

2020 Helmholtz – OCPC – Program for the involvement of postdocs in bilateral collaboration projects

PART A

Title of the project: Novel two-dimensional silicon FET structures for biosensing applications

Helmholtz Centre and institute: Forschungszentrum Jülich, Institute of Complex Systems, Bioelectronics (ICS-8)

Project leader: Prof. Dr. Svetlana Vitusevich

Web-address: Electronic Sensors Group <https://www.fz-juelich.de/ics/ics-8/EN/AboutUs/OrganizationAndResearchGroups/ElectronicSensing/_node.html>

Description of the project:

Two-dimensional materials (2D) demonstrate unique properties completely different from their 3D counterparts. The aim of this project is to design and fabricate 2D silicon field-effect transistor (FET) structures. Structural analysis of fabricated structures should be performed using scanning electron microscope (SEM), X-ray photoelectron spectroscopy (XPS), atomic force microscopy (AFM) techniques. In addition, to obtain deeper insight into electrical properties of the developed structures, I-V characteristics have to be measured and studied in a wide temperature range. Because properties of 2D materials, in ideal case containing one atom thick layer channel, are determined also by the dielectric layer covering the 2D channel, the interface and dielectric performance have to be investigated using noise spectroscopy. We expect that the 2D channel obtained by new optimized technology will result in a dense dielectric layer, almost without dangling bonds and a sharp interface between a dielectric and 2D Si channel. In addition, possible tunneling and quantum processes that may occur in the novel structures have to be analyzed. Effective control of transport phenomena will enable better engineering of nanostructures and developing advanced biosensor devices. The long-term goal of this work is the development of novel active Si FET structures, which can be used to test various biological objects. Aptamers developed in collaboration will allow not only sensitivity but also selectivity improvement for biomarker detection. The innovative technology is very promising for the development of Point-of-Care (POC) diagnostic platform. Recently opened Helmholtz Nanoelectronic Facility (HNF) will be available for the candidate to implement the novel technology approaches and to develop test biosensor structures. Therefore, I strongly recommend supporting the application for two years Post Doc project and certify that my laboratory and office space will be provided in our Institute at Forschungszentrum Jülich.

Description of existing or sought Chinese collaboration partner institute:

The Post-Doc project combines the advantages of existing collaboration with Shanghai Institute of Microsystem and Information Technology (SIMIT), started in 2006 with topic (1) focused on development of techniques for nanoparticle-assisted improved diagnostic of diseases and topic (2) - development of new materials and structures aiming at a deep understanding of interfacing mechanisms between biological objects such as cells together with novel approaches for biosensor developments on the basis of nanostructured field-effect transistor (FET) structures. The aptamers are promising due to their unique properties in replacing the antibodies which are currently used to bind target molecules. It is known that SIMIT has huge experience in nanowire biosensor activity. Therefore, we are very interested to strengthen of ties with SIMIT or to establish new collaborations with institutes in China on elaboration of Nano-FET biosensors.

Additionally, we welcome collaboration with any Chinese institution that deals with the same subjects and shares our scientific interests.

Required qualification of the post-doc:

- PhD in Microelectronics, Bioelectronics or Electrical Engineering
- Experience with in semiconductor device and surface functionalization technologies
- Additional skills in microfluidic chip fabrication and biosensor characterization

PART B

Documents to be provided by the post-doc, necessary for an application to OCPC via a postdoc-station in China, which is affiliated to a research institution like a university:

- Detailed description of the interest in joining the project (motivation letter)
- Curriculum vitae, copies of degrees
- List of publications
- 2 letters of recommendation
- Proof of command of English language

PART C

Additional requirements to be fulfilled by the post-doc:

- Max. age of 35 years
- PhD degree not older than 5 years
- Very good command of the English language
- Strong ability to work independently and in a team