Topic "Strain Free All Heusler Alloy Junctions (SAHAJ) – Theoretical Research"

The **Department of Topological Quantum Chemistry** (MPI CPfS, Dresden) headed by Prof. Dr. Claudia Felser performs cutting-edge research on advanced topological materials, with a focus on both fundamental and application-oriented perspectives.

We are seeking a highly motivated and talented

Postdoctoral Researcher (f/m/d)

to join our dynamic research team in the field of spintronic materials and devices.

To theoretically conduct individual and collaborative research projects, duties to include: modelling of ferrimagnetic materials and interpretation of research data; use of appropriate research techniques and methods; writing up of research results and dissemination through publications, seminar and conference presentations.

To conduct research under the supervision of Prof. Hirohata and to contribute to the production of research.

Project Overview

Spintronics is anticipated to replace current semiconductor-based memories and sensors based on fast-operating times (< ns) and low power consumption (<pJ per read/write operation). The spintronic devices typically consist of a magnetoresistive junction with a free ferromagnet/oxide barrier or non-magnet/pinned ferromagnet trilayer and may suffer from edge-domain formation and leakage current through the barrier by further miniaturisation (<10 nm in cell diameter). To avoid such obstacles, antiferromagnetic spintronics has recently been developed by introducing spin-orbit torque which can reduce the power consumption by over two orders of magnitude but contain critical raw materials.

In this transformative project, we aim to develop a ferrimagnetic Heusler-alloy film, in which the magnetic properties will be controlled by substituting the constituent element to achieve compensated ferrimagnetism (effectively the same as antiferromagnetism) sandwiched by weak and strong ferrimagnet in a single-step deposition. This will be achieved based on our Heusler-alloy database developed recently through existing collaborations. The selected alloy(s) without using critical raw materials will be grown by dedicated combinatorial sputtering under low pressure and characterised by conventional structural and magnetic analysis as well as non-destructive imaging we have developed and synchrotron-beam imaging at the Paul Scherrer Institute. Such atomic

engineering can offer a new way for material development for low-power electronics. The simplified growth process for a junction without any interfacial scattering is adoptable for future spintronic devices as will be demonstrated using the 200-mm-wafer production line at IMEC by the end of this project.

Hence this proposed project will reveal both fundamental magnetic coupling in a ferrimagnetic alloy and atomic control of the alloy for new growth process, which can revolutionalise spintronic device production.

Requirements

- Qualification: PhD in Theoretical Physics/Materials Science/Electronic Engineering/Computer Science.
- Knowledge: Knowledge of Spintronics/Magnetism to engage in high quality theoretical research, Knowledge of modelling a crystalline structure and crystallisation process (namely on Heusler alloys), Knowledge of calculating crystallisation energy against lattice strain using first-principles, Knowledge of simulating a band structure with/without atom substitution, Knowledge on modelling spin-polarised electron transport across an all Heusler-alloy junction, and Knowledge of machine learning for materials search and *ab initio* calculations on alloys.
- Skills: Highly developed communication skills to engage effectively with a wide ranging audience, both orally and in writing using a range of media, Ability to write up research work for publication in high profile journals and engage in public dissemination, Competency to conduct individual and collaborative research projects, and Competence to make presentations at conferences or exhibit work in other appropriate events.

Our offer

- Conduct theoretical and modelling research in the area of materials development for spintronic devices
- Have access to cutting-edge laboratory facilities, collaborative research opportunities, and a vibrant academic environment.
- Competitive salary according to the German public pay scale (TVöD). The appointment is for two years (extension possible).
- The Max Planck Society strives for gender and diversity equality. We welcome applications from all backgrounds.
- The Max Planck Society is committed to increase the number of individuals with disabilities in its workforce and therefore encourages applications from such qualified individuals.

Your application

We actively support the reconciliation of work and family life.

Please, submit your application to **personal@cpfs.mpg.de** **by 15 March 2024**, including the following documents:

- Curriculum vitae
- One-page letter of motivation
- Certificates and transcripts and a statement of past research accomplishments
- List of publications
- Names and email addresses of two academic references

Applications will be accepted from immediately until the position is filled. We look forward to your application. Detailed information about MPI CPfS via https://www.cpfs.mpg.de.

We actively support the reconciliation of work and family life.

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audit berufundfamilie