

Newsletter

April, 2014



Kestcells: First 18 months

Kestcells (GA 316488) is an FP7-Marie Curie funded project with a total budget of 3.7M €, that has the objective of creating an Initial Training Network for the structured interdisciplinary training of researchers in advanced thin film photovoltaic (PV) technologies.

Scientifically, the project proposes the development of new PV technologies compatible with the cost, efficiency, sustainability and mass production requirements that are needed to become a reliable future alternative to conventional non renewable energy sources. With this objective in mind, the project is focused on the development of Kesterite based solar cells. The main expected achievement is to develop cost efficient thin film solar cells based on Kesterites, with a deeper understanding of the fundamental properties of these materials; the development of customized routes for the absorber preparation; the implementation of solar cells with the inherent requisites of this material; and the development of specific simulation tools and dedicated characterization methods for quality control assessment. In addition, the project expects to create a new generation of scientist devoted to the study of new PV technologies either in the industry or in the academia. During the first year twelve Early Stage Researchers (ESR) have been recruited, a first result of their research has been obtained and will be published soon. With this newsletter we want to introduce you to the first PhD students that have joined the project, their backgrounds, main tasks and which expectations they have on the Kestcells project, for the next 2-3 years



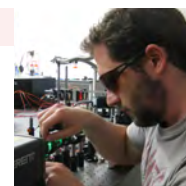
This project has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) for research, technological development and demonstration under grant agreement no. 316488. Sole responsibility lies with the authors and the European Commission is not responsible for any use that may be made of the information contained therein.

Coordinated by:



ESR 1.1 Jan Sendler. PhD student at the University of Luxembourg

Obtained a Physics diploma from the University of Mainz in 2012. In this work he analyzed data that was taken with the ATLAS-detector at the Large Hadron Collider at CERN in Switzerland. The topic of his Master Thesis was the determination of the differential production cross section of Z-Bosons with respect to their rapidity.



Within the Kestcells-project his tasks are the preparation of reference materials by physical vapor deposition and optical characterization of thin films using Raman and Photoluminescence spectroscopy. So far, he has been able to use intensity dependent Photoluminescence measurements to establish the existence of several different phases in absorber layers produced by the University of Uppsala.

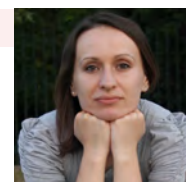
ESR 1.2 Eduard Garcia Llamas. PhD student at the Universidad Autónoma de Madrid

Graduated in Materials Engineering at Universidad Autònoma de Barcelona, he was awarded with a scholarship within the program Erasmus Mundus to perform a Master in Materials Science in France, Germany and Italy. He obtained experience in different research centers around Europe, like OCAS in Belgium, HZB in Germany and ISP in Ukraine. His experience in the industrial world gave him practical skills to apply to the Kestcells project. His motivation, willingness to work hard -thanks to his own convictions in solar energy-; his previously knowledge of quaternary compounds, and its knowledge on synthesis and characterization are added values to enhance the options to overcome problems and bring the project to achieve improvements. Some of these achievements may be improvements in Kesterite as absorber light material by the optimization of the synthesis of the material with the appropriated optoelectronic properties. He thinks that one important aspect of this project is that it provides him the opportunity to meet both PhD students and senior researchers of the solar energy field, which would be an invaluable value in the progress of his research career.



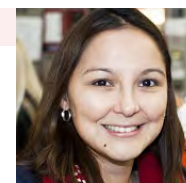
ESR 1.3 Mirjana Dimitrievska. PhD student at IREC

Mirjana Dimitrievska is a PhD student at the University of Barcelona, and is working as a PhD fellow at IREC. Her research is on vibrational properties of kesterites, using Raman spectroscopy. She obtained her Bachelor degree in physics and her Master degree in Physics of Materials at the University of Novi Sad. Her previous experience is mostly in characterization of materials, especially structural properties, using Raman spectroscopy and XRD. Her current tasks in the KESTCELL project are in identifying the main Raman modes in CZT(S,Se) and solid solutions, and developing a model to determine the presence of the defects in these compounds. She is also working on theoretical research on phonon confinement effects in CZTS and CZTSe thin films.



ESR 1.4 Laura Elisa Valle Rios. PhD student at the Free University of Berlin

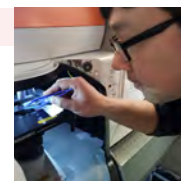
She graduated in 2007 as a chemical engineer in the Technological Institute of Madero City, in Mexico. In 2011 she obtained a Master of Science in Engineering called "Materials and processes of suitable Energetics hosted" at the Tallinn University of Technology in Estonia. She combined her master studies with a research assistant job in the Department of Material Science at its center of excellence in solar energy materials. Her research at this phase centered on the chemical bath deposition of intrinsic Zinc Oxide as a window layer for CZTS monograin solar cells.



Her input in the Kestcell project starts with the solid state synthesis of stoichiometric and off-stoichiometric kesterites powder samples. The use of X-Rays and Neutron diffraction techniques, complementary with chemical characterization and Rietveld analysis are performed in order to determinate its crystal structure, cation distribution, concentration and type of point defects, which are key aspects for the understanding of the solar cell performance.

ESR 2.2 Yi REN. PhD student in Ångström Solar Center of Uppsala University

His topic is to use sputtering based methods for the formation of CZTS absorber, which is used as the alternative material to CIGS based PV technology, and the chemical composition and band alignment of this material will be typically studied during his PhD. Prior to starting his PhD, he finished his bachelor study in Material Science and Engineering in the University of Science and Technology Beijing in China. He also took a Masters study in Material Engineering in the University of K.U. Leuven, in Belgium. It was a very interesting experience for him to have his master study in Leuven, where he touched CZTS material for the first time. He did his master thesis – “CZTSSe absorber formation from metallic sputtered layers” – at imec, with different characterization methods, such as Scanning Electron Microscopy, Energy Dispersive X-Ray Spectroscopy, X-Ray Diffraction, Current-Voltage measurement, etc. The challenges and the mysteries of this material attracted the researcher attention. Yi Ren chose to work in the KESTCELL project and Ångström solar center to continue on working with CZTS, and he believes he can learn a lot from both, science and the passionate researchers he is working with.

**ESR 2.3 Markus Neuschitzer.** PhD student at IREC

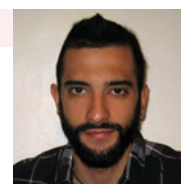
He obtained his Master's degree in technical physics from the Graz University of Technology in 2012. During the master's program he was abroad for one year studying in Grenoble, France, in the framework of an Erasmus student exchange program. While being there, he had the opportunity to complete a six month internship, where he investigated AlN/GaN nanostructures using different X-ray based characterization techniques. His master's thesis was on the realization of a grazing incidence diffraction set-up using standard laboratory equipment to characterize inorganic thin films, organic monolayers and self-assembled monolayers used in organic electronic devices and inorganic thin film heterojunction solar cells. His PhD position in the KESTCELLS project is focused on chemical strategies for the synthesis of CZTSSe absorbers. His work is mainly centered on the development of routes based on spray pyrolysis under controlled atmosphere to obtain high quality CZTSSe precursors and the optimization of thermal processes to crystallize these chemical based precursors. Furthermore, he applies different surface treatments to PVD grown reference cells to improve the absorber buffer interface and to gain a deeper understanding of the junction.



The main research activities in the first months of his PhD were focused on the optimization of the growth parameters for obtaining good precursor films in spray pyrolysis. Here, especially the right temperature is the key parameter to obtain homogeneous and dense films. Furthermore, different concentrations and ratios of precursor solutions were used to optimize the composition and investigate a possible enhancement of grain growth using an initial Cu-rich growth phase followed by a Cu-poor growth phase to adjust the overall composition. By optimizing the thermal treatments sprayed CZTSSe solar cells of 1.2% efficiency could be produced. Further, he was working on possible surface modifications of reference PVD grown solar cells using different surface treatments and short reannealing. Here, the efficiencies the PVD grown cells could improve from below 2% to above 7%.

ESR 5.1 Dario Cozza. PhD student at Aix-Marseille University

Before joining the Kestecells Project he graduated in Electronics Engineering (Bachelor Degree) at the Polytechnics of Turin in Italy and after was awarded a Master of Science in Microelectronics and Nanotechnologies for Integrated Systems (Polytechnics of Turin, INPG, EPFL) with a master thesis at the NASA Ames Research Center in California (USA) entitled “Development of a TiO₂ thin film coated fiber solar cell”. Solar Energy exploitation and Computer Science are two passions of this young researcher that are combined in his tasks in the Kestcells project. Dario Cozza explains “We are at a Consortium that includes some of the best research centers in Europe in the field of Thin Film Solar Cells (CIGS and CZTS) and we, as young researchers, have the opportunity to have a role in the next advancements of CZTS solar cells that, from the commercial point of view in the next future can become a true low-cost alternative with respect to other existing PV technologies”.





Training

In the Frame of the project a series of Seminars will be given by each partner, specially designed for each researcher. These seminars are open to all members of the local institutions as well as to all the members of the Network. In addition the Network will organize five thematic workshops where the researcher will discuss his research and the advances of their theses.

Herewith you will find the training program of years 2012-2013

November 2013

- Seminar on “*Optoelectrical characterization of thin films photovoltaics absorbers and devices*” Institut de Recerca en Energia de Catalunya (IREC)
- Seminar on “*Safety Assessment and Comparing Safety Records and Public Recognition of Various Energy Supplies*” Freie Universität Berlin (FUB)
- Seminar on “*Characterisation of novel Solar Cells*” University of Northumbria (UN)
- Seminar on: “*Phase Diagrams*” Eidgenössische Materialprüfungs- und Forschungsanstalt (EMPA)

October 2013

- A series of lectures on the topic “*Thermodynamics of phase diagrams*” University of Uppsala (UU)

September 2013

- Seminar on “*Ab-Initio Modeling and Simulation of materials for solar cells*”. Aix Marseille University (AMU)
- First Workshop organized in the frame of project Kestcells. Workshop on Advanced Characterisation Techniques for Thin Film Technologies”
 - > Rosalia Serna CSIC. “Optical characterisation of thin films (T-R, ellipsometry)”
 - > Victor Izquierdo-Roca. IREC Raman spectroscopy of thin films
 - > Susan Schorr HZB, Free University of Berlin. “X-ray and neutron scattering methods”
 - > David Regesch University of Luxembourg. Photoluminescence
 - > José Manuel Merino UAM. Electrical transport measurements

July 2013

- Seminar on “*Kesterites: an overview*” Institut de Recerca en Energia de Catalunya (IREC)
- Seminar on “*Chemical routes for the synthesis of Kesterites*” Institut de Recerca en Energia de Catalunya (IREC)
- Seminar on “*Doping (charge carrier statistics in equilibrium, p-, n-type doping)*”. University of Luxembourg
- Seminar on “*Charge Carrier transport (conductivity, mobility, scattering mechanisms)*”. University of Luxembourg
- Seminar on “*Non-equilibrium (quasi-Fermi levels, SRH recombination)*” University of Luxembourg
- Seminar on “*p/n-homojunction (band structure, IV (diode factor 1 and 2, QE)*” University of Luxembourg
- Seminar on “*p/n-heterojunction, (band structure, IV, QE)*”. University of Luxembourg

June 2013

- Seminar on “*Bonds and crystals of semiconductors (ionic and covalent bonds, basic crystal structures, miller indices, reciprocal space)*” University of Luxembourg
- Seminar on “*Electrons in semiconductors - band structure. (E-k relationship, (in)direct band gaps)*” University of Luxembourg
- Seminar on “*Electronic defects (hydrogen model for shallow defects, behaviour of deep defects)*” University of Luxembourg

May 2013

- Seminar on “*Principles of basic characterization of solar cells*”. Aix Marseille University (AMU)

April 2013

- Seminar on “*Extracting information from Rietveld refinement*”. Freie Universität Berlin (FUB)

Dissemination

One of the objectives of the FP7 Marie Curie program is the dissemination of the research and its impact in society. For this reason the project Kestcells has made a series of actions to inform society.

- Press releases from the consortium the project Kestcells appeared in 51 national and regional newspapers and websites, as part of a first press campaign (<http://www.kestcells.eu/press-releases-clipping>)
- First Multimedia of the first recruited PhD students have been recorded and released. For more information visit our webpage.
- A project brochure was designed and produced at the early stage of the project (month 6) describing the goals, strategies and motivation of KESTCELLS. The brochure has been distributed at several International Conferences and events where researchers of the project have participated.

News

Northumbria participated in the Newcastle Maker Fair 27th and 28th April, 2013 (Estimated visitors 10,000) and will participate in the British Science Festival (BSF) Newcastle 2013 – The NU proposal for an event (*A Brilliant Future: how sunlight will wave goodbye to our fossilised past*) has been approved by the British Science Association. The event will take place on 11th September 2013.

Researchers from KESTCELLS participated in the second EU PV Clusters Workshop and General Assembly that took place in Barcelona (Spain) in November 2013. The event is organized with the support of the SCALENANO European project (www.scalenano.eu), XaRmae (Catalan Network of Excellence on Materials for Energy) and the University of Barcelona. This Workshop builds on the success of the first Workshop on "Photovoltaics and nanotechnology: from innovation to industry", a timely and very successful event organized by CEA (France), which launched the "EU PV Clusters" of projects (www.eupvclusters.eu) at the end of 2010.

Papers

The project is in a very early stage, and in the 12 month meeting high impact results were presented, that will be published soon. In this short period, two papers have been published:

M. Dimitrievska, A. Fairbrother, X. Fontané, T. Jawhari, V. Izquierdo-Roca, E. Saucedo, A. Pérez-Rodríguez, "Multiwavelength excitation Raman scattering study of polycrystalline kesterite $\text{Cu}_2\text{ZnSnS}_4$ thin film", *Appl. Phys. Lett.* 104, 021901 (2014)

M. Dimitrievska, A. Fairbrother, A. Pérez-Rodríguez, E. Saucedo, V. Izquierdo-Roca, "Raman scattering crystalline assessment of polycrystalline $\text{Cu}_2\text{ZnSnS}_4$ thin films for sustainable photovoltaic technologies: phonon confinement model", *Acta Materialia* 70 (2014) 272–280

