Paul-Drude-Institut für Festkörperelektronik (PDI) - Magnetic Materials for Spintronics and Magnetoacoustics

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.

Magnetic properties and phase diagram of large-scale layered magnets using SQUID magnetometry

Master Thesis Title

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

Tasks

Layered magnets can be seen as ideal platforms for exploring magnetism in the 2D limit. To
establish their potential in future technologies, the realization of high-quality magnetic layered
materials exhibiting ferromagnetism (FM) and/or antiferromagnetism close to room temperature
is urgently needed. Recently, we have successfully synthesized at wafer-scale using molecular
beam epitaxy on the one hand side a metastable α-FeGe2 layered phase (not found as a bulk
material) and on the other hand side layered Fe5GeTe2 as well as Fe3GaTe2 films. The first one
shows a ferromagnetic to anti-ferromagnetic phase transition (supported by density functional
theory) below room temperature and the letter ones are 2D conductors exhibiting itinerant
ferromagnetism with Curie temperature values around or even above room temperature.

Objective:
The aim of the project is to investigate the magnetic properties and to establish the magnetic
phase diagram of α-FeGe2 and/or Fe5GeTe2 (Fe3GaTe2) films. In principle, there is room for two
individual projects.

Methodology:
The structural properties of the films are characterized in-house by electron and X-ray diffraction
as well as atomic force microscopy to confirm superior growth results. The

superconducting
quantum interference device (SQUID) is an excellent tool to study fine details of the magnetic
properties with respect to magnetic field and temperature. The recently acquired, state-of-the-art
SQUID magnetometer at PDI allows the study of samples at magnetic fields up to 7 T in a temperature range from 1.4K up to 400K.

During the project, your tasks will include:

1. Learn the principles of SQUID magnetometry and the sample preparation for the SQUID
   measurements.
2. Perform SQUID measurements on a variety of α-FeGe2 and/or Fe5GeTe2 films prepared
   by different growth conditions (thickness, growth temperature)
3. Additionally the student will gain insight in the growth process and other magnetic characterization techniques such as magneto-transport.

Expected Outcomes:
The expected main results of the project are:

- Understanding of the magnetic properties and establishing the magnetic phase diagram
  of α-FeGe2 and/or Fe5GeTe2 (Fe3GaTe2) films.
- Correlation of the magnetic properties with the structural properties of the films.

Requirements

Skills and Requirements

- Background in solid state physics, materials science, or related fields.
- Experience or interest in magnetism and magnetic materials.
- High motivation, excellent interpersonal and project management skills.

What we offer

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.

Application

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More information at https://stellenticket.de/201906/TUB/
Offer visible until 26/03/26