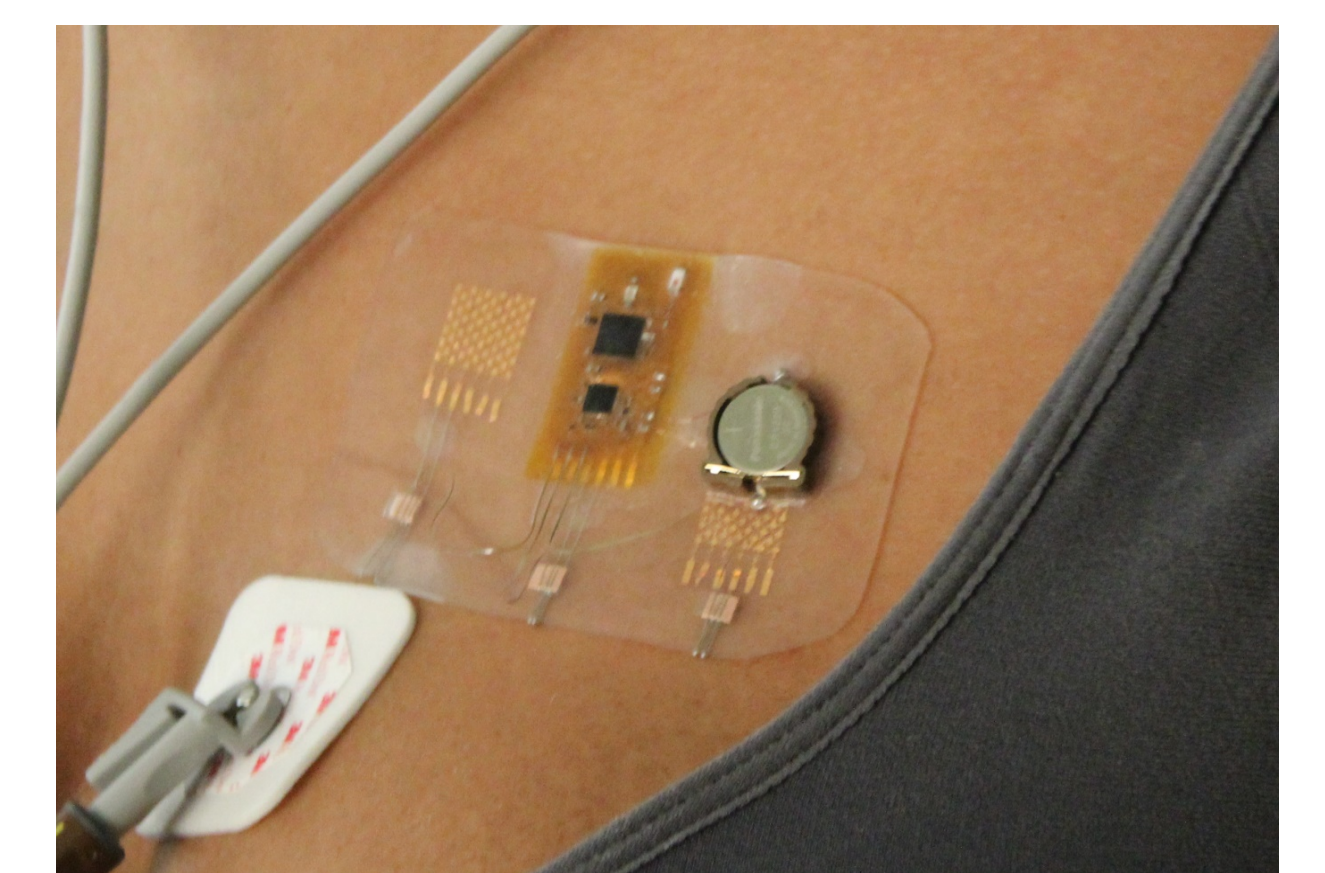
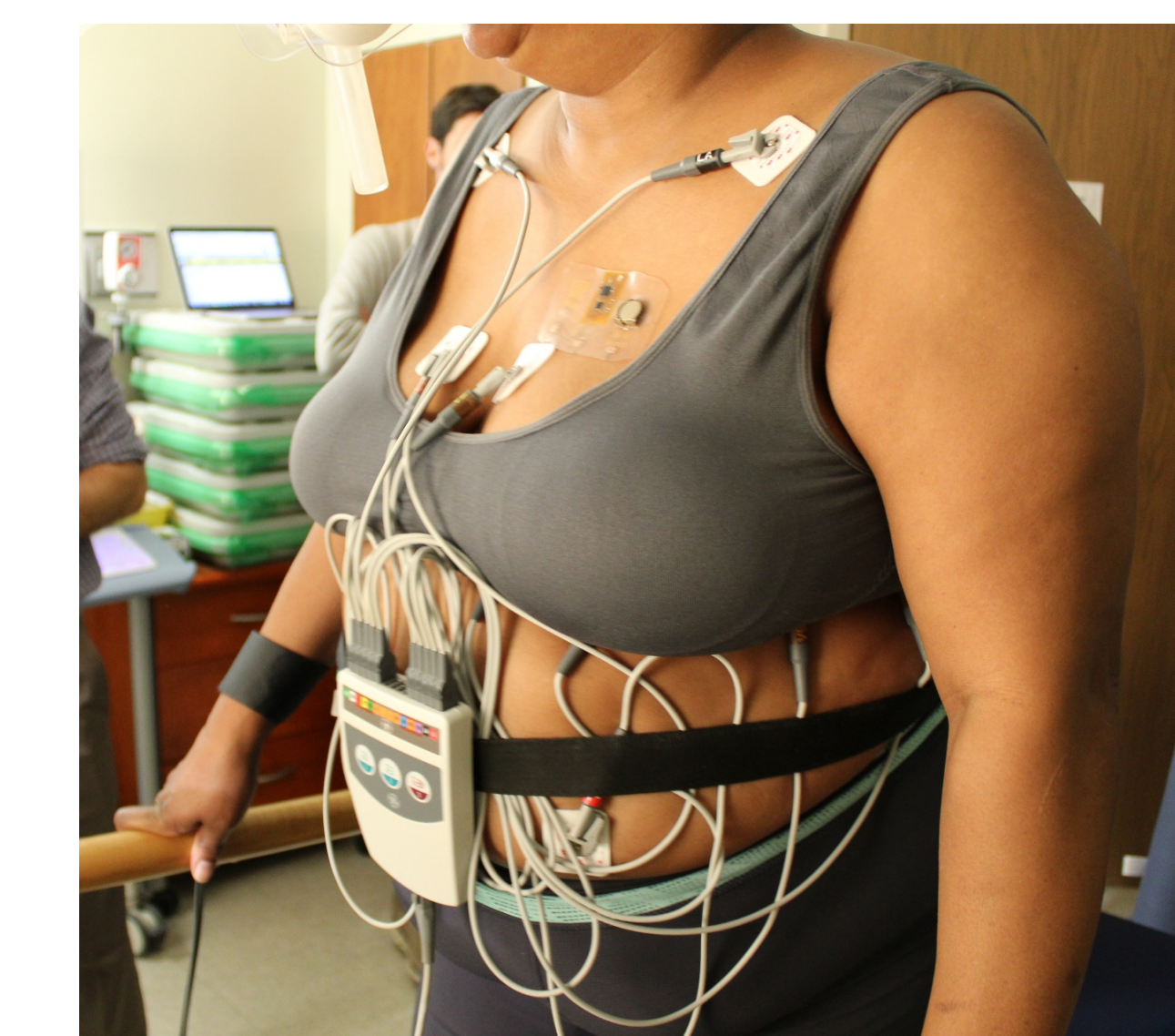
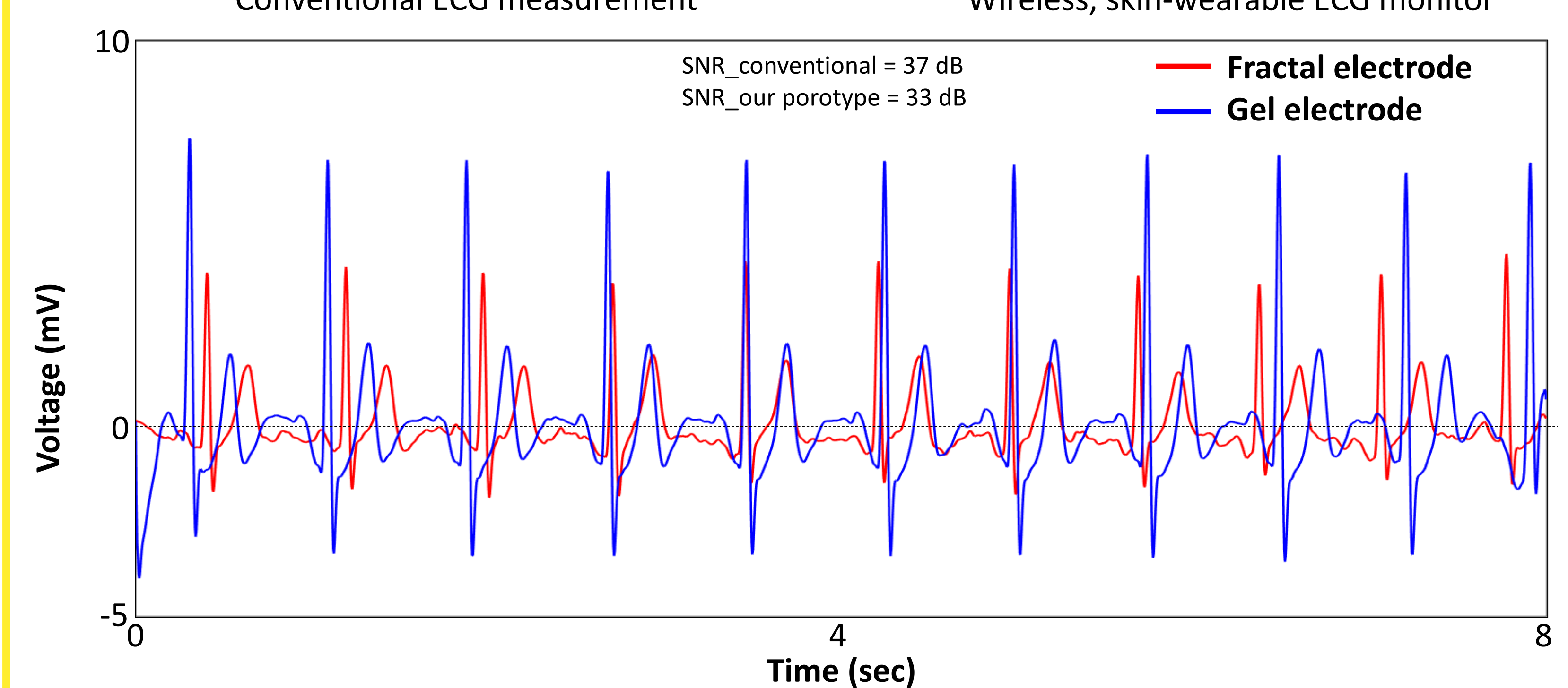
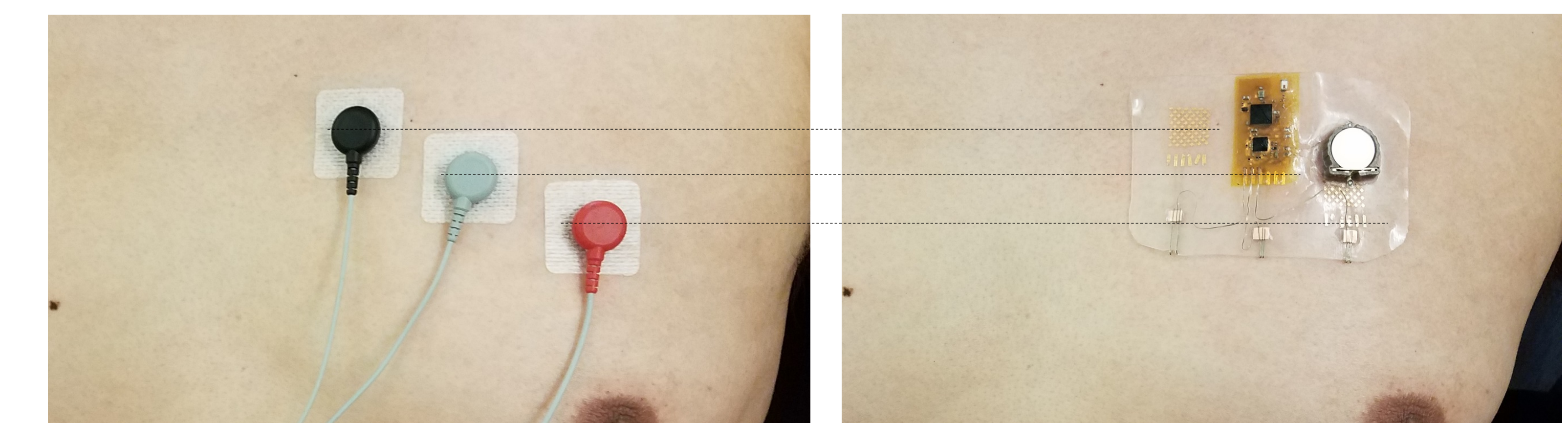
h : The thickness of the dielectric layer
 W : The width of transmission line



2. Tuning impedance matching circuit (IMC)



In Vivo Study



Prototype testing compared to conventional medical ECG

Close view of prototype placement on patient

Conclusions

- We successfully designed a skin-like ECG monitor that is flexible and stretchable for gentle mounting on the skin.
- On-chip wireless system offers *in vivo*, real-time monitoring of ECG with a smart appliance (Android tablet).

Sponsors

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