2016 Jülich – OCPC – Programme
for the involvement of postdocs in bilateral collaboration projects

PART A

Title of the project: Optical Design of Spectral Light Management for Novel Tandem Solar Cell Concepts

Jülich's institute: Institute of Energy and Climate Resaerch 5 - Photovoltaics

Project leader: Dr. Karsten BITTKAU

Web-address: http://www.fz-juelich.de/iek/iek-5/EN/Forschung/Abteilung%20AS/AG%20Optikv2/AG_Optik_node.html

Description of the project (max. 1 page)[1]**:** see overleaf

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

The institute should be experienced in thin-film optics and optical characterization of thin films. A background in photovoltaics is welcome. Experiences with optical models like transfer matrix method and Finite-Difference Time-Domain method would be helpful.

Required qualification of the post-doc:

- PhD in Physics, material science, electrical engineering or a comparable discipline
- Experience with thin-film optics, rigorous optical simulations
- Additional skills in scientific English writing, data analysis, handling of big data

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

[1] Please add overleaf

PART C

Additional requirements to be fulfilled by the post-doc:

- Max. age of 33 years
- PhD degree not older than 5 years
- Very good command of the English language
- Strong ability to work independently and in a team

Description of the project:

The silicon photovoltaic (PV) technology is the dominating technology for direct solar-to-electricity conversion. Due to a huge effort, the energy conversion efficiency was brought closer to the theoretical limit and is expected to raise further in future. One promising approach to achieve higher efficiencies is the implementation of tandem solar cells, where a high band gap absorber (e.g. Perovskites) is stacked on top of the crystalline silicon solar cell. The idea behind such a stacked device is to absorb the high energy photons in the high band gap absorber (top cell) and the low energy photons in the low band gap absorber (bottom cell) in order to achieve a higher electrical power.
The reduction of optical losses is one big issue here. These optical losses might occur if, e.g., a high energy photon is not absorbed in the top cell but in the bottom cell. Furthermore, a low energy photon might be redirected to the top cell instead of being absorbed in the bottom cell. To overcome these possible losses, a good photon management needs to be applied where, on the one hand, the incident sunlight is spectrally distributed between the two subcells. On the other hand, the light paths need to be enhanced in particular in the weak absorbing range of the spectrum in order to increase the absorption propability. Therefore, textured interfaces or incorparated nanostructures are typically used.
The aim of the project is the optical design of different light management concepts for tandem solar cells by using rigoros optical simulations. Multilayered thin-film stacks should be placed between the two subcells as spectrally selective optical interlayer. The influence of different nanostructures at the front or the back interface on the external quantum efficiency should be studied. Two different device concepts should be considered. The first concept is a monolithical layer stack with two terminals, where the totally generated photocurrent in the top and the bottom cells needs to be equalized. The second concept is a four-terminal device, where additional contact layers are placed between the two subcells but current matching is no longer necessary. For the optical design, materials, which are available at the IEK5, are investigated which assures the potential for technological application of the results. The computational infrastructure is provided by the IEK5.