Master Thesis Topic

Microstructural characterization of the 2D ferromagnet $Fe_{3-x}GaTe_2$

Background and Motivation

Magnetic two-dimensional (2D) materials are very promising building blocks for the realization of ultra-compact and innovative spintronic devices. However, most of the 2D magnets explored so far exhibit magnetic transition temperatures well below 300 K, which hinders applications. Hence, the investigation of 2D magnets that can sustain magnetic long-range order at or above room temperature (RT) is highly demanded. Recently, we have successfully synthesized at wafer-scale using molecular beam epitaxy layered Fe_5GeTe_2 as well as Fe_3GaTe_2 films. Those materials are 2D conductors exhibiting itinerant ferromagnetism with Curie temperature values around or even above room temperature.

Objective

This project aims at the investigation of the structural properties of ultrathin Fe_3GaTe_2 films grown on graphene by molecular beam epitaxy (MBE). The idea is to obtain a better understanding of the layered structure of this material. The periodic arrangement of atoms in the individual layers of Fe_3GaTe_2 is often disturbed by the presence of stacking faults or defects such as vacancies, which directly affects the magnetic properties of the material.

Methodology

The student will perform experiments on x-ray diffraction and (scanning) transmission electron microscopy (STEM) measurements.

During the project, your tasks will include:

1. Characterize the crystallinity of the layer and the orientation with respect to the underlaying substrate at large scale using X-ray diffraction.
2. Perform basic (S)TEM measurements to observe and analyze the local defect structure.

Expected Outcomes

The expected main results of the project are:

- Understanding the structural properties of ultrathin Fe_3GaTe_2 films grown on graphene.
- Obtaining a more accurate picture of the microstructure of this complex layered material and thus contribute to a better understanding of its magnetic properties.

Skills and Requirements

- Background in solid state physics, materials science, or related fields.
- Experience or interest in van-der-Waals 2D materials.
- High motivation, excellent interpersonal and project management skills.

Opportunities and Benefits

- 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.

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For further details or clarification, please feel free to contact us. Lab tours are also available for interested applicants.