Ministry of Human Resources and Social Security

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

# 2019 Helmholtz – OCPC – Program

## for the involvement of postdocs in bilateral collaboration projects

**PART A**

**Title of the project:**
Crystalline silicon solar cell with transparent microcrystalline silicon carbide as low temperature transparent passivated contact

**Helmholtz Centre and institute:**
Forschungszentrum Jülich, Institute of Energy and Climate Research (IEK-5)

**Project leader:** Dr.-Ing. Kaining Ding

**Web-address:** www.fz-juelich.de/iek/iek-5/EN/

**Description of the project:**

To date, the tunnel oxide passivated contact (TOPCon) design is one of the most promising concepts for two-side contacted c-Si solar cells. It has gained more attention due to low cost potential and relatively high energy conversion efficiency (up to 25.8%). Conventional TOPCon consists of thin polycrystalline silicon layers on c-Si wafers. The key feature of the TOPCon concept is the incorporation of an ultra-thin tunnel oxide on the surface of the c-Si wafer, which increases the efficiency potential due to the excellent surface passivation. However, the conventional TOPCon consists of a-Si:H that is crystallized into polycrystalline silicon (poly-Si). This leads to two major drawbacks. On one side, used on the front side of the cell the poly-Si layer would absorb a significant part of the light parasitically that would not contribute to the photocurrent. On the other side it the passivated contact concept cannot be combined with the low temperature silicon heterojunction concept due to the high annealing temperature process needed. IEK-5 showed that highly-transparent hydrogenated microcrystalline silicon carbide (µc-SiC:H) layer is successfully introduced to replace poly-Si in the TOPCon concept to form a transparent passivated contact (TPC). This TPC fulfils the requirements of excellent surface passivation of the c-Si front side without any further high temperature steps.

This work aims at the demonstration of crystalline silicon solar cells consisting of n-type µc-SiC:H TPC on the front side and p-type heterojunction contact on the rear of the n-type solar cell. The complete cell will be fabricated under 200°C. In particular, the optimization of the oxidation process, the film growth as well as the hydrogenation and the metallization steps need to be tackled. The purpose is to optimize energy conversion efficiency of the novel solar cell concept and identify limiting factors. Additional research questions are whether (i) transparent conductive oxide or silicon nitride antireflective coating can be omitted, (ii) the deposition rate of µc-SiC:H can be increased further and (iii) a good bifaciality of the cell can be reached.

**Description of existing or sought Chinese collaboration partner institute:** A strategic partnership already exists with the Research Center for New Energy Technology (RCNET) at the Shanghai Institute of Microsystem and Information Technology (SIMIT) under the framework of the Virtual Joint Research Institute on Functional Materials and Electronics. Further collaborations with Institute for Solar Energy System, Sun Yat-sen University (SYSU-ISES) and Institute of Electrical Engineering, the Chinese Academy of Sciences (IEE-CAS) exist. Chinese research institutes with state-of-the-art c-Si solar cell technology platform can be considered as collaboration partner institutes.

**Required qualification of the post-doc:**

- PhD in physics, chemistry, material sciences, electrical engineering or a comparable discipline
- Fabrication of crystalline silicon solar cell, in particular silicon heterojunction or passivated contact
- Additional skills in scientific English writing and presentation and evaluation tools e.g. Originlab

**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