



HIGHLIGHTS FROM THE FP7 PROJECT CHEETAH: MORE POWER WITH LESS MATERIAL

Jan Kroon – Project coordinator

Berlin, 30 November 2017



This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration

Facts and Figures

- FP7-Energy-2013 Integrated Research Project (IRP)
- Grant agreement no.: 609788
- Combination of collaborative research project (CP) and coordination action (CSA)
- Total planned costs: 13.2 M€, EC Contribution 9.7 M€
- Duration 48 months: (1/1/2014 -1/1/2018)
- Coordinator: ECN + 33 partners
- Website: www.cheetah-project.eu

History and European context

-  **European 20-20-20 targets**
-  **Solar Europe Industry Initiative**
-  **SET plan for PV for 2020**
-  **European Energy Research Alliance (EERA-PV):** Established 2010
 - Definition of Joint Programme for PV
 - Accelerate PV development in Europe through R&D alignment

First examples of joint projects in support of EERA-PV:



Link EERA PV - CHEETAH

- Activities within EERA-PV:

- **Silicon PV**
- **Thin film PV**
- Emerging (**OPV**, perovskites)
- Concentrated PV
- Building Integrated PV and systems
- Reliability (since 2017)
- **Mobility and research infrastructure**

- CHEETAH executes selected part of Joint Programme
 - Total budget 13 Meuro / EC contribution 9.7 Meuro
 - Duration 48 months: (1/1/2014 -1/1/2018)

Project approach and structure

NEEDS

CHEETAH innovations

Research

Cheaper and more efficient cells and modules

Earth abundant and non-toxic materials



New concepts for

- **Silicon PV → <100μ thick**
- **thin film → light management**
- **OPV → low cost barriers**

At reduced cost, environmentally friendly....

Coordination

Structure for managing R&D & cooperation

Exchange & communication



Create tools for cooperation

Improve exchange & communication

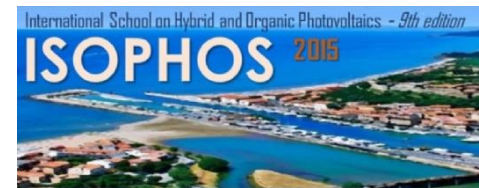
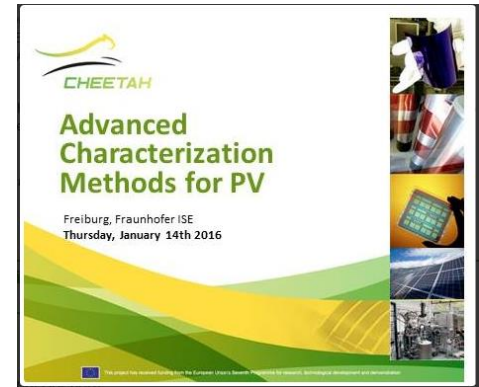
Interfacing with industry

Consortium: 34 partners



Coordination activities

- **Joined actions** and **mobility exchange** actions
- **E-learning platform**
- **Training workshops, summer schools, webinars**
- **Contacts with industrial stakeholders** via workshops & web meetings
- **Standards, surveys, reports**
- **Dissemination & exploitation**
- **'Knowledge exchange web portal'**



Website: www.cheetah-project.eu



- Today's Challenges
- CHEETAH's objectives
- Overall strategy of the workplan
- Consortium
- Acknowledgments
- News and events
- Press room
- Scientific publications
- Exchange Portal**



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CHEETAH PROJECT

CHEETAH - *Cost-reduction through material optimisation and Higher EnErgy output of solar photovoltaic modules - joining Europe's Research and Development efforts in support of its PV industry* - is a combined collaborative project (CP) and coordination and support action (CSA) funded under the European Commission's 7th Framework programme. CHEETAH's aims to solve specific R&D issues in the EERA-PV Joint Program and to overcome fragmentation of European PV R&D in Europe and intensify the collaboration between R&D providers and industry to accelerate the industrialization of innovations.



With 16 nationalities represented in the consortium, CHEETAH's ambition is to develop technology and faster innovative manufacturing capabilities and photovoltaic products so that Europe can develop its technological and industrial capacity in all parts of the value chain.

Events

no news in this list.

[+ Read more news](#)

News

16 December 2014
SYMPOSIUM ON EUROPEAN PV RESEARCH INFRASTRUCTURES - 22ND JANUARY 2015
A Symposium on European PV Research Infrastructures is organised by CEA-INES and will take place on the 22nd January 2015. During this symposium, CHEETAH will also be presented by Jan Kroon, coordinator of the project. The...

16 December 2014
CHEETAH LEAFLET
CHEETAH leaflet has been issued and is available for download.

[+ Read more news](#)

PV Knowledge Exchange Portal

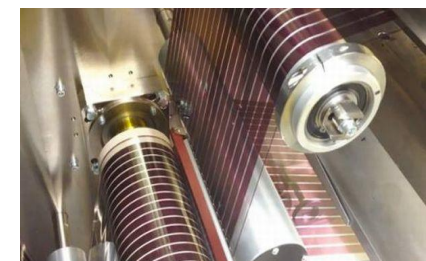
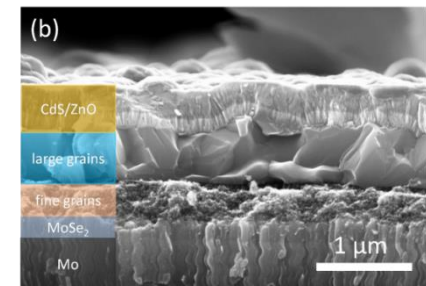
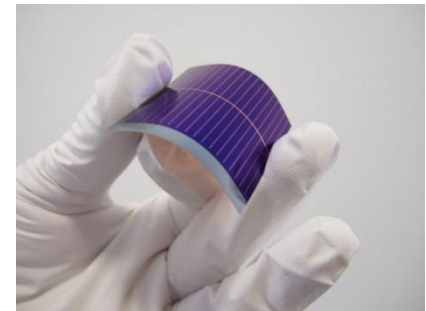


<http://www.cheetah-exchange.eu/>

- So far, only Cheetah participants and JP PV partners are listed in database
- Will be extended to non – JP PV institutes in near future
- Knowledge exchange Portal will be maintained by JP PV after Cheetah project ends under new name
- Overview of national and EC funded projects will be added

Drivers for research activities

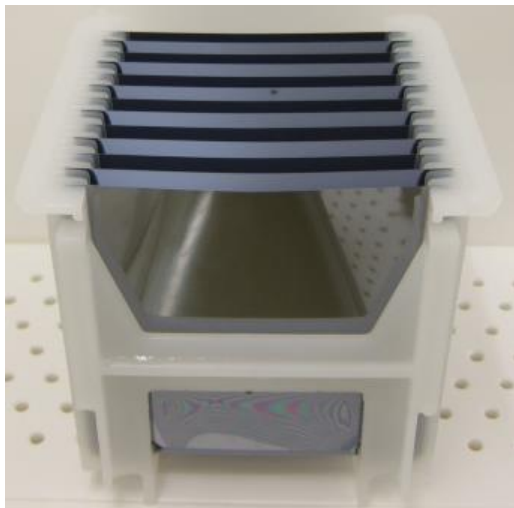
- **COSTS** dominated by the materials, where to reduce?
 - Crystalline Si: wafer costs,
 - *Go to thin wafers < 100 micron!!!*
 - Thin film PV: semiconductor + Indium
 - *Smart cell architectures (microconcentrator)*
 - *Light management*
 - OPV/Perovskite PV: encapsulation!!
 - *Intrinsic stable materials and device structures*
 - *Reduction of barrier layer requirements*



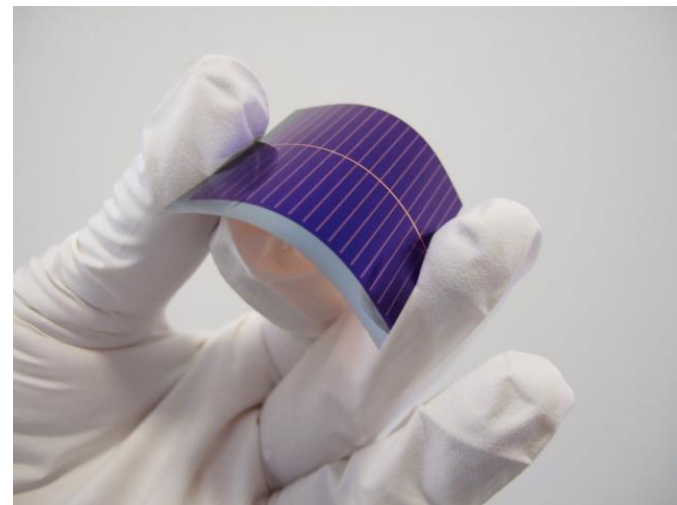
Crystalline Si research: wafer and cell production

Fabricate (ultra) thin Si kerf free wafers and cells on 40 – 80 μm

- By epitaxial growth
- Develop new technology bricks for ultra-thin wafers (40 μm)
- 17 % heterojunction cells achieved on 50 μm epi foils



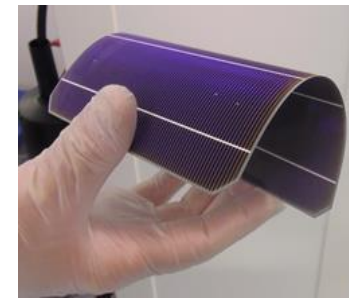
12.5 x 12.5 cm² 40 -50 μm epifoils



Heterojunction cells on 50 μm epifoil

Crystalline Si research: cell and module production

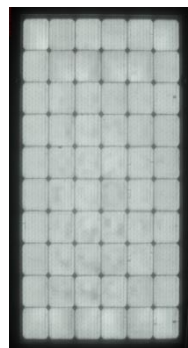
Develop/redesign industrially compatible **cell** and **module** processes for thin cells down to 80 μm and proof mechanical stability



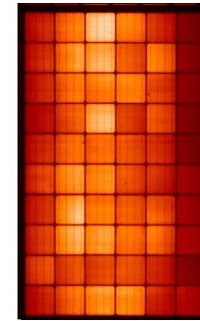
$\eta_{\text{max}} > 22 \%$

at $\sim 90 \mu\text{m}$

Heterojunction (HJ) cell production on industrial pilot line



$\text{CtM} < 1 \%$ loss



$P_{\text{max}} = 313 \text{ Wp}$
1 g Si/Wp

60 cells IBC thin cell module

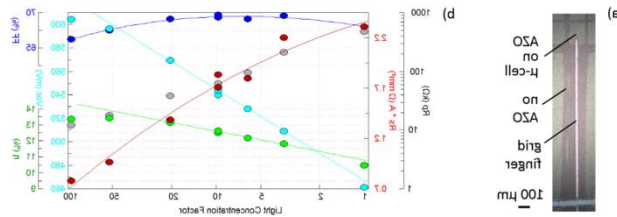
60 cells thin cell HJ module

Thin film PV material research strategy

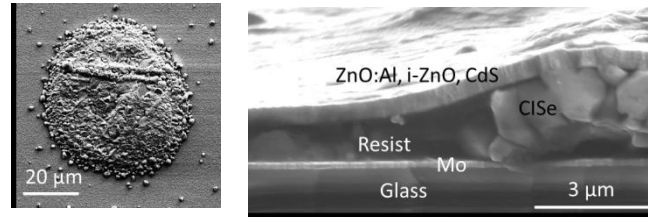
Example: micro concentrator approach for CIGS

- Restriction of absorber material
- Low and medium concentration of sunlight
- Proof of concepts have been demonstrated

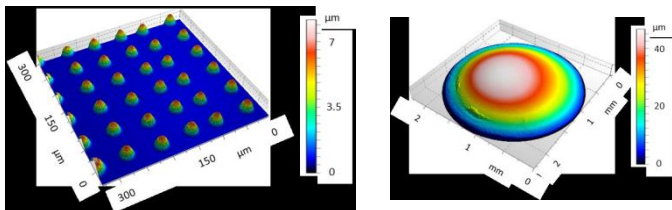
Top-down μ cells based on inkjet-printed CIGSSe



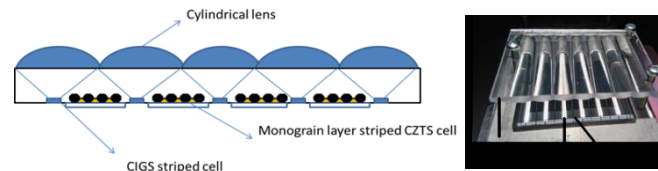
Bottom-up growth of CIGSe μ cells from In droplets



Inkjet-printed PMMA micro lenses



CIGSe-CZTS direct-diffuse micro concentrator

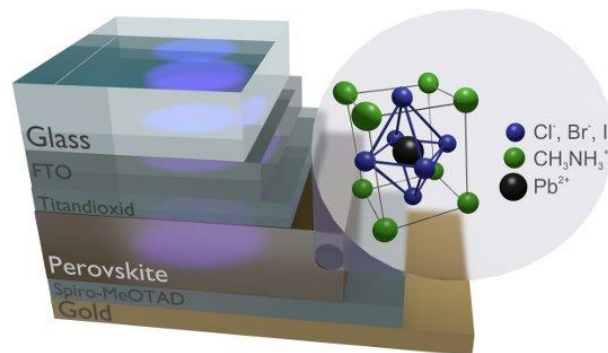


Organic/Hybrid PV materials research strategy

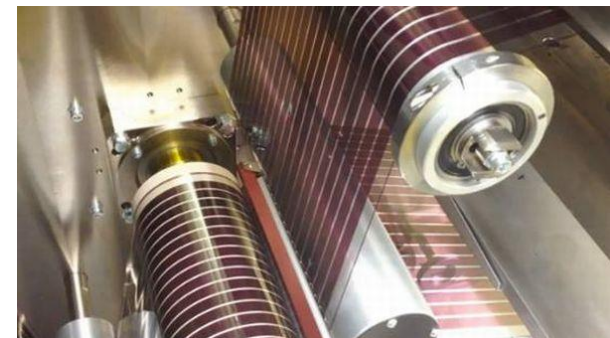
- *Intrinsic stable materials and device structures*
- *Reduction of barrier layer requirements* \Rightarrow *reduction of costs*



Screening organic materials on stability



Device design



R2R printing

**More detailed results on the
CHEETAH achievements
will be presented
in the parallel sessions
after the break!**

Summary

CHEETAH created the means to perform part of the EERA Joint Program on PV in a “formal” collaborative project

Coordination

Creation of tools like dynamic database, e-learning platform.....

Joint research

Focus on **Lower TRL, long-term research** to generate new innovations



**Thank you for your attention and I
wish you a very nice event!!**
