2020 HGF – GSI – OCPC – Programme

for the involvement of postdocs in bilateral collaboration projects

Title of the project:

High-pressure transformation of nanomaterials synthesized by ion-track technology

Helmholtz Centre and institute:

GSI Helmholtz Centre

Project leader:

Maria Eugenia Toimil-Molares

Contact Information of Project Supervisor: m.e.toimilmolares@gsi.de, +496159711807

Web-address

https://www.gsi.de/en/work/research/appamml/materials_research.htm

Department

Materials Research

Programme Coordinator (Email, telephone and telefax)

Dr. Pradeep Ghosh
FAIR/GSI - International Programme for Students and Researchers (INTL)
Phone: +49 6159 71-3257
Email: Pradeep.Ghosh@fair-center.eu / International@gsi.de

Description of the project (max. 1 page)**:**

The implementation of nanowires and nanotubes for applications such as thermoelectrics, catalysis, or plasmonics, requires both, an excellent control on geometry, crystallinity and composition of the individual nanostructures, as well as its successful assembly into 2-D and 3-D architectures.

At GSI, the unique combination of electrodeposition and tailored nanochannel templates provides an excellent platform (i) to study and control the nanowire growth, (ii) to synthesize 3-D nanostructure assemblies and (iii) to investigate their size-dependent properties.

Membranes with parallel nanochannels are fabricated by swift heavy ion irradiation and subsequent chemical etching. In addition, templates with interconnected tilted nanochannels are obtained by applying ion irradiation at several incident angles in consecutive steps. Nanochannel density and orientation, as well as diameter and geometry, are adjusted by the irradiation and etching conditions, respectively. Subsequent electrodeposition in the channels results in nanowire arrays and highly ordered 3-D nanowire ensembles of various materials. Recently, metal (Au, Cu,...), semiconductor (ZnO and p-Cu_2O) and semimetal (Bi, Sb) nanowire arrays and nanowire networks have been synthesized by this technique (see Fig. 1).

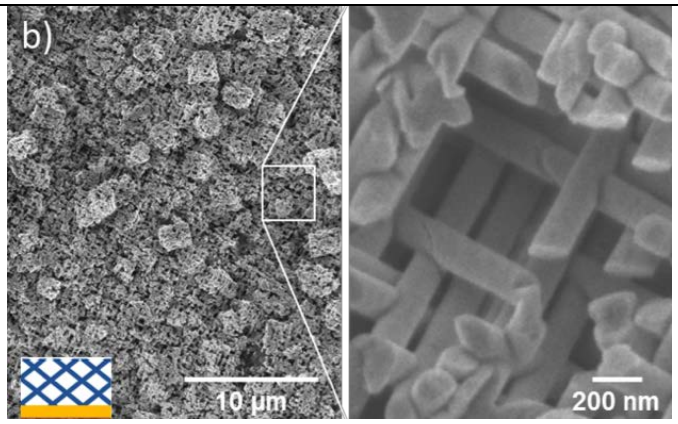

Fig.1 SEM image displaying a three-dimensional ZnO nanowire network fabricated by ion-track technology and electrodeposition

Within this project, we plan to investigate the high pressure phase transformations of these nanostructured materials, as a function of size, by using diamond anvil cells (DACs). The tasks include (i) the synthesis of the nanomaterials and their characterization by several techniques including x-ray diffraction, scanning and transmission electron microscopy, and Raman spectroscopy, (ii) preparation of the nanomaterials in DACs, (iii) structural investigations under high pressure (upon proposal application at synchrotron facilities), and (iv) swift heavy ion irradiation experiments.

Therefore, previous experience of the postdoc candidate with DACS, high pressure physics, and/or experiments at large-scale facilities is desired.

Required qualification of the post-doc:

- PhD in Physics or materials research
- Experience with high pressure physics
- Additional skills in materials characterization techniques
- Language requirement: fluent English (spoken and written)
- Proficient written and verbal communication skills as reflected in effective presentations at seminars, meetings and/or teaching lectures.
- Motivation and interpersonal skills to work in a collaborative, multidisciplinary team environment.