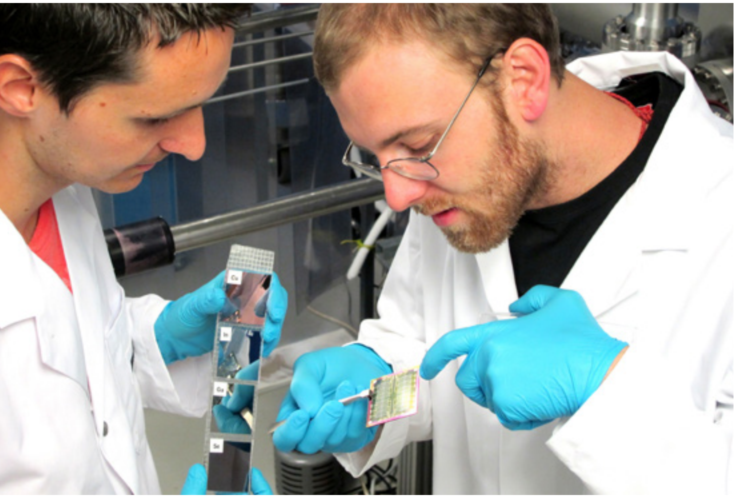
IMPLEMENTATION & IMPACT

The performance of thin-film solar cells based on chalcopyrite has improved markedly in recent years to conversion efficiencies around 22 %.

Sharc25, an acronym for “**S**uper **h**igh efficiency Cu(In,Ga)Se_2 thin-film sol**ar c**ells approaching **25** %”, aims to raise the bar even higher. The five research institutes, four universities, and two companies are pursuing three strategies to achieve this goal: Improve the absorber material, harness the power of new designs for more efficient surfaces and interfaces, and optimize light management to raise the efficiency threshold another few notches.

An improvement on this scale could give the PV industry and related manufacturing equipment industry a decisive boost. The cost of manufacturing solar modules in Europe could drop below 0.35 €/W_p and the cost of installed PV systems to below 0.60 €/W_p. Further savings could be achieved by ramping up the new technology for mass production. This would drive down investment costs, for example, to less than 0.75 €/W_p of annual production capacity for CIGS solar module factories with more than 100 MW_p manufacturing capacity.



Empa researchers in the lab. Photo: © Empa

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Partners

ZSW Germany	**INL** Portugal
Aalto University Finland	**Manz** Germany
Empa Switzerland	**Université de Rouen** France
Flisom Switzerland	**University of Luxembourg** Luxembourg
HZB Germany	**University of Parma** Italy
imec Belgium	

Photo cover: Transmission electron micrograph of a CIGS solar cell at Empa

SHARC25

SUPER HIGH EFFICIENCY Cu(In,Ga)Se_2 THIN-FILM SOLAR CELLS APPROACHING 25 %

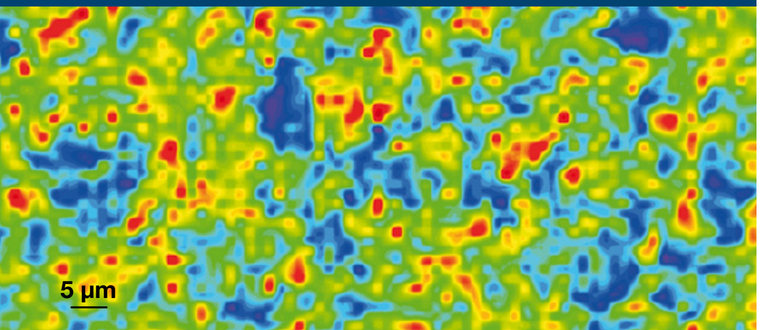
www.sharc25.eu

ABOUT SHARC25

The objective of the Sharc25 project is to achieve up to 25 % conversion efficiency in thin-film solar cells made of copper indium gallium diselenide (CIGS).

The €6.2 million Sharc25 photovoltaic (PV) project is mainly funded by the European Union's Horizon 2020 research and innovation programme and partially funded by the Swiss government. Eleven research partners from eight countries including Belgium, Finland, France, Germany, Italy, Luxembourg, Portugal, and Switzerland are on board and the project runs between May 2015 and October 2018.

ZSW researcher with CIGS solar cells. Photo: © ZSW



Photoluminescence measurement at the University of Luxembourg

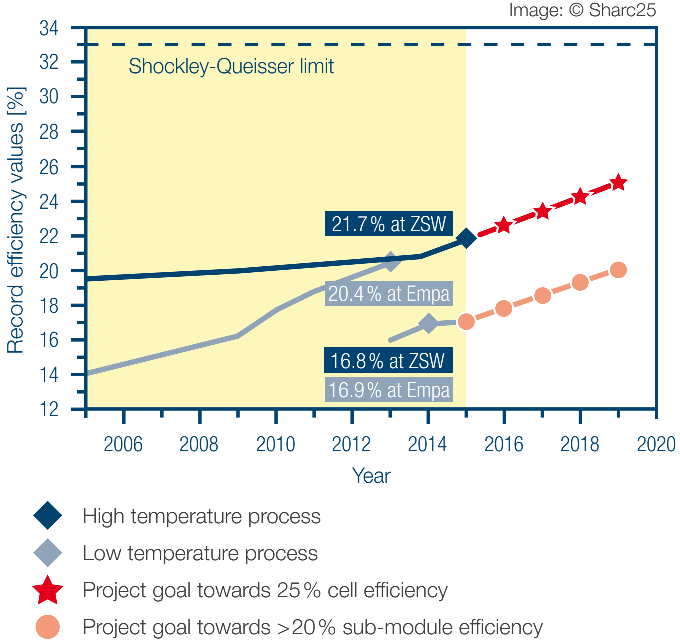
Ultra-high vacuum chamber at INL. Photo: © INL

+ 1 % by highly efficient CIGS absorber material

+ 2 % by introducing novel concepts for surfaces and interfaces

+ 1 % by advanced light management

Image: © Sharc25



APPROACH

In Sharc25 the practically achieved performance of CIGS thin-film solar cells will be pushed towards 25 %, i.e., the efficiency of monocrystalline silicon-wafer based devices and approaching the theoretical Shockley-Queisser limit (33 %).

The key limiting factors in state-of-the-art CIGS solar cells are non-radiative carrier recombination and light absorption losses in emitter layers. Both challenges will be addressed in this project:

ADVANCED CIGS BULK ABSORBER PROPERTIES

- Better matching to solar spectrum by employing novel doping concepts to CIGS deposited by coevaporation.
- Optical and electrical 2D/3D simulation on device level as well as density functional theory calculations on the material level will be another key for optimization.

TAILORING OF THE CIGS/BUFFER INTERFACE

- Application of wide bandgap buffer layers combined with CIGS absorbers modified in the near-surface region to yield a higher short-circuit current.

IMPLEMENTATION OF PASSIVATION LAYERS AND POINT CONTACTS

- Adaption of well-established deposition processes for silicon-based solar cells to CIGS technology.
- Introduction of surface passivation processes at the front and back side of the CIGS absorber will reduce recombination at interfaces to achieve higher open-circuit voltages.

ADVANCED LIGHT MANAGEMENT

- Reduction of reflection losses at multiple interfaces, parasitic absorption in layers and materials above the absorber layer, and insufficient absorption of light entering the absorber layer.
- New light scattering and trapping concepts as well as application of back side reflector for CIGS cells.