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# Integration of GaAs-based Lateral Field Excitation (LFE) Sensor with PDMS Microfluidic Channel: Simulation and Experimental Validation

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The losses in acoustic signals strength is one of the biggest hurdles in the integration process of acoustic waves-based sensor with PDMS microfluidic channel, due to the viscoelasticity of PDMS. Here we design, simulate and experimentally validate two different structures of GaAs-PDMS integrated microfluidic devices, where we found that the impact of viscous damping from PDMS can be reduced by using a thicker GaAs frame around the suspended active plate area that confines the acoustic energy in the transducer and acts as a microfluidic channel.

## Design and Simulation Results

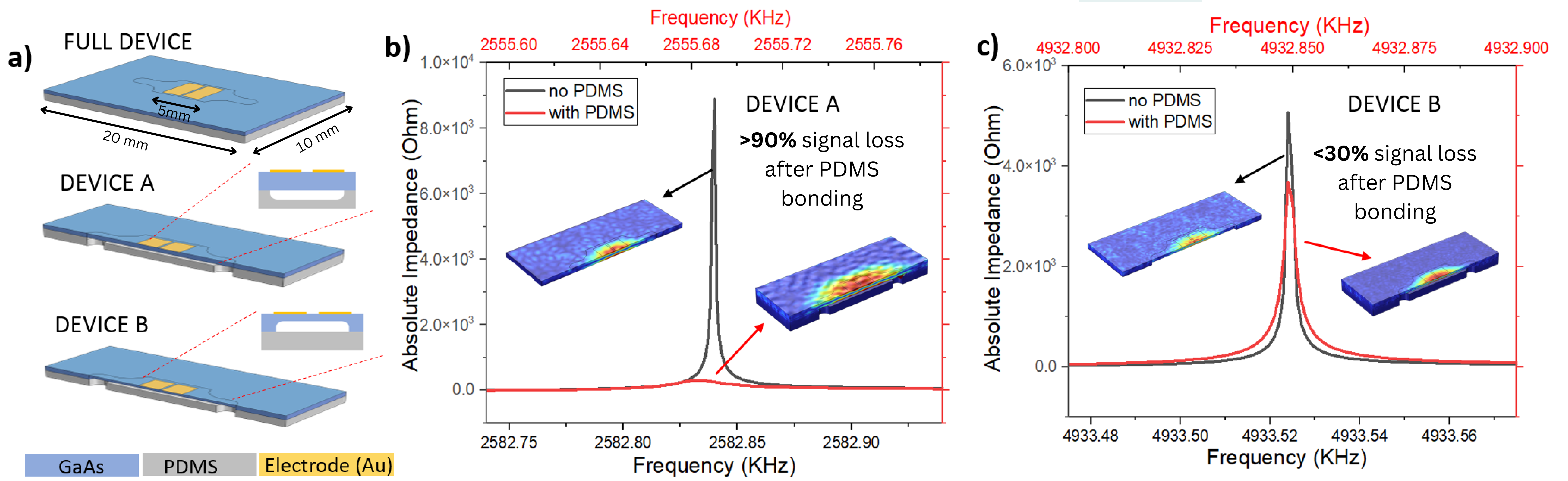


Figure 1: Sketch of the Integrated GaAs-PDMS Device (a) Full Device, Device A with PDMS microchannel, and Device B with GaAs microchannel. Comsol Simulation Results of (a) Device A with **more than 90% reduction** in signal amplitude and (b) Device B with **less than 30% reduction** in signal amplitude before and after PDMS Bonding

## Microfabrication Process

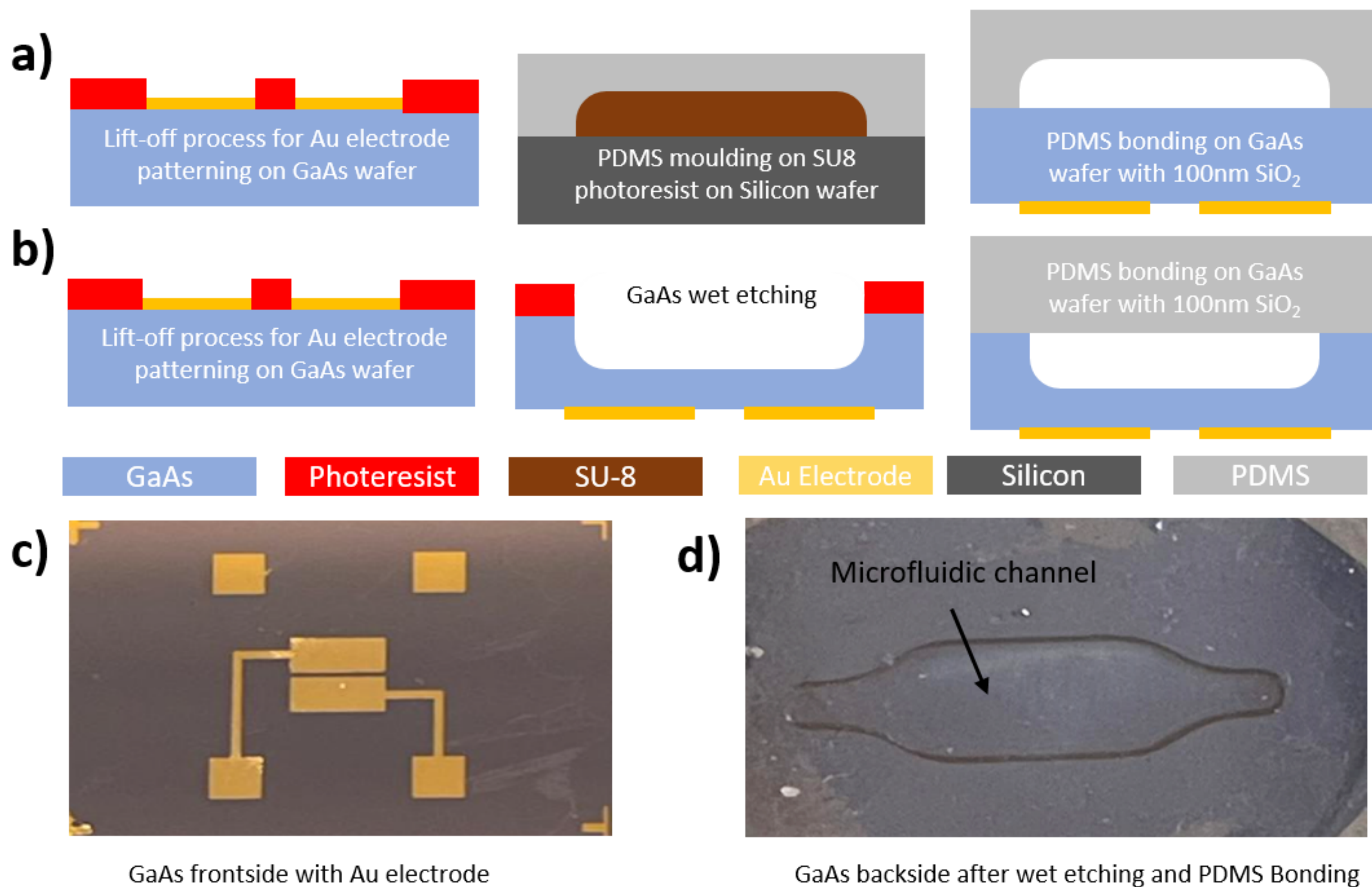


Figure 2: Simplified fabrication process flow chart (a) Device A and (b) Device B, and fabrication results (c) front side and (d) backside of the integrated GaAs-PDMS sensor of Device B

## Conclusion

We have demonstrated a new design, fabrication, and integration strategy of acoustic sensor with PDMS microfluidic channel without significantly reducing acoustic signal strength and Q-factor, as shown in the simulation and experimental results of device B. This integration strategy allows applying this GaAs-PDMS microfluidic structures with integrated sensors for in-liquid chemical and biological sensors

## Characterisation Results

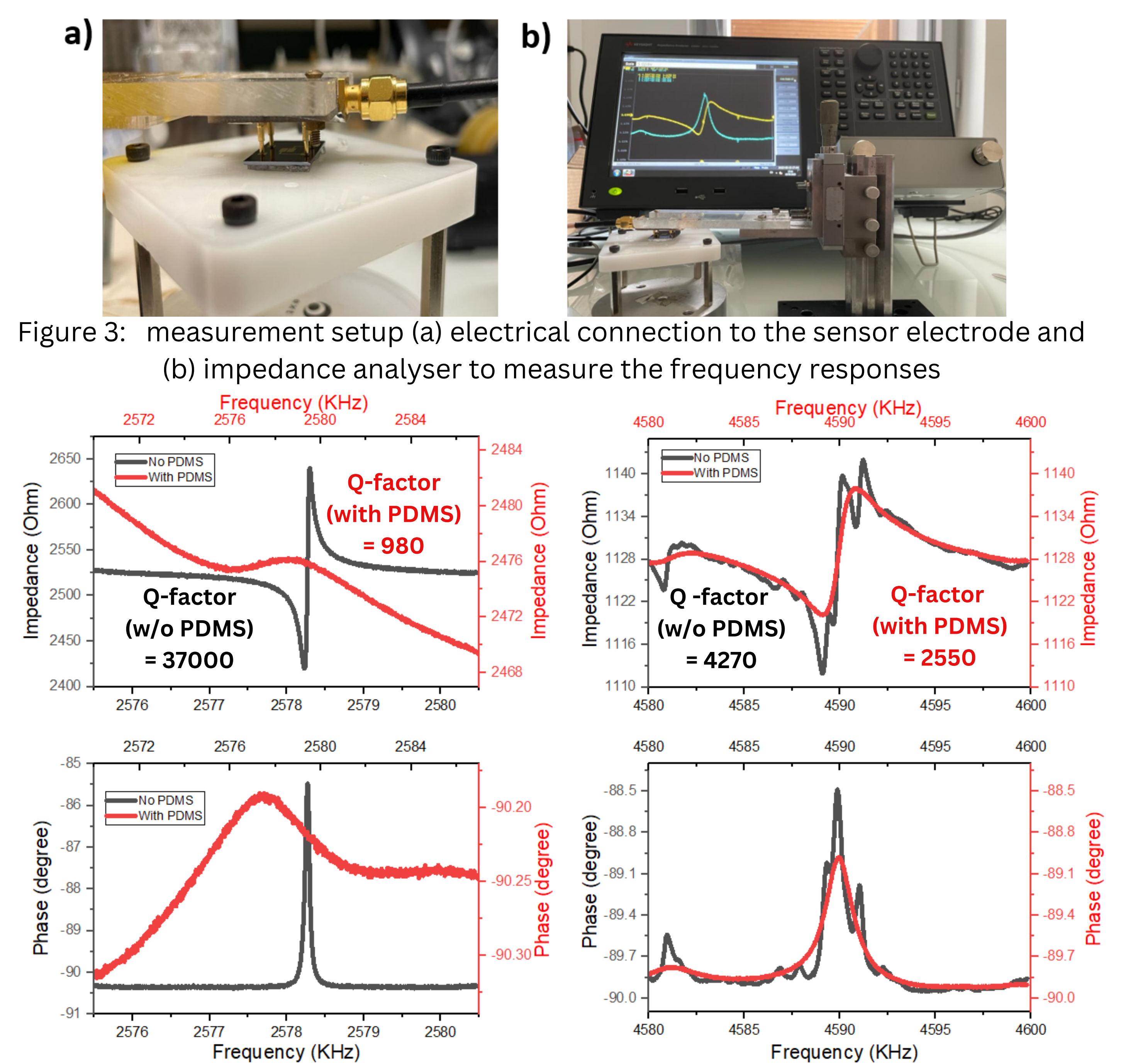


Figure 3: measurement setup (a) electrical connection to the sensor electrode and (b) impedance analyser to measure the frequency responses

Figure 4: Characterisation results: The Impedance magnitude and phase of (a) Device A and (b) Device B with Q-factor after PDMS bonding of **900 and 2550** respectively. Furthermore, the ripples due to reflected signal interference from the edge of the thicker GaAs frame disappear after bonding, as they are absorbed by PDMS layer

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