2017 Helmholtz – OCPC – Programme
for the involvement of postdocs in bilateral collaboration projects

PART A

Title of the project:

Helmholtz Centre and institute: Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Young Investigator Group "Interface Design"

Project leader: Prof. Dr.-Ing. Marcus Bär

Web-address: http://www.helmholtz-berlin.de/forschung/oe/ee/grenzflaechendesign/

Description of the project (max. 1 page)**:**
In the past years, solar cells based on the material class of hybrid organic-inorganic halide perovskites have shown the steepest power conversion efficiency learning curve, becoming the rising star in photovoltaics (PV). On the laboratory R&D level, device efficiencies have exceeded those of the commercially dominant multicrystalline Si-wafer based cells and are now on par with those of the classic thin-film cells based on CdTe and Cu(In,Ga)Se_2; there are however still many open questions, particularly pertaining to the chemical and electronic structure at the interfaces in corresponding device layer stacks. The current drive to develop tandem devices using (relatively) wide-band gap perovskites paired with established PV technologies further increases the demand for detailed insight into the interface properties.
One of the main challenges is the (monolithic) interconnection between the perovskite-based top cell and the bottom cell. This requires the development of a transparent and highly conductive tunnel junction that provides a "low-loss" optoelectronic connection of the top with the bottom cell. Usually this is realized by a highly doped diode (in opposite direction to the pn-junction of the top and bottom cells) that is based on wide-band gap semiconductors. If a sufficiently high doping concentration can be achieved the depletion region is narrow enough to allow for unimpeded charge carrier tunneling. However, to ensure this additional diode works properly and to prevent it from becoming parasitic, the alignment of the energy levels at all interfaces needs to be deliberately opti-mized. Within this project the postdoc will learn how to use x-ray photoelectron spectroscopy (XPS) to investigate the chemical surface/interface structure of perovskite-based thin-film tandem PV layer stacks, with a focus on the tunnel junction. UV photoelectron spectroscopy (UPS) and inverse photoelectron spectroscopy (IPES) will additionally be used to give insight into the occupied (valence band) and unoccupied (conduction band) states, respectively. Ultimately, the combination of XPS, UPS, and IPES will allow a direct and independent determination of the valence and conduction band offsets at the interfaces in the solar cell device while also monitoring changes at the buried interfaces that may potentially be induced by subsequent deposition steps. The expected insights will be crucial for a rapid and knowledge-based development of the necessary transparent and highly conductive tunnel junction.

Description of existing or sought Chinese collaboration partner institute (max. half page)**:**
Recently, we have initiated a collaboration with the group of Prof. Xuhui Sun, Associate Director of the Institute of Nano Functional & Soft Materials (FUNSOM) and Associate Dean of the College of Nano Science and Technology (CNST) of the Soochow University (199 Ren-Ai Road, Suzhou Industrial Park, Suzhou, Jiangsu Province, 215123 China). In order to strengthen our collaboration in the field of the preparation and characterization of perovskite thin-film solar cells absorbers, we have recently offered Dong-yang Liu – who did his M. Sc. in Chemistry at FUNSOM – a PhD position in our group. FUNSOM focuses on research and development in the areas of optoelectronics, new energy, green environment and biomedicine. It conducts both fundamental and applied researches in an interdisciplinary way on molecular design, material synthesis and characterizations, as well as device fabrication and characterizations. FUNSOM is dedicated to academic innovation, technology development, and cultivation of talents. The institute aims at enhancing the interdisciplinary research in chemistry, physics, materials science, electronic engineering, and biomedical sciences. The group of Prof. Sun, mainly focuses on one-dimensional semiconductor nanomaterials and carbon nanostructures and their applications in nanoelectronics, sensors, and energy harvesting. In addition, the team also works on the development and application of synchrotron radiation techniques for the study of nanoscale materials. Please see the group's webpage for more details: http://funsom.suda.edu.cn/index.aspx?menuid=13&type=articleinfo&lanmuid=28&infoid=164&language=en

Required qualification of the post-doc:

- PhD in physics, chemistry, electrical engineering, or materials science
- Profound expertise in photoelectron spectroscopy is essential
- Additional experience in experimental campaigns at synchrotron light sources and thin-film deposition is advantageous

PART B

Documents to be provided by the post-doc:

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

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