Project SOPHIA

PhotoVoltaic European Research Infrastructure

GA N° 262533

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NA03: Interoperability benchmarking, definition of test procedures, common database

D3.1 – Organisation of networking events on at least three selected topics (M36)

Document Information

Document Name	**SOPHIA_D3.1_M36.doc**
Revision	Final | ~~Draft~~
Due date Annex I	M36
Author	Jan Kroon, ECN
Dissemination Level	Public | ~~Restricted~~ | ~~Confidential~~

Document approval

Name	Position in the project	Beneficiary	Date	Visa
Philippe Malbranche	Coordinator	CEA-INES	31/03/2014	PM

Document history

Revision	Date	Modification	Author
V0	10 02 2014	First version	J.M. Kroon
V1	12 02 2014	Second version	L. Kropp
V2	13 02 2014	Third version REVISED	J.M. Kroon
V3	26 03 2014	Fourth version	J.M. Kroon
V4	30 03 2014	Check	F Bergeron
V5	31 03 2014	Final check	P Malbranche

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1. Executive summary

1.1 Description of the deliverable content and purpose

The objective of this deliverable is to report about seven workshops that took place within the framework of the SOPHIA project in the third year (M25-M36, February 2012 to January 2013). The workshops and networking activities bring together the expert groups within SOPHIA.

Workshops are one of the key elements to form a fruitful research infrastructure because working together will boost idea generation and knowledge exchange, and avoid the useless replication of a large number of small efforts.

1.2 Deviation from objectives, corrective action

N/A

1.3 Technical progress

The amount of workshops in year 3 increased considerably compared to year 2 and is in line with the increased visibility and effectiveness of the expert groups. The commitment in the DoW was to organise events on at least three selected topics. It appears now that workshops are organised in almost all the SOPHIA topics.

1.4 Impact of the results

Most workshops are open for researchers from all across the EU, to allow discussions and idea exchange with people from research institutes and industry in- and outside the SOPHIA consortium.

1.5 Dissemination activities carried out, planned

The workshops are dissemination activities by themselves. Some of the results presented during these workshops have been disseminated via written publications in proceedings and peer reviewed magazines as reported under NA05.

2. Workshops in the M25-M36 period

The following Table 1 lists all networking seminars and workshops that have been organised in the first three years of the SOPHIA project. The main characteristics of the workshops and their connection to the Technical Topics in NA02 are given.

In the M25-M36 period, seven workshops have been organized and are described in more detail in the next sub-sections.

Table 1. Overview of workshops and seminars organized in the first three years of the SOPHIA project. NA = networking activities expert groups : 2.1 Si Material ; 2.2 Organic material ; 2.3 Thin Film Technology ; 2.4 Concentrated PV ; 2.5 Cell modelling ; 2.6 Lifetime prediction ; 2.7 Module and system performance ; 2.8 BIPV .

Workshop	NA	When	Organisation by	Number of participants
Testing Organic Photovoltaics	2.2	November 8-9, 2011	ENEA, Franco Roca Riso, Peter Sommer-Larsen	34
Innovative Thin Film Device Structures	2.3	October 10-11, 2011	HZB, Iver Lauermann FZJ, Jürgen Hüpkes	27
PV Modelling infrastructures	2.5	October 12, 2011	FZJ, Jürgen Hüpkes	27
PV –Module Reliability	2.6	April 5-6, 2011	ISE, Michael Köhl	110
MWT workshop	2.6	November 10, 2011	ISE, Florian Clement ECN, Ian Bennett	120
PV- Module Reliability Workshop	2.6	May 3-4, 2012	ISE, Michael Kohl	118
MWT Workshop	2.6 2.9	November 20-21, 2012	ECN, Maarten de Bruijne, Ian Bennett ISE, Florian Clement	174
European Workshop on PV performance modelling	2.5 2.7	February 21-22, 2013	INES, Jens Merten	45
PV- Module Reliability Workshop	2.6	June 6-7, 2013	ISE, Michael Kohl	97
Spins as functional probes in SE research	2.1 2.3	April 10-12, 2013	HZB, Iver Lauermann	56
Workshop BIPV	2.8	29-20 August, 2013	CEA-INES, Brigitt Ya-Assoa	43
Workshop on Silicon Materials	2.1	6-7 October, 2013	ECN, Giunluca Coletti	75
Euroregional Workshop " Characterisation and modelling of Si-based thin film solar cells "	2.5	September 16-19, 2013	FZJ, Jurgen Huepkes/Yael Augarten	18
Workshop "Materials and processes for encapsulation of OPV devices"	2.2	December 10-12, 2013	CEA/INES, Stephane Cros	70

2.1 1st European Workshop On PV Performance Modelling

CEA-INES organized the 1st European Workshop on PV performance modelling. It was held at INES during two days on 21 and 22 of February 2013. The aim of this workshop was to coordinate modeling activities and exchange views on this subject. The main part of the participants came from JRA2 and JRA4 of the SOPHIA project. 45 participants from 15 nations were present at this workshop.

The workshop had three parallel sessions on physical modeling, empirical performance modeling, and on building integration aspects.

Some presentations in the plenary session have been invited in order to link the modeling activities with the needs of the PV industry:

- Werner Knaupp, PV-PLAN, Industrial interests and requirements in PV module performance modeling:
  - Werner Knaupp is founder of PV-plan, Engineering Office for Photovoltaic Planning - Consulting - Expert Assessment
  - He is active in several standardisation committees
  - He gave a comprehensive view on the requirements of system installers on module performance modelling
- André Mermoud, PVSYST, PV module model: requirements for use in simulations using a wide database:
  - André Mermoud developed PVSYST and is founder of the PVSYS company
  - He detailed the modelling strategy of the commercial PVSYST modelling software
- Gabi Friesen, SUPSI, Evaluation of PV module energy prediction models within the project Performance:
  - Gabi Friesen coordinated PV performance modelling activities in the “PV Performance” project
  - She informed the audience on the benchmarking of the performance models realised in the PV-Performance project

A visit at INES facilities was organised to close the workshop.

The output of this workshop will be used by the participants to further develop their models, which will be evaluated in the SOPHIA project.

In a second workshop to be held in 2014, these results will be discussed and made visible for interested parties from research and industry.

2.2 PV-Module Reliability Workshop 2013

For the third time, the Fraunhofer Institute for Solar Energy Systems (ISE) organized a workshop on the subject 'PV-Module Reliability' in cooperation with CEA-INES. The workshop took place in Chambéry (France) on the 6th and 7th of June, 2013 and hosted 97 guests from international research institutes and industrial companies. 97 participants from 14 countries met in Chambéry to discuss the topics PID (potential-induced degradation), FMEA (categorization of failure modes), accelerated weathering tests, corrosion processes in PV modules and the demands of investors, banks and insurance companies. Introductory lectures held by experts from renowned international institutes provided a basis for fruitful discussions in small groups. Afterwards, the lecturers and the discussion group leaders educed important research subjects for further work from each specific discussion topic, which were presented in the plenum in the concluding discussion.

2.3 Workshop Spins as Functional Probes in Solar Energy Research

Recent years witnessed the advent of dedicated electron paramagnetic resonance (EPR) and electrically detected magnetic resonance (EDMR) methods to solve open questions related to defect states in silicon solar cells. These methods are now available to the PV community via Sophia, the European PV characterization network. Within the discussion meeting "Spins as Functional Probes in Solar Energy Research" recent advances in EPR for solar energy research were presented. The meeting was organized by HZB and took place in HZB's Institute of Silicon Photovoltaics from April 10th till 12th. 56 international scientists attended the meeting.

Topics of the meeting:

- Light induced and stable defects in non-crystalline silicon solar cells
- Paramagnetic defects at functional interfaces
- Trans National Access (TNA) and joint research for PV research within Sophia
- Paramagnetic states in novel solar energy materials
  - Modelling and simulation of EPR data
  - Advanced and indirect EPR detection for material and energy research

2.4 BIPV workshop

The workshop took place at CEA-INES site from 29th to 30th of August 2013. 43 participants have attended this event, coming from France, Italy, Germany, Australia, Austria and Spain. The participants were composed of research engineers and technicians, architects, industrials, installers and associations (See http://www.sophia-ri.eu).

On the first day, through the presentations, participants have defined a list of requirements concerning solar photovoltaics in buildings. Thus, the requirements of BIPV systems come from different actors (architects, engineers, construction companies and workers, building users and operators and building authorities). They are related to quality standards (mechanics, electrical safety, waterproofness, mechanical strengthening…). Many deviations exist between the PV world and the construction world. The main solution proposed during the discussion is to harmonize BIPV requirements in each country considering standards and products design.

On the second day, the technical presentations showed the urgent need for improvement since the topics of the first projects on BIPV system (from nearly 20 years ago) are still relevant. The existing software and general equations, the usual time steps are not always suitable for BIPV systems. There is a necessity for harmonization of testing and analysis (in IEC standards) methods.

Thus, training sessions should be organized in order to diffuse results and information through common channels of communication and according to the audience. Some actions were proposed in order to improve BIPV and BAPV systems current situation.

2.5 Workshop "Challenges on Silicon Materials for Photovoltaics

Background and motivation

The idea of the Si Materials workshops is to target a specific topic in the area of silicon materials for photovoltaic applications. The first workshop, organized in 2008, focused on solar-grade feedstock specifications. At that time the poly-silicon shortage bring up again the definition of solar grade silicon and its specifications. After 5 years, the global situation of photovoltaic and economic have changed considerably. Initially triggered by the shortage of feedstock and by the need of clear understanding of the limitation factors, in the past years research on silicon materials proliferated. However due to the rapid change in the economic and market situations, the alignment between the shorter term industrial needs and longer time horizon research results is not always possible. Therefore the aim of the 2nd Silicon Materials workshop was to discuss about industrial needs versus research effort and to sketch a roadmap for the Si material challenges for the next period.

The workshop was organized in close cooperation between ECN, Imec, INES, Sintef, Fraunhofer-ISE, ENEA and the University of Rome. ECN was the lead coordinator with Gianluca Coletti as workshop chairman and took place in Rome on October 7th and 8th 2013.

Online survey

In preparation for the workshop discussion, the organizing committee found useful to carry out a survey to sketch a roadmap for Si material that can be discussed during the workshop.

The survey was open to everyone with the idea to collect opinions from a large number of experts. The results of the survey were presented at the workshop to identify the most debated topic which would then be the focus of the workshop discussion session. The entire survey will be publically accessed. A summary of the discussion will be disseminated in an editorial to be published in the journal Solar Energy Materials and Solar Cells.

Program

The workshop program was divided into five sessions:

1. Status and future prospects for Si Materials
2. Material requirements
3. Towards Si materials roadmap - Workshop
4. Characterization and control technique
5. Challenges for p-type wafers
6. Challenges for n-type wafers

Main conclusions (short)

During the workshop several discussions were held on the “Challenges for Si materials” question. The discussion focused on the interpretation of the results of the online survey and of the outstanding contributions of the presenting authors and audience during the wrap up sessions.

One of the most debated point was on which technologies would enable dramatic cost reduction. There is general agreement that a technology cannot be properly evaluated without looking at the overall value chain contest in which operate. Therefore any alternative technology should be evaluated within a certain scenario for wafer, cell and module production together. Few scenarios were proposed. It is within a scenario that a technology can and should be evaluated.

Agreements were found on the major challenges for p- and n-type ingots and for the characterization techniques. Also on the front of material requirements the focus is on minority carrier lifetime and resistivity range for high efficiency device. It was also discussed if low cost Si feedstock and high efficiency cell concepts are compatible. In this topic there was not a unilateral agreement. It was largely agreed that high efficiency is now a key issue especially for a roadmap towards cost reduction. N-type is addressed as the most appropriate material however some p-type based cell concept can also achieve high efficiencies and cannot be discarded too quickly.

On the crystallization front, few innovative techniques for multicrystalline ingot manufacturing have been presented. Major challenges here are the dislocation density and their reduction. High performance multi (HPM) is being already largely implemented in industry for manufacturing p-type mc-Si ingots. Other crystallization techniques mentioned were dendritic growth and electromagnetic casting furnaces. Cast mono ingots have large potentiality still to be disclosed. Currently, because dislocation and lifetime issues, they have difficulties to reach low cost in short term and are more or less replaced by HPM in industry which already reached higher efficiency and cost effectiveness.

On the monocrystalline front, the advantages of continuous Cz (CCz) with small resistivity and oxygen variation have been presented. The main challenge is to define the lifetime requirements for the cell process in order to determine the number and length of the ingots per run. Oxygen and striations are one of the major factor limiting cell performance and yield in n-type silicon, despite more research is still needed here it has been shown how to mitigate the effect of striations.

In total, 75 participants attended the workshop.

Dissemination

A special edition of Solar Energy and Solar Materials published by ELSEVIER will be dedicated to this workshop. 17 contributions were invited to submit a contribution to the journal. A summary of the workshop conclusions and the survey will be reported in the editorial as well.

2.6 Euroregional Workshop " Characterisation and modelling of Si-based thin film solar cells ", Monschau, Germany

The Euro-Regional workshop on the characterisation and modelling of Si-based thin film solar cells was organised by Forschungszentrum Juelich, and took place in Monschau, Germany, from 16th - 19th September 2013. It was the first time this workshop had been held and it attracted 17 participants from 7 institutes (Juelich FZJ, HZB / PVComB, TU Berlin, PV lab IMT Neuchatel, TU Eindhoven / Universiteit Utrecht, TU Delft, University of Ljubljana, Slovenia) in 4 countries (Germany, Netherlands, Slovenia and Switzerland). Institutes both within and outside of the Sophia consortium attended. The workshop opened with an introductory talk about the Sophia project in general, which then focused on the JRA 4 topic (modelling infrastructure). Several participants from institutes not currently involved with the Sophia project expressed interest in contributing to the modelling chain. Experimental characterisation facilities available at several institutes were presented and described. The majority of the talks focused on simulation, some introducing new models and methods, with a range of subjects including improvements in light trapping and power matching, modelling of AFM measurements, indoor and outdoor electro- and photoluminescence, and

local defects. The workshop was informative, and a number of the talks led to early discussions about possible collaborations.

2.7 Workshop "Materials and processes for encapsulation of OPV devices", Chambery, France

On December 11th 2013, a workshop was organized within the framework of the International Summit on Organic Photovoltaic Stability (ISOS-6) by CEA-INES. The workshop was dedicated to the topic of barrier materials and encapsulation processes of flexible solar cells. The audience was the participants of the conference (approximately 70 people) that included scientists, industry and members of organisations for international standards. The aim of the workshop was to share the current developments within the topic of barrier materials and processing on flexible solar cells and to create a ground for the upcoming JRA3.2 activities related to characterization of materials and devices with and without flexible encapsulation to be executed in M37-M42 (more details will be provided in the reports of JRA3.2 activities).

3. Upcoming workshops

Four workshops are under preparation so far for the upcoming year :

3.1 Workshop on metastabilities of thin film solar cells and modules.

This workshop will be organized by HZB and Loughborough University after completion of the thin film round robin (JRA 2, Sub-Task 3).

- Targeted audience: Scientists from within and outside SOPHIA from the field of thin film PV.
- Goal: discussion of results obtained during round robin, draft of a measurement protocol for thin film modules including pre-treatments.

3.2 PV module reliability workshop 2014

The 2014 SOPHIA-workshop 'PV-Module Reliability', organized by Fraunhofer ISE and JRC in Freiburg (Germany) on June 3rd to June 4th 2014, is dedicated to topics related to the development of Accelerated Life Tests (ALT). The first focal point will highlight various aspects of the weathering and degradation of PV-modules in operation in order to create a base for realistic severity levels for ALT. The following blocks will report recent results from accelerated stress testing for module components and commercially available modules considering and combining different degradation factors like temperature, humidity, high voltage, UV and appropriate methods for data evaluation and modeling of degradation over time, acceleration and service life estimation. The next talks present the ongoing work in the

IEC TC82 WG2 regarding updating standards and creating new-ones. The research work actually covered by the Quality Assurance Forum, particularly with regards to production issues, UV-weathering and other stress factors and the results from other national and international research projects is the base for the elaboration of research needs for the development of ALT procedures. Highly sensitive analytical tools are needed for the comparison of the results of accelerated tests with outdoor exposure testing after relatively short exposure times. Some helpful tools will be discussed from a practical point of view. Registration for the workshop will open soon.

3.3 2nd European workshop on modelling module performance

This workshop will be a follow up of the first workshop as described under 2.1. Details will follow later.

3.4 2nd workshop on bifacial modules

This workshop will be organized on the 26th and 27th of May in Chambery and will be partly supported by SOPHIA. The goal of the workshop is to review all existing technologies on the market but also to start to set standards and to identify the market potential of bifacial modules.

4. Conclusions

Seven workshops took place during the third year of the SOPHIA project. These workshops were closely connected to almost all of the technical topics within SOPHIA BIPV, Lifetime prediction, Module and System Performance, Modelling, Silicon Materials and OPV. This was a considerable increase compared to the second year.

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D3.1 – Organisation of networking events on at least three selected topics (M24)

Document Information

Document Name	**SOPHIA_D3.1_M24.doc**
Revision	~~Final~~ | Draft
Due date Annex I	M24
Author	Maarten de Bruijne
Dissemination Level	Public | ~~Restricted~~ | ~~Confidential~~

Document approval

Name	Position in the project	Beneficiary	Date	Visa
Philippe Malbranche	Coordinator	CEA	28/02/2013	PM

Document history

Revision	Date	Modification	Author
V0	11/02/2012	First version	Maarten de Bruijne
V1	19/02/2012	Input Iver Lauermann, Eric Gerritsen, Ya-Brigitte Assoa, Barbara Werner, Ian Bennett, Gianluca Coletti	Maarten de Bruijne
V2	26/02/2012	Final	Maarten de Bruijne

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1. Introduction

The objective of this deliverable is to report about workshop activities that took place within the framework of the SOPHIA project in the second year (M13-M24, February 2012 to January 2013). The workshops in the first year have been reported in an earlier deliverable (D3.1_workshops_M12).

The workshops and networking activities bring together the expert groups within SOPHIA. Most workshops are open for researchers from all across the EU, to allow discussions and idea exchange with people from research institutes and industry in- and outside the SOPHIA consortium. Workshops are one of the key elements to form a fruitful research infrastructure because working together will boost idea generation and knowledge exchange, and avoid the useless replication of a large number of small efforts.

The following table lists all networking seminars and workshops that have been organised in the first two years of the SOPHIA project. The main characteristics of the workshops, and their connection to the Technical Topics in NA02 are given:

Workshop	NA	When	Organisation by	Number of participants
Testing Organic Photovoltaics	2.2	November 8-9, 2011	ENEA, Franco Roca Riso, Peter Sommer-Larsen	34
Innovative Thin Film Device Structures	2.3	October 10-11, 2011	HZB, Iver Lauermann FZJ, Jürgen Hüpkes	27
PV Modelling infrastructures	2.5	October 12, 2011	FZJ, Jürgen Hüpkes	27
PV –Module Reliability	2.6	April 5-6, 2011	ISE, Michael Köhl	110
MWT workshop	2.6	November 10, 2011	ISE, Florian Clement ECN, Ian Bennett	120
PV- Module Reliability Workshop	2.6	May 3-4, 2012	ISE, Michael Kohl	118
MWT Workshop	2.6 2.9	November 20-21, 2012	ECN, Maarten de Bruijne, Ian Bennett ISE, Florian Clement	174

Table 1 Overview of workshops and seminars organised in the first two years of the SOPHIA project. NA = networking activities expert groups : 2.1 Si Material ; 2.2 Organic material ; 2.3 Thin Film Technology ; 2.4 Concentrated PV ; 2.5 Cell modelling ; 2.6 Lifetime prediction ; 2.7 Module and system performance ; 2.8 BIPV .

Chapter 2 reports on the workshops that took place in the second year. An outlook of workshops that have been planned for the third year of SOPHIA is given in Chapter 3.

2. Workshops in the M13-M24 period

1.1. PV-Module Reliability Workshop 2012

Due to the success of the first Workshop on PV-Module Reliability, Fraunhofer ISE decided to organize another workshop in Lugano (Switzerland) as part of the 30th anniversary of the PV activities at SUPSI. The workshop took place on May 3 and 4, 2012 in Lugano and was devoted to the complex key topic of the growing importance of reliability and efficiency of PV modules. The Fraunhofer Institute for Solar Energy Systems ISE and the ISAAC Supsi invited the international public involved in the field of photovoltaics to discuss the current state of the art and to attempt to integrate existing industry requirements into the durability of modules in research and testing practices. 118 participants attended the workshop.

1.2. MWT Workshop 2012

ECN organized the MWT Workshop 2012 together with Fraunhofer-ISE. This year, the MWT Workshop was held in Amsterdam on 20-21 November and attracted 174 participants. 74% of the participants represented industry (equipment builders, materials suppliers, module manufacturers, etc), which considerably increased the visibility of the SOPHIA project in the PV community. European research institutes from the SOPHIA consortium (CEA-INES, Fraunhofer-ISE, ECN, imec, and Tecnalia) and outside (ISFH, ISC Konstanz) participated. The workshop provided an overview of the current status and latest developments in metal wrap through (MWT) solar cell and module technology. To widen the scope and draw parallels between innovative module technologies, one session was dedicated to other types of rear contact technologies (eg IBC). The central theme of this year's workshop was *lab2fab*: making MWT cell and module technology viable. This theme directly connects to NA2.9 (Research infrastructure to scale up lab-scale pilots) and JRA1/NA2.6 (Module reliability aspects). Presentations and discussion on the scaling up of lab-scale pilots at institutes to industrial pilot- and production lines triggered interesting points of view from different perspectives. Institutes tend to choose strategic partners (eg. equipment manufacturers) to scale up beyond the lab, or deliberately stick to existing processes as a basis for a new technology (eg. the ZEBRA technogy of ISC Konstanz). Module manufacturers and equipment builders, given the current economic tide, hesitate to invest in a new technology as long as the business case is not rock-solid, and competitors did not yet make a move. Manufacturers expressed that they like to see multiple equipment suppliers in a field before they adopt new technology, in order to reduce their risk and dependence. Materials suppliers see pilot lines at institutes as a platform for (joint) development, at a stage where module manufacturers might not yet be involved. Several stakeholders stressed the importance of development of characterization methods, standards and apparatus, to be able to assess and compare the performance of new technologies.

The module reliability aspects that were discussed include: reverse current characteristics of back contact modules, innovative materials like new encapsulants and conductive adhesives,

and the comparison between interconnection approaches based on tabs or conductive foils. Interestingly, SunPower showed that innovation can lead to improved module reliability in terms of climate chamber tests and reverse current performance. Back contact technology inherently has a different module structure, and may display different failure mechanisms than standard module performance. These changes may require development of new or adaptation of existing lifetime tests, characterization methods and test equipment.

3. Upcoming workshops

3.1. 1st European Workshop On PV Performance Modelling

The 1st European Workshop on PV performance modeling will be organized by CEA-INES on 21-22 February 2013 at INES, Chambéry, France. The workshop has an opening session with speakers from industry: Werner Knaupp (founder of PVplan) and André Mermoud (founder of the PVsyst company). Then, three parallel sessions will cover: Modelling the technology chain (JRA4), Performance models for PV modules (JRA2), and BIPV (JRA2.6). The key results for these three topics will be discussed in plenary wrap up sessions on day two.

3.2. PV-Module Reliability Workshop 2013

The 2013 SOPHIA-workshop 'PV-Module Reliability', organized by Fraunhofer ISE and CEA INES in Chambery (France) on June 6th to 7th, 2013, is dedicated to three up-to-date topics.

First point of attention will be the so called bankability of components for solar systems, especially PV-modules. The asset rating of PV-systems and their reliability need to be assessed considering alternating energy availabilities and a changing demand. Are PV-modules and systems reliable investments? How can we estimate and manage the reliability and risks of PV-systems? And which technical issues are relevant for investors?

In a second step, we will be approaching the subject of modelling, with emphasis to the field of metallic corrosion: How can we create models to generate data for a reliability analysis and prediction? Furthermore, we will glance into the methods of other industries (like microelectronics, automotice and aeronautics) : How do they handle the degradation and ageing mechanisms of metallic components? Also, how can we model and rate stress factors for PV-modules?

On the basis of the models that we will discover during the Workshop, we will – in a third step – raise the question of analytical methods with a special emphasis on metals: Which are adequate ways to analyse degradation of cell metallisation and connectors? How reliable are new methods like lead-free soldering and alternative interconnect technologies based on conductive adhesives ?

3.3. Workshop Spins as Functional Probes in Solar Energy Research

The workshop Spins as Functional Probes in Solar Energy Research is planned for 10.04 - 12.04.2013 in Berlin, Germany.

In 2008, the German network *EPR-Solar* was formed with the aim to exploit advanced EPR and EDMR methods to solve open questions related to defect states in silicon solar cells and develop novel EPR methods, dedicated to the needs of solar energy research. These methods are now available to the PV community via SOPHIA, the European PV characterization network. After 5 years of successful research, the funding period of EPR-Solar terminated by the end of 2012. With the discussion meeting "Spins as Functional Probes in Solar Energy Research" we would like to reflect on recent advances in EPR for solar energy research achieved within and outside the network and discuss future perspectives and demands in the field.

Topics:

- Light induced and stable defects in non-crystalline silicon solar cells
- Paramagnetic defects at functional interfaces
- Trans National Access (TNA) and joint research for PV research within Sophia
- Paramagnetic states in novel solar energy materials
- Modeling and simulation of EPR data
- Advanced and indirect EPR detection for material and energy research

3.4. BIPV workshop

Organisation of some workshops and training sessions about BIPV have been proposed within the JRA2.7 expert group as next activities for years 3 and 4. Potential topics are BIPV system performance measurement and modelling. A first workshop could be organized from 29th and 30th August 2013 during the IBPSA World conference in Chambery. Further discussions will permit to validate this proposal.

3.5. Workshop on Silicon Materials for Photovoltaics

ECN is organising a workshop on Silicon materials for photovoltaics in Autumn 2013, in close cooperation with Fraunhofer-ISE. The main topic will be the new challenges for feedstock, ingots and wafers in the current market situation, and how research meets the industry needs. The workshop structure and content will be discussed with the JRA3.1 partners in the next (Feb 27) telcon.

4. Conclusions

Two big workshops have been organised in the second year of the SOPHIA project, both predominantly connected to the Module reliability topic. It is expected that in the third year, as results from the JRAs become available, more workshops will be organised related to other Technical Topics as well (eg. BIPV, Module and System Performance, Modelling, Silicon Materials).

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Document Information

Document Name	**SOPHIA_D3.1.doc**
Revision	Final | ~~Draft~~
Due date Annex I	M12
Author	Michael Köhl
Dissemination Level	Public | ~~Restricted~~ | ~~Confidential~~

Document approval

Name	Position in the project	Beneficiary	Date	Visa
Philippe Malbranche	Coordinator	CEA	02/03/2012	PM

Document history

Revision	Date	Modification	Author
V0	28/02/2012	Creation	Michael Köhl

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1. SOPHIA workshops in 2011

1.1. Introduction

The objective of this deliverable is to report about workshop activities that took place within the framework of the SOPHIA project. The organisation of workshops and networking activities helps to bring expertise together. Researchers from all across the EU are invited to meet each other and to discuss subjects of their interest with other researchers in the same field. In addition, it becomes more apparent who is doing what, which is often the basis for the definition of new projects. Workshops are one of the key elements to form research infrastructures because working together will avoid the useless replication of a large number of small efforts.

In 2011 a number of networking seminars and workshops have been organised. Following the structure of the networking activities in work package 2, they can be subdivided as:

Workshop	NA	When	Organisation by	Number of participants
Testing Organic Photovoltaics	2.2	November 8-9, 2011	ENEA, Franco Roca Riso, Peter Sommer-Larsen	34
Innovative Thin Film Device Structures	2.3	October 10-11, 2011	HZB, Iver Lauermann FZJ, Jürgen Hüpkes	27
PV Modelling infrastructures	2.5	October 12, 2011	FZJ, Jürgen Hüpkes	27
PV –Module Reliability	2.6	April 5-6, 2011	ISE, Michael Köhl	110
MWT workshop	2.6	November 10, 2011	ISE, Florian Clement ECN, Ian Bennett	120
Module and System performance	2.7	See 2.5 - Modelling	FZJ, Jürgen Hüpkes	27

1.1. Workshop on testing of Organic Photovoltaics

The workshop took place on November 8-9, 2011 on the premises of ENEA in Portici (Napoli), Italy with a total of 34 participants. It was organised by Franco Roca from ENEA and Peter Sommer-Larsen from Risø-DTU Energy Conversion.

An overview of OPV technology development was presented by looking at materials, encapsulation of OPV devices, processing of OPV devices and stability issues. The workshop strongly focused on measurement procedures of OPV devices. Also, a round robin was initiated with the ambition to obtain more uniform measurement results in the field. Each lab gets to measure both devices at their early lifetime and devices that have been subjected to testing at different laboratories. SOPHIA partners that take part in this round robin are ISE, JRC, IMEC, CEA-INES, TECHNALIA, Risø, HZB, ECN, and ENEA.

The second day was focused on the test scheme for OPV performance and lifetime. This activity is related to NA2.2 and JRA3.

1.2. Innovative Thin Film Device Structures

The workshop took place on October 10-11, 2011 on the premises of Helmholtz-Zentrum Berlin für Materialien und Energie (HZB) in Berlin, Germany with a total of 27 participants from 20 different institutions and companies. It was organised by Volker Hinrichs and Iver Lauermann from HZB and Jürgen Hüpkes from FZ Jülich.

The workshop was split into three sessions. The first session was devoted to keynote talks on state-of-the-art developments in thin-film PV, with a focus on the strengths and limitations. The second session required an active role of all participants. A brainstorming session and parallel working groups were formed, where new ideas on the improvement of current thin-film devices and possible new concepts in thin-film PV were discussed. These ideas were then worked out in more detail during the third session on the second day. These ideas have been written down into five pre-proposals. Funding to execute these projects is aimed for through the WP2013 program within FP7 of the European Commission. These proposals cover the areas of encapsulation, light management, low- cost processing, multifunctional materials, and new materials. They were submitted to the EC as part of a larger package of proposals from EERA-PV in October 2011.

The second half of day 2 of the workshop was devoted to an expert meeting of NA2.3– Thin film PV cells.

1.3. PV modelling infrastructures

The workshop took place on October 12, 2011 on the premises of Helmholtz-Zentrum Berlin für Materialien und Energie (HZB) in Berlin, Germany with a total of 27 participants. It was organised by Jürgen Hüpkes from FZJ.

The workshop has its primary focus to structure JRA04, but the workshop was open to researchers outside the SOPHIA consortium. Therefore, the scope of this workshop was not only to investigate cell modelling methods, but also to look at modules and systems. Therefore, a link towards NA2.6 and JRA02 was established.

1.4. PV –Module Reliability workshop

The workshop took place on April 5-6, 2011 on the premises of the Humboldt-University Berlin, Germany with a total of 110 participants. It was organised by Michael Köhl from Fraunhofer-ISE.

This workshop focused on module reliability. Lifetime prediction methods were discussed in a larger forum. During this 2-day workshop, a detailed overview of the state-of-the-art of reliability assessment for PV-modules was presented and discussed openly with all participants. This topic was approached from different angles by discussing the needs of different stakeholders, i.e., material suppliers, module manufacturers, installers and investors.

Evaluation of actions needed for further development of methods for test, analysis and simulation the PV-module reliability was further discussed with a smaller expert group within the framework of JRA01 and NA2.6.

1.5. MWT Workshop

The workshop took place on November 10, 2011 on the premises of Fraunhofer-ISE, Freiburg, Germany with a total of 120 participants. It was organised by Florian Clement from ISE and Ian Bennett from ECN.

The workshop covered the latest technology developments in the field of MWT solar cells and modules. A strong focus was related to the reliability challenges of such a new technology and the subsequent industrialisation. Therefore, this workshop has links to JRA01.

2. Planned workshops for 2012

ECN is planning to do a workshop on "Silicon feedstock for n-type solar cells" in 2012.

Fraunhofer ISE and SUPSI organize a SOPHIA Workshop PV-Module Reliability in Lugano/ Switzerland as part of the 30th anniversary of the PV activities at SUPSI. The SOPHIA workshop should serve as a European option for the discussion of the main topics of durability testing in order to take into account the big experience with production and operation of PV modules in Europe for the IEC-TC82 WG2 meeting in the week from May 7th to 11th, 2012.

ESTI is planning to do a workshop on "PV Power measurement" in November 2012. This is a follow-up to the event held in 2009 as part of the FP6 IP PERFORMANCE project and will also mark the opening of the completely modernised ESTI indoor testing facilities. The format will be combine expert presentations with interactive sessions and aims at providing a state-of-the-art on PV calibration procedures.

RSE is organising a solar irradiation measurement comparison in the week 11-15 June, to be hosted at ENEL's site in Catania. JRC will provide technical coordination. This follows from a similar exercise held in May 2011. It involves Italian organisations as well as Uni. Cyprus, SUPSI and perhaps WMOD this year. Cooperation with SOPHIA should be established and is considered beneficial.

HZB is organising a workshop on analytical tools for PV in the week of 15-19 October 2012. This will be a hands-on workshop on the application of two different advanced analysis methods for the characterization of PV materials, i.e., surface sensitive synchrotron based materials analysis and multi resonance EPR/EDMR.

3. Conclusions

A number of SOPHIA related workshops and events were organised in 2011. Such workshops are highly appreciated by the audience and often lead to the definition of new project proposals. Hence, such events help to align and structure research activities between different parties. It is apparent that the organisation of workshops is sometimes driven by personal motivation or requirements from the institute. The link towards SOPHIA, as an enabler to facilitate the organisation of such workshops and events, is not always made. This is something that has to be stressed more in 2012. Subsequently, the alignment of workshop events will contribute to realise SOPHIA's ambition to structure research activities across Europe.