

Paul-Drude-Institut für Festkörperelektronik (PDI) - Control of Elementary Excitations by Acoustic Fields



PDI is a research institute in Berlin, Germany. We perform basic and applied research at the nexus of materials science, condensed matter physics, and device engineering.

Surface Acoustic Waves in Semiconductor Heterostructures Containing 2D Materials

Master Thesis Topic

City: Berlin; Starting date (earliest): At the earliest possible; Remuneration: 13,90€/hour; Closing date: 27/03/26

Tasks

There is an increasing interest in coupling the dynamic strain of surface acoustic waves (SAWs) to electrical excitations in semiconductor heterostructures containing 2D materials to acoustically manipulate their optoelectronic properties. While optical phenomena in 2D nanostructures can be conveniently mapped by photoluminescence, local probing of mechanical properties remains challenging. This task can, nevertheless, be assisted by high-frequency (GHz) SAWs, which are particularly suitable for probing very thin objects due to their micron-size wavelengths and their confinement near the surface.

Objective:

The goal of this project is to spatially probe the SAW profile in semiconductor heterostructures containing 2D materials using atomic-force microscopy (AFM). The key objectives are:

1. Characterization of the efficiency of SAW transfer onto stamped 2D flakes such as BN and transition-metal dichalcogenides.
2. Exploration of the interaction between SAWs and 2D materials either stamped or epitaxial.

Methodology:

The project will involve a combination of clean-room, RF characterization and AFM scanning probe techniques. The key tasks include:

1. Sample fabrication: Sputtering of piezoelectric films such as ZnO or AlN, and patterning of interdigital transducers (IDTs) for the excitation and detection of SAWs. Transfer of 2D flakes.
2. RF characterization of SAW resonators: Measurement of the reflection and transmission coefficients of the IDTs.
3. SAW imaging using AFM: spatial mapping of the SAW profile in the substrates and 2D materials.

Expected Outcomes:

The expected main results of the project are

- Fabrication of the integrated system.
- Detailed study of SAW transfer efficiency in 2D materials, mapped with AFM.
- Detection of acoustoelectric or acoustooptical effects.

Requirements

Skills and Requirements

- Background in solid state physics, materials science, or related fields.
- Experience or interest in clean-room technology, electrical measurement or optical spectroscopy techniques.
- High motivation, excellent interpersonal and project management skills.

What we offer

Opportunities and Benefits

- Modern labs with a wide range of experimental techniques.
- Supportive environment with experts for various scientific sub-fields.
- International and culturally diverse community.
- Location in the heart of Berlin with excellent public transport connections.
- Subsidized travel ticket.

Application

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More information at <https://stellenticket.de/201932/FUB/>
Offer visible until 27/03/26

