2023 Helmholtz – OCPC – Programme

for the involvement of postdocs in bilateral collaboration projects

PART A

Title of the project:

Development of silicon heterojunction solar cells based on novel hot-wire chemical vapor deposition techniques

Helmholtz Centre and/or institute:

Forschungszentrum Jülich

Project leader:

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

To date, three major concepts (without diffused emitters) have been developed to deal with the limitation of most crystalline silicon (c-Si) solar cells, resulting from the recombination in diffused emitter regions and at the contact between metal electrodes and the silicon absorber. Although their capacities to enable high efficiencies, they also suffer from a significant drawback - parasitic optical absorption losses. A suitable material candidate, nc-SiC:H (n), has been shown to be suitable for the utilization as the highly transparent front contacts. However, due to the trade-off between relevant parameters, it is difficult to combine high transparency, good conductivity, and sufficient hydrogenation content for the high-quality passivation simultaneously. This issue limited the performance of SiC-based TPC solar cells for a long time. Luckily, the work completed at IEK-5 has paved a way to overcome the problem, only using low-temperature processes, by implementing a nc-SiC:H(n) based-highly transparent passivating contact scheme mainly prepared by hot-wire chemical vapor deposition(HWCVD) process. An independently confirmed efficiency of 23.99% ± 0.29% was demonstrated.
This work aims at the at further development of this TPC using innovative approaches. Several issues: the optical management at the front side, the application of the TCO-free cell concept, the

development of a double-sided TPC solar cell, the stability of the device at the cell and the module levels will be investigated and the optimal solutions will be implemented in the device in order to improve the efficiency further. Additionally, the assembly of TPC solar cells in to mini modules as well as the stability tests of the TPC under operation conditions and accelerated stress tests will be performed. Also, alternative concepts based on HWCVD to reduce the optical loss in SHJ solar cells besides TPC will be explored.

Description of existing or sought Chinese collaboration partner institute (max. half page)**:**

Partnerships already exists with the Research Center for New Energy Technology (RCNET) at the Shanghai Institute of Microsystem and Information Technology (SIMIT), with Institute for Solar Energy System, Sun Yat-sen University (SYSU-ISES) and Institute of Electrical Engineering, the Chinese Academy of Sciences (IEE-CAS). 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 postdoc:

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