

Helmholtz–OCPC Programme 2017-2021 for the Involvement of Postdocs in Bilateral Collaboration Projects with China

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Office of the China Postdoctoral Council (OCPC)
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(MoHRSS)

Project Proposal: Tunable electronic and magnetic properties of nanostructures

Name and contact data of project leader / supervisor:

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<http://www.int.kit.edu/hahn.php>

Part A

Project Proposal:

Functional properties of materials can either be controlled via compositional and microstructural modifications, yielding properties that are fixed to the particular microstructure and that cannot be altered in a reversible way, or through a change in their electronic structure by means of an external electrical field. In the latter case the property modulation (tuning) becomes fully reversible. The proposed project will be in the field of tunable nanomaterials, in particular in the area of reversible control of electronic and magnetic properties.

The research will involve the preparation of appropriate nanostructures in the form of thin films, nanoparticles, nanoporous and nanocrystalline materials. The following synthesis methods will be employed: thin film deposition techniques, such as MBE, PLD, ALD and sputtering, nanoparticle synthesis using chemical routes and gas phase synthesis, and de-alloying.

The nano- and microstructure of the materials will be studied using the full range of modern characterization techniques, such as XRD, SEM, TEM, STM, AFM, etc., all methods readily available at INT.

The reversible control, or tuning, of the electronic and magnetic properties will be achieved by means of several gating concepts, depending on the morphology of the nanostructures selected. Gating can be done (1) using dielectric or ferroelectric layers, (2) using electrolytes, i.e., Helmholtz double layer and pseudocapacitive charging of the interfaces between the active material and the electrolyte, or (3) using the concept of reversible electrochemistry, i.e., intercalation and de-intercalation of ions (for example Li) into the active material. All facilities for the different concepts are readily available at INT, as well as the necessary expertise in performing such experiments. It is anticipated that the candidate will work independently on the project, including the preparation of publications and reports.

The experimental equipment is available, including the synthesis methods, the characterization techniques and experimental set-ups for the measurements of the electronic and magnetic properties.

- **Qualifications of the applicant required:**

The candidate must have many years of expertise in the area of synthesis of nanoporous, nanocrystalline materials using de-alloying and the measurement of tunable properties. The candidate must also have a profound understanding of electrochemistry and electrochemical gating. With this expertise, it is expected that he will make rapid progress, in particular as he will be integrated into the group of Dr. Robert Kruk working on these aspects for many years. It is preferred that the candidate has a broad background in materials science and materials physics, in order to quickly get integrated into the complex behavior of functional materials.

Part B

- Reason for the candidate's personal interest in a research visit to KIT
- CV and copies of certificates
- List of publications
- Two letters of recommendation
- Evidence of competence in English

Part C

- Completion of PhD within the past five years
- Not older than 35 years at the time of application