

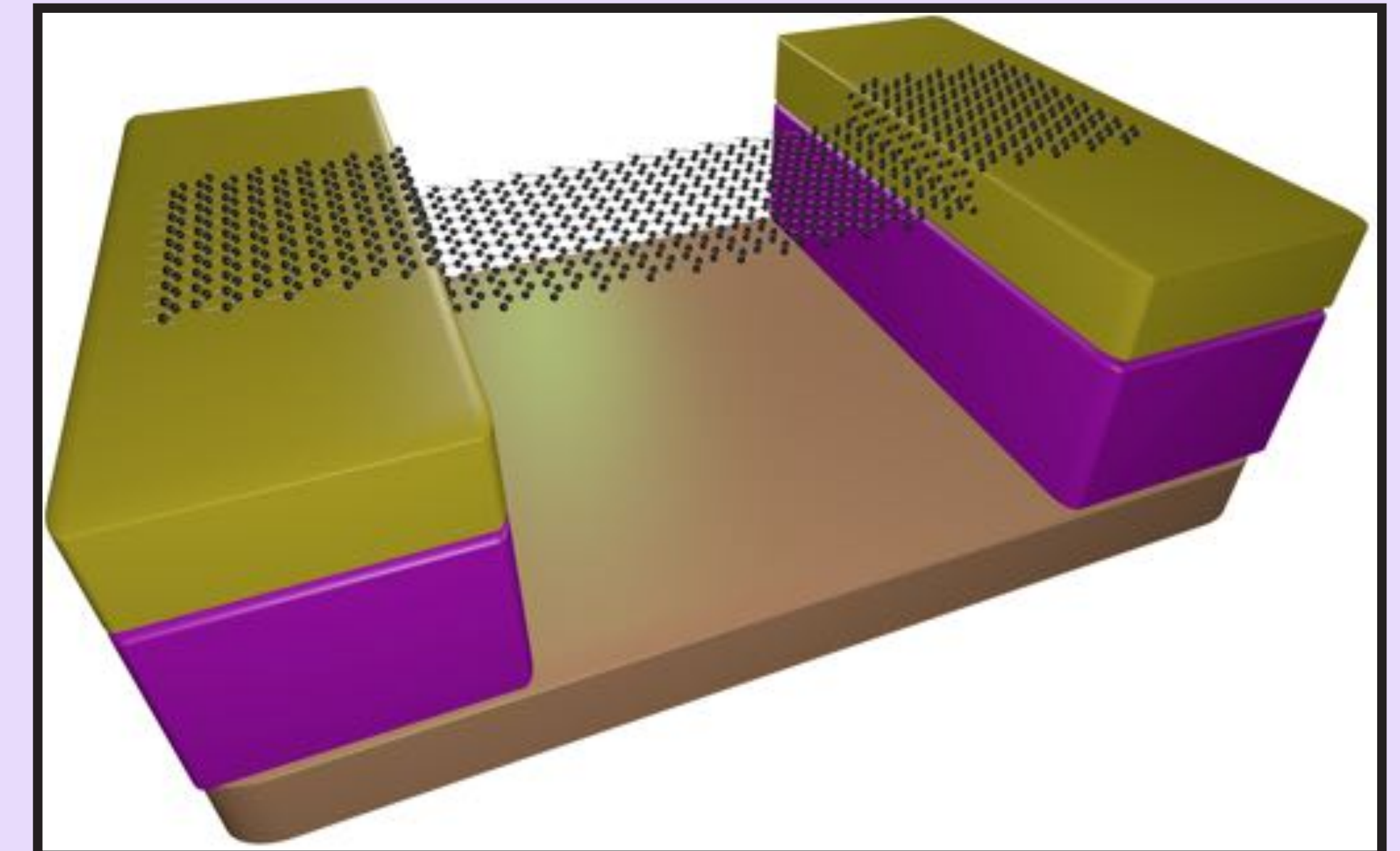
# Fabrication of 2D Material Based NEMS Resonators

## Abstract

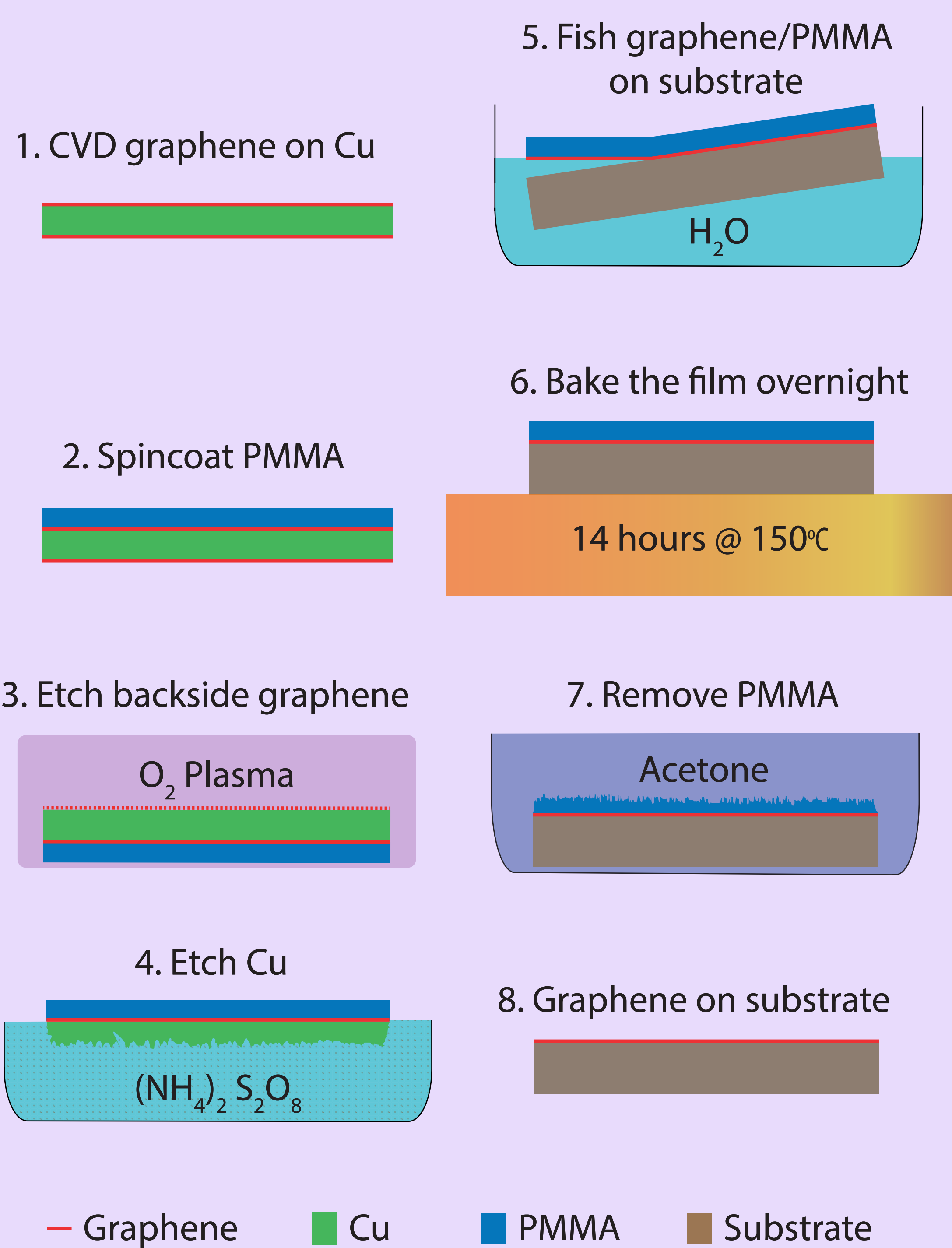
2D materials such as graphene [1], MoS<sub>2</sub> [2] and phosphorene [3] are promising candidates for resonating mechanical sensors due to excellent tunable electrical/mechanical properties, low masses, and maximal surface to volume ratios.

Mechanical resonators based on suspended graphene have been realized.

- CVD graphene wet-transferred onto 10x10 mm Si/SiO<sub>2</sub> chips with Au electrodes
- Graphene patterned in O<sub>2</sub> plasma with a resist mask
- Graphene is released by etching SiO<sub>2</sub> in BHF and critical point drying



## Graphene Transfer



## Device Fabrication and Results

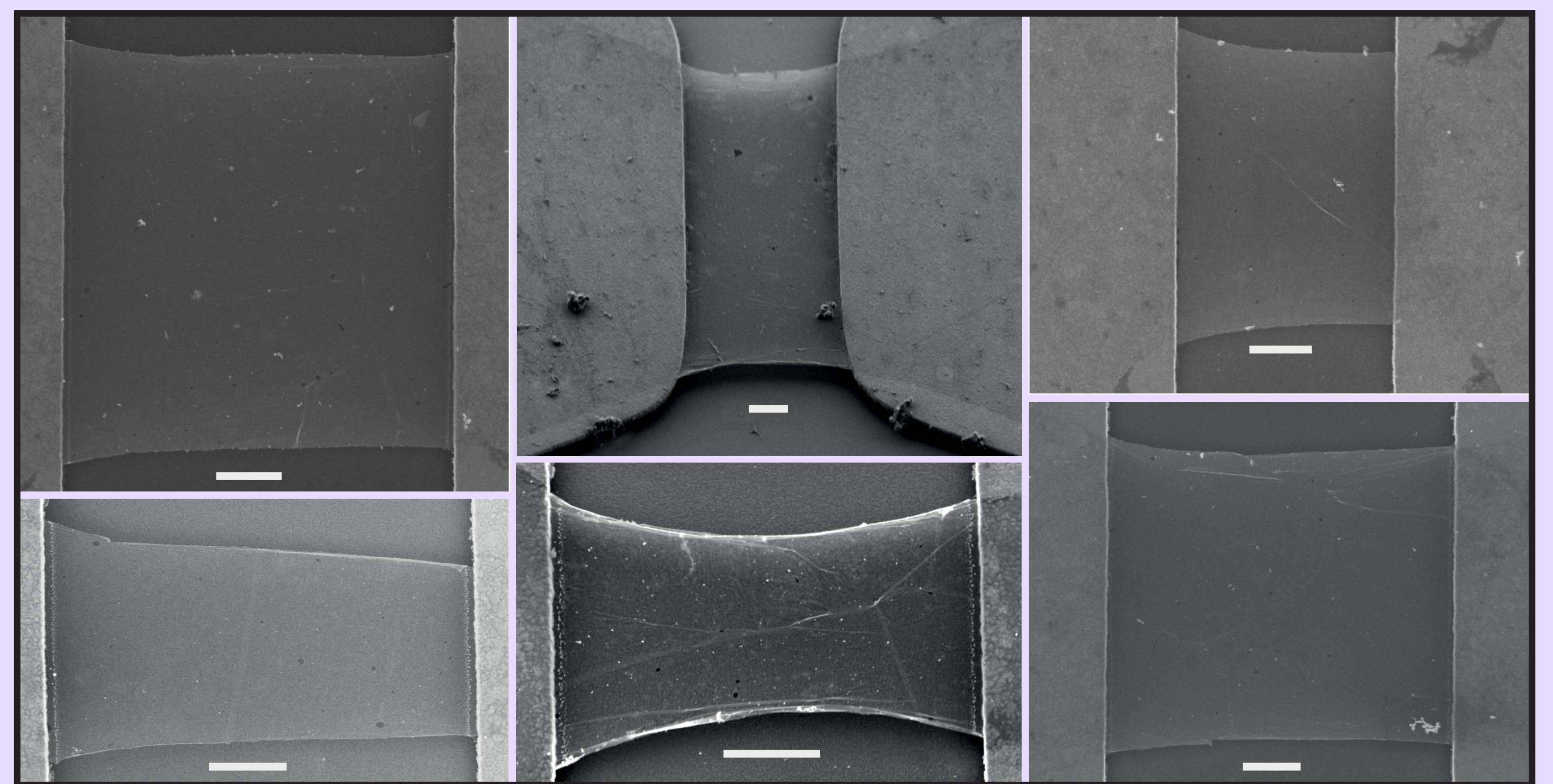
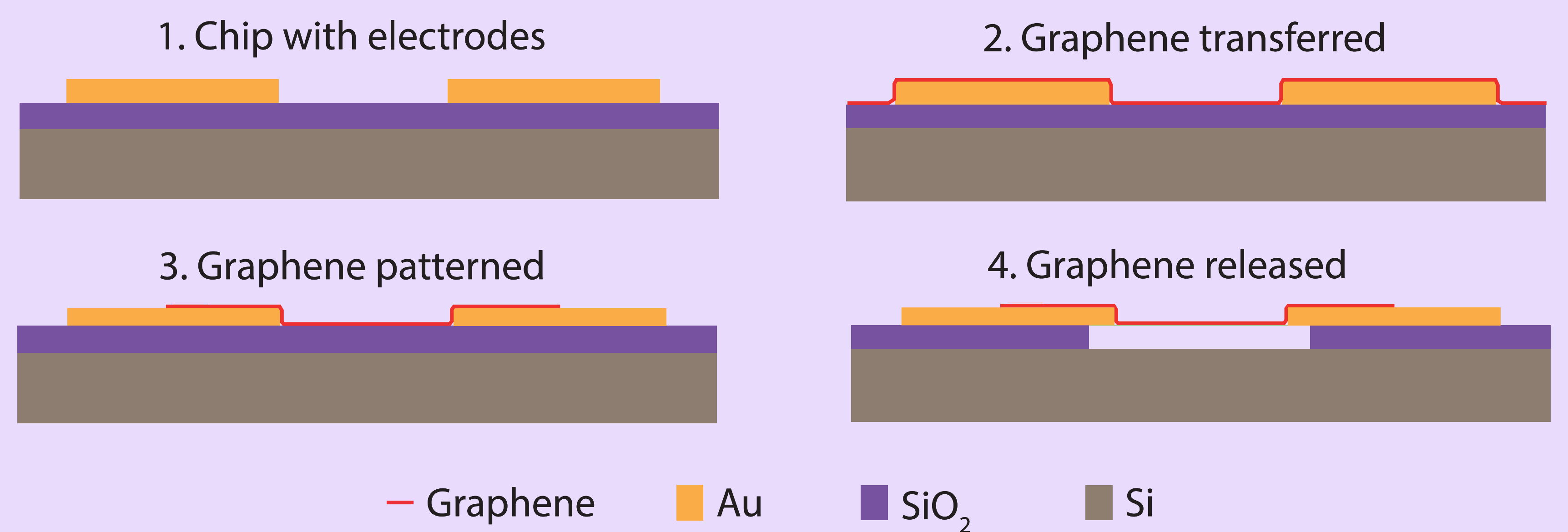


Fig. 1: SEM pictures of fabricated devices having different dimensions. Scale bar: 1 μm.

## Measurements

Sheet Resistance Measurement with Transmission Line Method

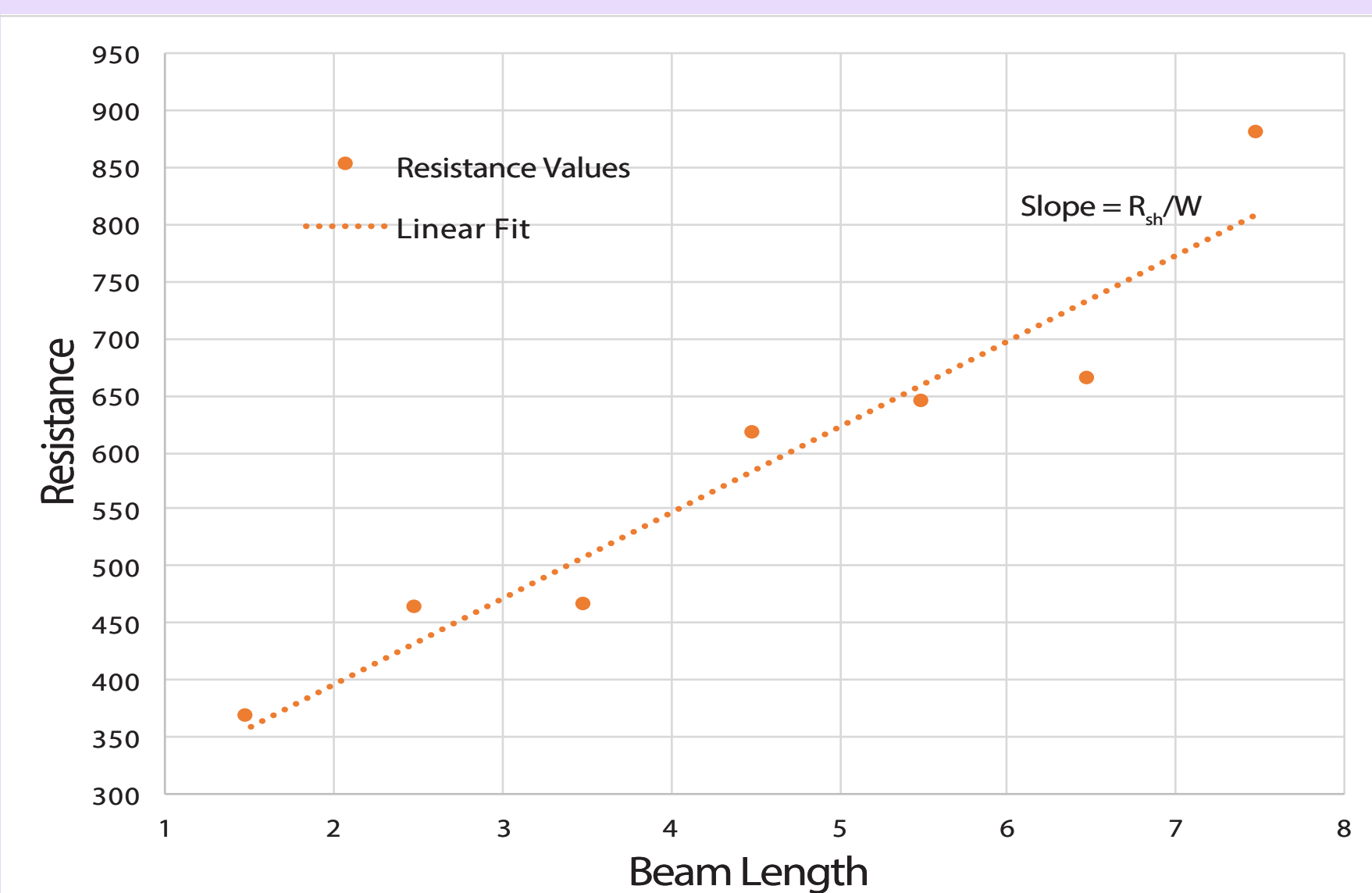


Fig. 2: Resistance vs. Gate voltage for graphene sheets of width 6.5 μm.

Field Effect Transistor Behavior

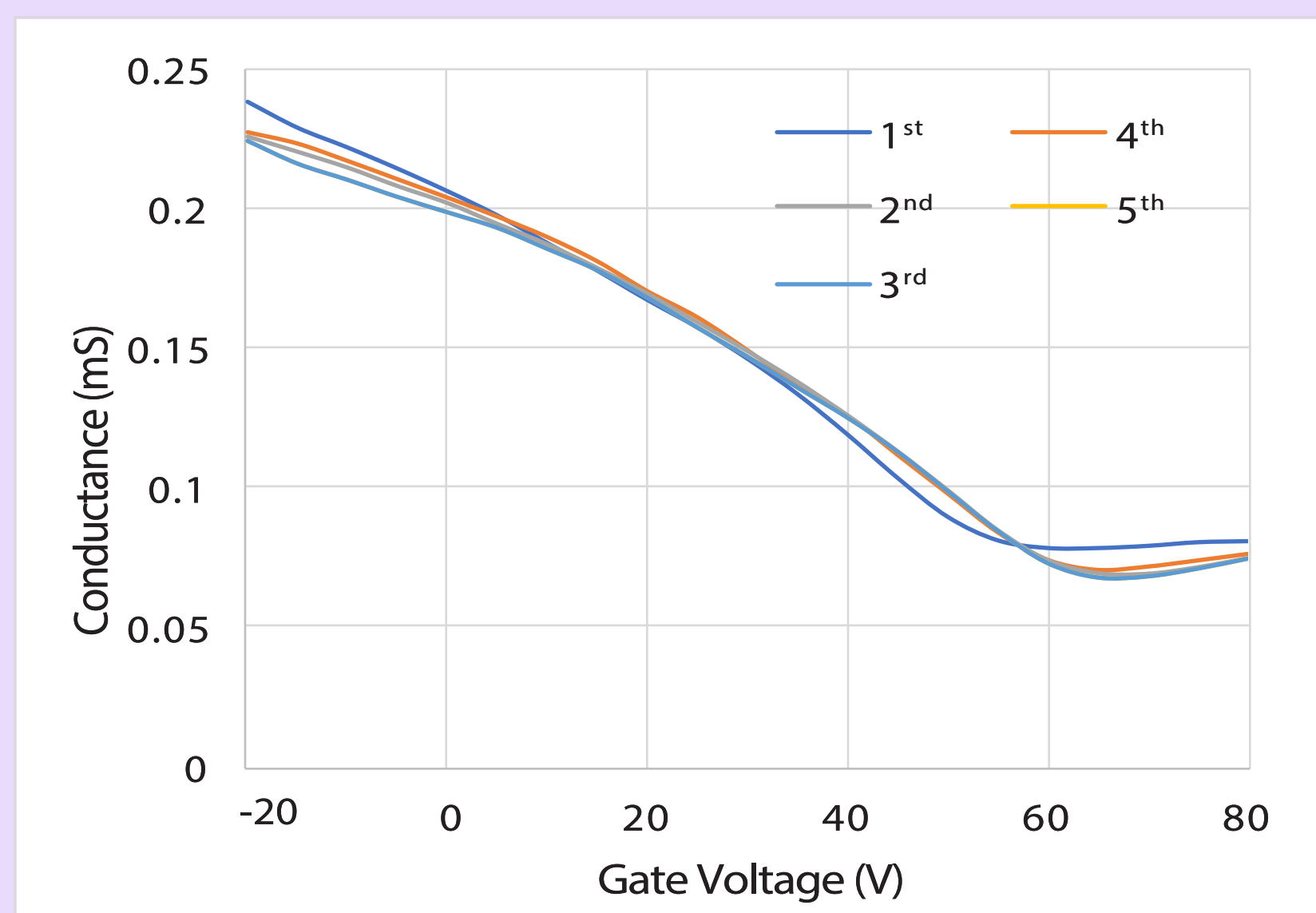


Fig. 3: Conductance vs. Gate Voltage profile of an unsuspended graphene sheet, for five consecutive measurements.

## Conclusion

- Suspended graphene sheets 3-9 μm in width and 2-8 μm in length have been fabricated.
- Graphene's sheet resistance was measured to be 1500 Ohms/Sq and 500 Ohms/Sq for unsuspended and suspended graphene, respectively.
- Graphene's FET behavior was confirmed.
- The next step is to implement electrostatic transduction and operate the device at its mechanical resonant frequency.

## References

- [1] C. Chen, et al. Nat. Nanotechnol., 4(12), 861-867, 2009  
 [2] J. Lee, et al. ACS Nano, 7(7), 6086-6091, 2013  
 [3] Z. Wang, et al. Nano Lett., 16(9), 5394-5400, 2016

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