Aachen Graphene & 2D Materials Center

2D Materials and Quantum Device Group | RWTH AACHEN UNIVERSITY

July 2026

Master Thesis:

Fabrication and Characterization of Graphene Quantum Nanomechanical Devices

Motivation:

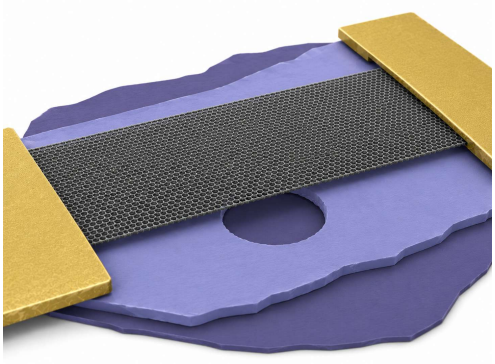
Graphene-based van der Waals heterostructures have emerged as a powerful platform for quantum technologies due to their exceptional electronic and mechanical properties. Suspended graphene membranes can act as ultra-high-frequency mechanical resonators, while electrostatically defined quantum dots enable precise control of individual electronic charges. Integrating these two systems opens a new research direction in quantum nanomechanics, where mechanical motion and quantum electronic states become coupled.

Such hybrid devices are promising candidates for future mechanical qubits, offering long coherence times, compact device footprints, and novel sensing capabilities. A crucial step toward these goals is the fabrication of high-quality suspended graphene devices and the development of sensitive electrical readout techniques while downscaling the device footprint to reach a high frequency.

Aim of this thesis:

The aim of this thesis is to fabricate suspended graphene drum resonators integrated into van der Waals heterostructures and to establish sensing techniques for the readout of bilayer graphene double quantum dots and the coupled mechanical motion.

The project combines advanced nanofabrication with cryogenic electrical characterization. The fabricated devices will be studied using atomic force microscopy (AFM), low-temperature quantum transport, and RF charge sensing techniques.



Schematic illustration of a suspended graphene drum resonator.

Your task:

Your work will cover the complete development cycle of graphene quantum electromechanical devices, from fabrication in the cleanroom to characterization at cryogenic temperatures.

In this project, you can broaden your knowledge in:

- Work with modern semiconductor fabrication technology
- Quantum devices based on 2D materials
- Nanoelectromechanical systems
- Low temperature experimental setups

Furthermore, you take part in group seminars and journal clubs where you follow current developments in this field of research and discuss recent experiments.

Contact us:

For further information, please contact Philipp Schmidt (philipp.schmidt3@rwth-aachen.de) or Nikita Berg (nikita.berg@rwth-aachen.de). More information about our work you can find at www.stampferlab.org and www.graphene.ac.