PhD position
CINaM, Marseille, France

Epitaxial growth the antiferromagnetic Mn_5Si_3 compound for magneto-thermo-electric applications

PhD duration: 36 months

Starting period: ASAP from January 2021

Remuneration: 1500€/month

Financial support: ANR MATHEEIAS project

Supervisors: Lisa Michez and Matthieu Petit

Subject description:

Context:

Antiferromagnetic (AF) spintronics explores the spin-dependent properties of AF materials. This type of material can be magnetic at the atomic scale and non-magnetic at the macroscopic scale, and as a result, have a unique combination of properties able to solve the current challenges of information and communication technology (ICT). Identifying and exploiting novel transport mechanisms in complex antiferromagnets are the main objectives of the MATHEEIAS project cofounded by the ANR and the DFG. This project lies therefore on the growth of high-quality crystalline AF thin films and on the characterizations of their structural and magnetic properties. We will focus here on the Mn_5Si_3 compound presenting a metamagnetic phase transition (AF with a chiral spin structure below 65K and collinear above). This material will serve as a versatile platform to investigate various transport mechanisms (particularly, the topological, spin of crystal Hall effect) to demonstrate and control their relative contributions.

Objectives:

The various Hall effects can be experimentally distinguished by analyzing their dependence with crystal orientation, strain and disorder. That is why this PhD aims at growing by MBE (Molecular Beam Epitaxy) Mn_5Si_3 thin films that will present various degrees of crystallinity (from single crystal to polycrystalline structures) and of interface qualities (presence of dislocations, species intermixing). These films will then be thoroughly characterized by RHEED, XRD, HR-TEM, AFM, EBSD, AES, XPS and eventually SIMS in order to determine their epitaxial relationship with the substrate and their state of strain. Growth of the ferromagnetic isostructural counterpart ($Mn_5Si_3C_x$) will also be investigated.

The student will focus his/her work on the synthesis and the characterization of structural properties, the Mn_5Si_3 thin films being synthesized by MBE. The main objectives of the student will be to realize the growth of:

- Mn silicides with different growth direction
- fully epitaxial $Mn_5Si_3/Mn_5Si_3C_x$ heterostructures
- Mn_5Si_3 on piezoelectric substrates

The student will also participate to the characterization of the magnetic properties (SQUID, XMLD…).

Profile and skills required:

Highly motivated candidates in experimental physics with a Master degree (or equivalent) in condensed matter physics or materials science. A prior experience in physical or chemical vapor deposition growth would be appreciated. A strong involvement in the maintenance of the MBE chamber will be expected. Qualities such as pragmatism, professionalism, taste for teamwork, but also autonomy are expected. A good English level will be appreciated.

Application procedure

Applications, including a CV, Master 1 and 2 marks, a cover letter and at least one recommendation letter, should be sent to Lisa Michez (michez@cinam.univ-mrs.fr, Tel: +33 (0)6 62 92 28 89) and Matthieu Petit (petit@cinam.univ-mrs.fr, Tel: +33 (0)6 62 92 28 65)

The deadline for application is end of december 2020.

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