

*EC Grant Agreement n°609788*

# **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**

## **Deliverable**

**D4.2 – Workshop with external participants**

**WP4 – Dissemination, internal and external communication**



## Section 1 – Document Status

### Document information

Deliverable name	CHEETAH_D4.2_Workshop with external participants
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### Document validation

Name	Organisation	Date	Visa
Karsten Bittkau – WP4 leader	JUELICH	18/02/2016	OK
Jan Kroon - Coordinator	ECN	19/02/2016	OK

### Document history

Version	Date	Modifications	Name
01	12/02/2016	Creation	K. Bittkau
02	17/02/2016	Minor corrections	K. Bittkau and M. Bossard
Final	19/02/2016	Final validation	J. Kroon

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## Section 3 – Publishable summary

The Workshop “Advanced Characterization for PV” took place on January, 14<sup>th</sup> 2016 at Fraunhofer ISE in Freiburg Germany. Aim of the full-day workshop (10:30-17:30) was the dissemination of scientific infrastructure for advanced characterization which are available within the CHEETAH consortium. Three different sessions covered the fields of material characterization, solar cell characterization and characterization of PV modules and systems. In total, 14 contributions were presented from CHEETAH partners from 10 different countries. Contributions came from HZB, EMPA, UPM, Unimib, CEA INES, DTU, IMEC, NPL, Jülich, TECNALIA, JRC, AIT, ECN and CRES.

The scope of each contribution was a talk of 20 minutes including discussion. Additionally, the sessions were closed by a discussion panel on the certain characterization session. 52 participants attended the workshop on-side while 63 were following by video stream and could interactively ask questions.

The presentations during the workshop were recorded and will be made available for download on the CHEETAH webinar platform:

[http://www.cheetah-exchange.eu/webinars.asp?i=7&t=CHEETAH Workshop on Advanced Characterization for PV](http://www.cheetah-exchange.eu/webinars.asp?i=7&t=CHEETAH%20Workshop%20on%20Advanced%20Characterization%20for%20PV).

## Section 4 – Executive summary

### **Description of the deliverable content and purpose**

In order to disseminate the scientific results from the project to a wide audience, different events are planned within the scope of the CHEETAH project. One is the organization of scientific workshops with external participants. Those participants might come from other international scientific organizations but also participants from industry are of high importance. The speakers of such a workshop should be partners from the consortium. Two dissemination workshops are planned in the description of work, one at M24 and another one at M48.

### **Brief description of the state of the art and the innovation brought**

NA

## Section 5 – Deliverable report

### 1. Deliverable D4.2 Dissemination Workshop

#### 1.1. Organizational Background

The Workshop “Advanced Characterization for PV” took place at January, 14th 2016 at Fraunhofer ISE in Freiburg Germany. Aim of the full-day workshop (10 :30-17 :30, see 1.5) was the dissemination of scientific infrastructure for advanced characterization which are available within the CHEETAH consortium. Three different sessions covered the fields of material characterization, solar cell characterization and characterization of PV modules and systems.

#### 1.2. Contributions

In total, 14 contributions were presented from CHEETAH partners from 10 different countries. Contributing partners were:

- **HZB, Jülich** (D)
- **IMEC** (BE)
- **ECN** (NL)
- **Unimib** (I)
- **UPM, TECNALIA** (E)
- **NPL** (GB)
- **JRC** (BE,I)
- **CRES** (GR)
- **DTU** (DE)
- **AIT** (AU)
- **CEA INES** (F)

The scope of each contribution was a talk of 20 minutes including discussion. Additionally the sessions were closed by a discussion panel on the certain characterization session.

The organization of the workshop was headed by Forschungszentrum Jülich (coordination, program chair, event organization, email communication, catering) with support from EPIA (registration portal, promotion, work support), ENEA (live streaming of the event, video editing and website dissemination), ALMA (event promotion on website), and Fraunhofer ISE (IT support, organizational support).

### 1.3. Participation

In order to disseminate the scientific infrastructure of advanced characterization to a maximum of people, the workshop was promoted as one-day on-site event at the location of Fraunhofer ISE. Additionally, the event was promoted as online webinar 3 days before to increase its visibility. A detailed evaluation of the registered and participated people is given below:

	Number of registrants (reg.)	Number of participants (part.)	CHEETAH part. (reg.)	Non-CHEETAH part. (reg.)	Non-CHEETAH	
					Research part. (reg.)	Industry part.(reg.)
<b>On-site</b>	79	52	41 (53)	11 (26)	8 (19)	3 (7)
<b>Online</b>	75	63	19 (28)	44 (47)	34 (36)	10 (11)
<b>TOTAL</b>	154	115	60	55	42	13

### 1.4. Further exploitation

The presentations during the workshop were recorded and are available for download on the CHEETAH webinar platform: <http://www.cheetah-exchange.eu/webinars.asp>.

#### Agenda

Time	Title	Speakers
10:30	<p><b>X-ray based analysis of PV materials and components</b></p> <p>The use of x-ray based spectroscopy like x-ray photoemission, x-ray absorption and x-ray emission spectroscopy for the characterization of materials and components used in photovoltaic devices is described. The emphasis is on thin film materials like chalcopyrites, kesterites, perovskites and TCO. Examples will be given on the chemical analysis of surfaces and interfaces of these materials and on the determination of electronic properties like work functions and band offsets.</p> <p><b>Equipment :</b> X-ray emission spectroscopy (XES) ; x-ray photo electron spectroscopy (XPS),  <b>PV Technologies :</b> CIGSS- Copper indium gallium diselenide ; TFSi- Thin Film Silicon  <b>Tags :</b> x-ray based analysis</p>	<div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 5px;">  LAUERMANN Iver         </div> <div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 5px;">  Video presentation         </div> <div style="border: 1px solid #ccc; padding: 5px;">  Cissy_web_page         </div>
10:40	<p><b>Measurements under concentrated light</b></p>	<div style="border: 1px solid #ccc; padding: 5px;">  SCHMID Martina         </div>

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## CHEETAH WORKSHOP ON ADVANCED CHARACTERIZATION FOR PV



CHEETAH Advanced Characterization Workshop took place on 14<sup>th</sup> January 2016 at Fraunhofer ISE in Freiburg, Germany and got an overview of the existing top-class PV research infrastructures in Europe.

The workshop was dedicated to the elaborate exchange about scientific infrastructures for advanced characterization available within the CHEETAH consortium. Target has been: the dissemination of advanced characterization methods to project partners, in particular to further scientific and industrial groups. Available advanced characterization techniques were presented on material, cell and module/system level. Additional discussion time were dedicated to bring together experts of the certain fields and evaluate the potential of future cooperation.

### Please note the possibility of accessing infrastructures and training exchanges within the CHEETAH project and to industry









- 👉 Feel free to contact the speakers if you have questions or ideas for possible collaborations
- 👉 If you are interested in getting or sharing a deeper insight into the presented methods, [contact us](#) to propose which webinars could be interesting to be given or offered by you.
- 👉 For further questions/comment regarding CHEETAH infrastructures, in general, click [here](#) or refer to the specific section: [CHEETAH Infrastructures](#).
- 👉 For further info about mobility click here: [Mobility](#)

### Informations

Contacts & info for the workshop

**Andre Hoffmann**    [a.hoffmann@iz-juelich.de](mailto:a.hoffmann@iz-juelich.de)  
 CHEETAH event web page    [here](#)  
 Final Agenda    [here](#)

### Agenda

Time	Title	Speakers
10:30	X-ray based analysis of PV materials and components	 LAURMANN Jev
	<p>The use of X-ray based spectroscopy like X-ray photoelectron, X-ray absorption and X-ray emission spectroscopy for the characterization of materials and components used in photovoltaic devices is described. The emphasis is on thin film materials like chalcogenides, kesterites, perovskites and TCO. Examples will be given on the chemical analysis of surfaces and interfaces of these materials and on the determination of electronic properties like work functions and band offsets.</p> <p><b>Equipment:</b> X-ray emission spectroscopy (XES) ; X-ray photo electron spectroscopy (XPS)  <b>PV Technologies:</b> CIGSS, Copper indium gallium diselenide ; TPSS, Thin Film Silicon  <b>Tags:</b> X-ray based analysis</p>	
10:40	Measurements under concentrated light	 SCHREI Martina
10:50	EBIC & PL for thin film solar cell characterization	 BROSNO Benjamin
11:10	Characterization of intermediate band materials and solar cells	 DEL CARIZO Carlos
11:30	Photoluminescence and Raman spectroscopy for defect identification in Silicon, CIGS and CZTS thin films	 BINETTI Simona
11:50	Characterization of oxygen-related defects in high-efficiency Czochralski silicon wafers	 VEJDMAN Jiri
12:10	PV Material Discussion and Idea Generation Forum	
13:00	Characterization of organic solar cells: Mechanical, electrical and photovoltaic stability	 CORAZZA Michiel
	Advanced material and atomic characterization techniques for Silicon and thin film panels	



## 1.5. Program/Timetable

### Advanced Characterization Methods for PV

Freiburg, Fraunhofer ISE

Thursday, January 14th 2016

#### 10:30 Welcome & Introduction

#### Session I: Materials (10:30-12:10)

10:35 I. Lauerma, *HZB* (D), "X-ray based analysis of PV materials and components"

10:50 B. Bissig, *EMPA* (CH), "Electron beam induced current and time resolved photoluminescence technique for TF solar cell characterization"

11:10 C. del Cañizo, *UPM* (ES). "Characterization of intermediate band materials and solar cells"

11:30 S. Binetti, *Unimib* (I), "Photoluminescence and Raman spectroscopy for defect identification in Silicon, CIGS and CZTS thin films"

11:50 V. Jordi, *CEA INES* (F), "Characterization of oxygen-related defects in high-efficiency Czochralski silicon wafers"

#### Session II: Solar Cells & Modules (13:00-14:35)

13:00 M. Corazza, *DTU* (DE), "Characterization of organic solar cells: Mechanical, electrical and photovoltaic stability"

13:20 I. Gordon, *IMEC* (BE), "Advanced material and device characterization techniques for Silicon and thin-film based photovoltaics"

13:40 F. Castro, *NPL* (GB), "Identification of degradation and manufacturing issues using multi-parameter mapping of organic solar cells"

14:00 K. Bittkau, *FZ Juelich* (D), "Electro-optical Characterization of Thin-film Solar Cells and Modules: From nanophotonic cell characterization to macroscopic module characterization"

#### 14:20 Solar Cell Discussion

#### Session III: Modules & Systems (15:10-17:30)

15:10 M. Machado, *Tecnalia* (ES), "Analytical prediction of photovoltaic modules efficiency for different encapsulation schemes"

15:30 N. Talyor, *EC Joint Research Center* (BE), "Precision PV Performance Assessment at the JRC's European Solar Test Installation"

15:50 M. Rennhofer, *Austrian Institute of Technology AIT* (AU), "Degradation and electric behavior in thin film photovoltaic devices"

16:10 J. Kroon, *ECN* (NL), "Accurate yearly yield calculation using PV module fingerprint method applied for MWT, H-pattern and thin film modules"

16:30 G. Halabalakis, *CRES* (GR), "CRES's labs for PV system characterization and analysis"

#### 16:40 Solar Systems Discussion and Idea Generation Forum

