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Contents

1.- Introduction

KESTCELLS consortium has implemented 5 Workshops and 2 Business Schools along the duration of the project, for the complementary training of the fellows. As is stated in the Table 3 of the Annex I, the following activities were planned (Table 1).

Table 1. Traning activities organized by KESTCELLS (from Table 3 of the Annex I).

	Training events, workshops & conferences	Lead Organising Institution	Planned date	Planned venue
1	Workshop WS1: Advanced characterisation techniques in Thin Film technologies: optoelectronic, vibrational and structural properties	UAM, UL	Month 13	UL
2	Workshop WS2: Advanced growth processes for Thin Film PV technologies: PVD / CVD based processes, reactive annealing and chemical based approaches	HZB, UU-ASC	Month 19	HZB
3	Workshop WS3: Modelling and design of PV devices: application to thin film technologies	AMU	Month 31	AMU
4	Workshop WS4: IPR Management: Framework, tools and European/international regulations. Market and industrial exploitation elements for exploitation of PV technologies: State of the art and future trends & needs	NEXCIS, ASNT	Month 37	NEXCIS
5	Workshop WS5: First conclusions and Evaluation of the Project, with the summary of key results achieved up to month 43 and their impact on the scientific community. Review on the future perspectives of kesterites from the research point of view towards their industrialization for large scale thin films modules production.	IREC	Month 43	IREC
6	Intensive short course SC1: From Science to Business	ESADE	Month 27	ESADE
7	Intensive short course SC2: Business Creation in the PV industry	ESADE	Month 39	ESADE

All these activities were successfully implemented during the Project, inviting renowned scientists all around the world in different fields, as well as contribution of high level researchers of the different hosting Institutions, allowing for a high level training of the fellows. The workshops were organized the day before of the corresponding project meetings, facilitating the active participation of the fellows and supervisors. In the next sections, a detailed description of each training activity is summarized.

2.- Summary of Network Workshops

Workshop WS1 – Advanced characterization techniques in Thin Film technologies: optoelectronic, vibrational and structural properties.

This workshop was organized by UL and UAM and was hosted in Luxembourg on 19th September 2013. The agenda of the workshop was the following:

Table 2. Agenda of the workshop WS1 organized by UL and UAM.

"*Workshop on Advanced Characterisation Techniques for Thin Film Technologies*"

Date: 19th of September, 2013.
Place: Luxembourg
Organizers: University of Luxembourg and Universidad Autónoma de Madrid

Program

Time	Title	Speaker
9:00 - 10:30	Optical characterisation of thin films (T-R, ellipsometry)	***Rosalia Serna*** CSIC, Madrid
10:30 - 10:45	Coffee break	
10:45 - 12:15	Raman spectroscopy of thin films	***Victor Izquierdo-Roca*** IREC, Barcelona
12:15 - 13:15	Lunch break	
13:15 - 14:45	X-ray and neutron scattering methods	***Susan Schorr*** HZB, Free University of Berlin
14:45 - 15:00	Coffee break	
15:00 - 16:30	Photoluminescence	***David Regesch*** University of Luxembourg
16:30 - 16:45	Coffee break	
16:45 - 18:15	Electrical transport measurements	***José Manuel Merino*** Universidad Autonoma Madrid

In this workshop most relevant optical, electrical and structural characterization techniques were reviewed including ellipsometry, Raman spectroscopy, X-ray and neutron diffraction, photoluminescence, Hall effect, etc. This worksoph addressed main characterization methodologies in order to improve the knowledge and skills of the fellows in techniques and methodologies that were intensively used during the development of their career development plans.

Workshop WS2 – Advanced growth processes for Thin Film PV technologies: PVD/CVDE based processes, reactive annealing and chemical based approaches.

This workshop was organized by HZB and UU-ASC and was hosted in Berlin on 24th March 2014. The agenda of the workshop was the following:

Table 3. Agenda of the workshop WS2 organized by HZB and UU-ASC.

"***Advanced growth processes of thin film PV technologies: PVD/CVD based processes, reactive annealing and chemical based approaches***"

Date: 24th of March, 2014.
Place: Berlin
Organizers: Helmholtz-Zentrum Berlin (HZB) and Uppsala University (UU-ASC)

Program

Time	Title	Speaker
9:00 - 10:30	Chemical based approaches for CZTS film growth	***Phillip Dale*** University of Luxembourg
10:30 - 10:50	Coffee break	
10:50 - 12:20	Sputtering for thin film PV	***Klaus Ellmer*** Helmholtz-Zentrum Berlin
12:20 - 13:20	Lunch break	
13:20 - 14:20	Student group discussions: annealing	
14:20 - 15:50	Annealing of CZTS	***Jonathan Scragg*** Uppsala University
15:50 - 16:10	Coffee break	
16:10 - 17:40	Conversion of metal precursors/annealing/in-situ XRD	***Roland Mainz*** Helmholtz-Zentrum Berlin
17:40 - 18:00	Wrap up/additional questions	

In this workshop thin film preparation methods were reviewed, including annealing processes and in-situ characterization of synthesis methodologies. This worksoph addressed the required general background for the training of the fellows in synthesis and crystallization methodologies.

Workshop WS3 – Modelling and design of PV devices: application to thin film technologies.

This workshop was organized by AMU and was hosted in Marseille on 11th March 2015. The agenda of the workshop was the following:

Table 4. Agenda of the workshop WS3 organized by AMU.

"***Modelling of solar cells***"

Date: 11th of March, 2015.
Place: Marseille
Organizers: Aix Marseille University (AMU) IM2NP

Program

Time	Title	Speaker
9:00 - 10:30	Electrical Modelling of Thin Film Solar Cells using SCAPS	***Dr. Samira Khelifi*** *Solar Cells group - University of Gent – Belgium*
10:30 - 10:50	Coffee break	
10:50 - 12:20	Physical Modelling of Solar Cell Devices using SILVACO ATLAS	***Dr. Ahmed Nejim*** *Silvaco Europe Ltd. – UK*
12:20 - 14:00	Lunch break	
14:00 - 15:30	Ab initio investigation of the low open circuit voltage of kesterite solar cell technology	**Dr. Julien Vidal** EDF R&D
15:30 - 16:00	Coffee break	
16:00 - 17:30	Simulation tools for predicting the opto-electronic properties of organic solar cells	***Dr. David Duché*** *Opto-PV group – IM2NP – Aix Marseille University*
17:30 - 17:45	Wrap up/additional questions	

In this workshop different aspects of modelling of PV devices were presented, including the different softwares that are available for the optical and electrical modelling. In particular, researchers from the University of Gent and Silvaco Europe Ltd. have participated. This university as well as the company, are at the forefront of the development of computational tools for PV devices modelling.

Workshop WS4 – IPR Management: framework, tools and European/International regulations. Market and industrial exploitation elements for exploitation of PV technologies: state of the art and future trends and needs.

This workshop was organized by ASNT and NEXCIS and was hosted in Seville on 28th September 2015. The agenda of the workshop was the following:

Table 5. Agenda of the workshop WS5 organized by ASNT and NEXCIS.

"IPR Management:

Framework, tools and European/international regulations. Market and industrial exploitation elements for exploitation of PV technologies: State of the art and future trends & needs

Date: 28th September, 2015
Place: Seville (Spain)
Organizers: Abengoa Solar New Technologies S.A.

Program Monday 28th September

Time	Tittle	Speaker
14:00 – 14:15	Welcome	Dr. José María Delgado R&D Project Manager at Abengoa Solar
14:15 – 15:15	IP management. Basic concepts and procedures	Ms. Lucía Fernández Patent Office at Abengoa Research
15:15 – 15:30	Coffee break	
15:30 – 16:30	PV Market. Financial strategy and O&M of PV plants.	Mr. Jose Antonio Pérez R&D Project Manager at Abengoa Solar
16:30 – 16:45	Coffee break	
16:45 – 17:45	PV Grid interconnections. Smart PV Plants and electrical market challenges	Dr. Pedro Rodríguez Technical Director of Abengoa Research
17:45 – 18:00	Wrap up/additional questions	

Program Tuesday 29th September

Time	Tittle	Speaker
9:00 – 9:30	Welcome	Dr. José María Delgado R&D Project Manager at Abengoa Solar
9:30 – 10:30	The future of doctorate & the role of the ITN projects	Mr. Jose Miguel Sanjuan and Dr. Francisco Hernández

In this workshop the fellows were introduced to management, finantial and marketing aspects including description of the possible future perspectives for their career. This has contributed to the development of complementary skills related to these aspects.

Workshop WS5 – First conclusions and evaluation of the Project, with the summary of key results achieved up to month 43 and their impact on the scientifica community. Reviw on the fugure perspectives of kesterites from the research point of view towards their industrialization for large scale thin films modules production.

This workshop was organized by IREC and EMPA and was hosted in Zurich on 17th February 2016. The agenda of the workshop was the following:

Table 6. Agenda of the workshop WS5 organized by IREC and EMPA.

"First conclusions and Evaluation of the Project. Review on the future perspectives of kesterites from the research point of view towards their industrialization for large scale thin films modules production."

Date: 17th of February, 2016.
Place: Zurich, Switzerland
Organizers: EMPA, IREC

Program

Time	Title	Speaker
9:30 - 9:45	Welcome and Introduction: What needs to be achieved for a successful thin film PV?	*Prof. Ayodhya Tiwari* EMPA
9:45 - 10:15	Advancements in fundamental properties knowledge during the Kestcells project	*Prof. Susan Schorr* FUB/HZB
10:15 - 10:45	Advancements in materials processing during the Kestcells project	*Dr. Ian Forbes* NU
10:45 - 11:15	Coffee break	
11:15 - 11:45	Why are kesterites not at 20% efficiency?	*Prof. Susanne Siebentritt* UL
11:45 - 12:15	Kesterites for PV: Reaching to the dead-end or still in the race towards 25% efficiency	*Prof. Charlotte Platzer-Björkman* - UU
12:15 - 14:00	Lunch	
14:00 - 14:45	Thin film PVs: advantages, drawbacks and challenges of a nascent Industry	*Dr. Verónica Bermúdez* EDF
14:45 - 15:30	Future perspectives of Kesterites	*Dr. Teodor Todorov* IBM
15:30-16:00	Coffee break	
16:00-16:30	Future career perspectives for the fellows: H2020 and beyond	*Dr. F. Hernández-Ramírez* IREC
16:30-17:30	Round Table	*ESRs*
17:30-18:00	Main Conclusions and Evaluation of Kestcells	*Dr. Edgardo Saucedo* IREC Coordinator of Kestcells

In this workshop two renowned scientists from the Academy (Dr. Teodor Todorov) and the Industry (Dr. Verónica Bermúdez), were invited to bring their personal point of view about the challenges and perspectives of thin film PV kesterite technologies. Additionally, researchers and proffesors from the consortium have presented main advancements and achievements of KESTCELLS.

3.- Summary of Business School Courses

Training on entrepreneurship, innovation and business management: ESADE modules.

As part of the multidisciplinary training of the Kestcells two modules have been designed to provide the ESR's with complementary training in entrepreneurship, innovation and business management. ESADE (Associated Partner) along with the SB and the CMO designed two personalized courses that took into account the training needs of the researchers. Having this in mind the first course ("Introductory Crash Course in Entrepreneurship" month 39 40 hours) was designed to provide to the fellows a general vision of the business and entrepreneurial concepts. And the second one ("Business Creation in the PV Industry" months 35-37 100 hours) was aimed to learn how to create, develop and present successfully a technology based business creation project. A detailed description of the contents of each module is provided bellow:

First module: "Introductory Crash Course in Entrepreneurship". The objective of this course was to make the students acquainted to the business and entrepreneurial worlds, to show them how new discoveries can be the basis of sound businesses that improve people's quality of life. An overview of the process of identifying an opportunity, turning an idea into a product or service and making a business out of it. The module had the following content: Introduction to Strategy, Entrepreneurship, Marketing for science/technology based start-ups, Entrepreneurial finances, Managing IPR, Managing entrepreneurial teams.

Second module: "Business Creation in the PV Industry" The second module focused in learning how to create, develop and present successfully a technology based business creation project. In order to achieve this objective ESADE's tutors, defined with the researchers an imaginary (although feasible) technological product. The tutors gave the researchers the general guidelines of how to prepare the project and how to present this product to possible investors. The researchers defined the opportunity, and designed and validated a suitable business model to take advantage of the opportunity.

Researchers were organized in four groups that will be supervised by ESADE's tutors. The Project Managing Office (PMO) of KESTCELLS were part of the groups with the role of "facilitating the work", providing framework information whenever is suitable. The course consisted of two in situ sessions and a regular follow up of the activity through Skype with an estimated effort of 100 hours.

The topics of the projects presented were: how to integrate PV in wearable equipment: Thin film flexible solar cell patches for outdoor equipment and clothing; in bikes: Sun for bikes; in mobile phones: See Through PV; and in motorbikes: Solar Riders. The evaluation and the projects are available in the intranet of the project.

4.- Conclusions

All the training activities planned in the frame of KESTCELLS project, related to the organization of Network Workshops and Courses, have been successfully implemented following the time frame and description of Annex I. These activities have fullfiled their objective: the complementary and specialized training of the fellows on different aspects very related and useful for their carreer development plan, as well as for their future development. The workshop and courses have covered from fundamental aspects (chemistry, physics, material science), to most applied ones, and managerial and financial issues, ensuring a very complementary, multidisciplinary and inter-sectorial training of the fellows.