

# APOLO OPEN DAY 2021

*The New Generation of Photovoltaic Cells*



## Preliminary Agenda

Speakers & Participating organisations

**Date:** 20 April 2021

**Place:** ZOOM

<https://project-apolo.eu>



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# Apolo Project

**APOLO** (<https://project-apolo.eu>) is a research and innovation project carried out by an international consortium led by **LEITAT**. APOLO will develop flexible, reliable and fully printable perovskite solar cells (PSC) with an efficiency of 22% and with 90% of performance after aging tests. The project partners are research centres such as the *Swiss Federal Institute of Technology Lausanne, Fraunhofer Institute for Solar Energy Systems ISE, Uninova, Università di Roma Tor Vergata and CEA, Arkema* as a large enterprise and SME's including *Flexbrick, Greatcell Solar Italia, Cambridge Nanomaterials Technology Ltd, and Accurec*.

During the 4 years of the project duration, the consortium is working on advanced optoelectronic materials and innovative green processes to bring the new generation of PSC on the market, initially in building integrated photovoltaics (BIPV), but also extending its applications to different market niches. In addition, **APOLO** is working in reducing the cost of PSC module manufacturing below 0.40€/Wp. Lastly, APOLO is also working in producing produce PSC modules to be integrated in facings for buildings.



## 1. APOLO Open Day 2021 – Preliminary Agenda

The APOLO Open Day is a great opportunity to learn about the progress of the project, meet the project partners and learn about their activities in the development of new materials for PSC, on its performance, on its manufacturing, and stability and recycling.

*Please take notice that all times shown in the agenda are CET.*

**09:30** Welcome to the APOLO Open Day 2021

**Ana Milena Cruz**, APOLO Project Coordinator, LEITAT, Spain

**Bojan Boskovic**, Managing Director, Cambridge Nanomaterials Technology Ltd (CNT), UK

APOLO Open Day 2021 Organiser

**09:35** Introduction to the APOLO Open Day

Presentation of the agenda and Individual introduction of the participants

**Bojan Boskovic**, Managing Director, Cambridge Nanomaterials Technology Ltd (CNT), UK

APOLO Open Day 2021 Organiser

**10:30** **Ana Milena Cruz & Joan Galí** LEITAT (APOLO Project Coordinator), Spain

**Title: Introduction of LEITAT; Overview of the APOLO project: modular flexible design of an BIPV perovskite solar panel**

Perovskite solar cells (PSC) have shown an impressive learning curve in the last decades in comparison with 1st, 2nd and initial 3rd generation solar cells (such as DSSC and OPV). Since the very beginning, the main market demands for 3rd generation PV were more flexibility and more colour choices. Both of these ideal properties lead to new business opportunities in BIPV. These technologies also have low cost using fully printing process, low temperature processes and out of clean rooms which reduce the production cost. The most important problem in PSC technology is the short lifetime which is currently the main barrier for the marketability of PSC. Up to now all the developed PSC used cheap materials and/or solution which did not exhibit high efficiencies. In contrast high efficiency PSCs usually require relatively expensive materials and processing. PSC toxicity is considered to be negligible since the amount of lead in perovskite layer is not relevant if it is compared against Si technology, nevertheless, the solvent toxicity should be taken in account in order to benefit industrialization of PSC products. APOLO consortium pretend surpass the aforementioned barriers for market deployment by providing flexible and stable PSCs using scalable and low-cost processes, reducing amount of toxic materials tackle the challenges to provide market niches solutions. APOLO solutions will allow the development of a totally new product by integrating the modules into the architecture design of buildings. New applications of this technology open doors to other markets apart from BIPV, such as automotive, textile, etc.

**11:00 Stéphane CROS**, CEA, France

**Title: A High Throughput Method to Screen Ambient Encapsulation Conditions**

Encapsulation is ones of the key issues regarding stability of Perovskites devices. To evaluate rapidly the effectiveness of encapsulation materials and design, an optical test of encapsulation procedures with simple sample fabrication in air is developed. The glass or flex samples of perovskite layers sealed with different sealing materials are fabricated. The analysis of the test data allows identification of gas permeation mechanisms from the edge of the device and from covers (if flexible). This test allows a faster selection of the best practices to ensure gas barrier protection fitting with stability standards.

**11:20 Break**

**11:30 Lukas Wagner**, Fraunhofer Institute for Solar Energy Systems ISE, Germany

**Title: Perovskite PV advancements at Fraunhofer ISE**

At Fraunhofer ISE, various perovskite solar cell (PSC) and module technologies are being developed. We will present the latest results for high-efficient perovskite cells in nip and pin configuration, including flexible cells, fully printed devices with carbon back electrode, mini-modules and silicon-perovskite tandem cells. A wide range of advanced solar cell characterization methods are available, covering techniques well established from silicon-PV research and novel approaches specifically developed for perovskites. Finally, we provide insights in the measurement procedures for certified efficiency measurements carried out at the accredited Fraunhofer ISE Calibration Laboratory.

**11:50 Bruno Charrière**, Arkema, France

**Title: Overview of Arkema and its role in project APOLO.**

Overview of Arkema as a leading supplier of specialty materials, with focus on renewable energies and photovoltaics. Brief review of Arkema's contribution to the APOLO project with the design of a photocurable encapsulation material for perovskite cells.

**12:10 Francesca Brunetti**, University of Rome Tor Vergata – CHOSE, Italy

**Title: The Center for Hybrid and Organic Solar Energy, CHOSE, University of Rome Tor Vergata**

**12:30 Luca Sorbello**, Greatcell Solar Italia srl, Italy

**Title: Greatcell Solar Italia and the Apolo project a general overview**

A short company and services introduction will be provided highlighting the company competence and what services and products GSI can offer. An introduction of the role of GSI within the Apolo project and of what GSI wants to achieve at the end of the project will be provided

**12:50 Rafael Pardo Lloría & Mikel Onandia Ruiz**, Flexbrick SL Spain

**Title: Flexbrick Dressing Architecture – Award winning next generation sunscreen**

Flexbrick has already changed the paradigm of installing facades around the world. Plied in lengths long as 20m and taken directly from the pallet to their final position in the building in a flash, the patented ceramic fabrics are safely and easily hanged like a curtain made of bricks with a customisable pattern that allows fast and reliable prefabricated construction while adding special features and beauty to the building envelope. Flexbrick tissues are manufactured from recycled and recyclable materials and installed with mechanical dry fixations allowing full recuperation. They are shipped on a compact way thus producing a nearly zero carbon print, while our terracotta bricks are manufactured 100% using biogas from our plant near Barcelona's landfill. What if you could do the cladding of your building the same spectacular way and at the same time you provide the extra functionality of producing clean energy? The key to easy BIPV for rehabilitation and modern architecture is in the sum of Flexbrick system and the high efficiency, versatile transparency, low gradient dependency, flexible, recyclable, and cost-effective qualities of the next generation PSC end-user development of the H2020 Apolo project. The aesthetic possibilities are infinite and completely disruptive.

**13:10 Discussion**

**13:30 Lunch break**

**14:30 Ana Mouquinho**, CENIMAT-CEMOP/UNINOVA. Portugal

**Title: Colloidal Lithography for Thin Film Solar Cells: an attractive route for light management**

The pursuit for ever more efficient, reliable, and affordable solar cells has pushed the development of nano/micro-technological solutions capable of boosting their photovoltaic (PV) performance without significantly increasing costs. One of the most relevant solutions is based on light management via photonic wavelength-sized structures, as these enable pronounced efficiency improvements by reducing reflection and trapping the light inside the devices. The colloidal lithography is considered the preferential structuring method for PV, as it is an inexpensive and highly scalable soft-patterning technique allowing nanoscopic precision over indefinitely large areas.

**Ugur Deneb Menda**, Cenimat i3N- Universidade NOVA de Lisboa, Portugal

**Title: High-Performance Wide Bandgap Perovskite Solar Cells Fabricated in Ambient High-Humidity Conditions**

Lead-halide perovskite solar cells (PSCs) are currently the most promising emergent thin-film photovoltaic technology, having already reached power conversion efficiency (PCE) levels of state-of-the-art wafer-based silicon cells. The class of wide bandgap PSCs has also demonstrated high PCE values, thus becoming highly attractive for top sub-cells in tandem devices constructed with silicon or other types of bottom sub-cells. In this study, wide bandgap double-halide ( $\text{Cs}_{0.17}\text{FA}_{0.83}\text{PbI}_{3-x}\text{Br}_x$ ) perovskite absorbers were developed with different bromine content, aiming to obtain bandgap values between 1.66 to 1.74 eV, by a glovebox-free (ambient) procedure. Low-cost inorganic materials, i.e.

TiO<sub>2</sub> and CuSCN, were used for the electron and hole transport layers, respectively. The 1.70 eV bandgap perovskite resulted in the highest reproducibility and stability (>80% initial PCE after 3500 hours) properties of the PSCs, remarkably attaining 16.4% PCE even with ambient and high humidity (~70%) fabrication conditions.

**15:00** **Laura Miranda Perez**, Oxford PV, UK – (*Guest presentation*)

**Title: Oxford PV: Addressing climate change with the rapid development of perovskite/silicon tandem photovoltaics**

Climate change has made transforming our energy economy into one that is clean, renewable, and sustainable a global imperative. Our perovskite/silicon tandem solar cell solution delivers high efficiency at a low cost, which is essential for solar to replace fossil fuels and meet growing energy demand. Our technology uses existing production routes taken from the Si industry and drastically enhances the power output with the addition of a perovskite top-cell in a tandem configuration. Supported by excellent advancements in the field of perovskite photovoltaics in recent years, we have demonstrated a certified world-record efficiency of 29.5%, which far exceeds the record Si single junction performance (26.7%) and even exceeds the physical limit of Si PV (29.3%). With this presentation, we will give a brief look at the activities at both our R&D site in England and our industrial site in Germany, where we will commence production in 2022.

**15:20** **Discussion**

*Facilitated by Bojan Boskovic, Managing Director, Cambridge Nanomaterials Technology Ltd (CNT)*

**16:30** *End of session*

## 2. APOLO Open Day 2021 – Speakers



Dr Ana Milena Cruz (APOLO Partner)  
**LEITAT**.de Innovació 2  
08225 - Terrassa  
Spain

Technical coordinator of APOLO project. **Dr Ana Milena Cruz Rodriguez** has a PhD in Materials Science from the Universitat Autònoma de Barcelona, a Master in Materials Engineering from the Universidade Federal de São Carlos in Brasil and a degree in Physics Engineering from the University of Cauca in Colombia. In this period her research career has focused mainly on the synthesis and characterization of materials in the area of ceramic, glass ceramic, polymer and biomaterials focusing specifically on their electrical properties. She is currently developing her professional career at LEITAT Technological Center as a senior researcher in the Energy and Photonics Conversion group. Within the group, she manages the Solar Energy area and works in the coordination, execution and exploitation of R + D + I projects financed by public or industrial contracts at national and European level. She has specialized in different technologies including photovoltaic, thermo solar, printed electronics and thermoelectric. Her work is related to the production and integration of devices, as well as the characterization of the materials involved and the evaluation of their final behaviour. She also actively participates in European and national technology platforms and clusters such as FOTOPLAT (Spanish Photovoltaic Technology Platform), EMIRI (Energy materials Industrial Research Initiative) or the OE-A (Organic and Printed Electronics Association).



Dr. Bojan Boskovic (APOLO Partner & Open Day Organiser)  
**Cambridge Nanomaterials Technology Ltd**  
14 Orchard Way, Cambourne  
Cambridge CB23 5BN  
UK

**Dr Bojan Boskovic** has more than 20 years of hands-on experience with carbon nanomaterials and composites from industry and academia in the UK and Europe. Previously, he worked as a R&D Manager at Nanocyl,. He also worked on carbon nanotube synthesis and applications as a Principal Engineer-Carbon Scientist at Meggitt Aircraft Braking Systems, as a Research Associate at the University of Cambridge, and as a Senior Specialist at Morgan Advanced Materials. During his PhD studies at the University of Surrey he invented low temperature synthesis method for production of carbon nanomaterials that has been used as a foundation patent for the start-up company Surrey Nanosystems. He was a member of the Steering and Review Group for the Mini-IGT in Nanotechnology that advised the UK Government on the first nanotechnology strategy policy document. Dr Boskovic was working as an advisor for the European Commission (EC) on Engineering and Upscaling Clustering and on setting up of the European Pilot Production Network (EPPN) and European Materials Characterisation Cluster (EMCC). He has experience in exploitation and dissemination management on a number of FP7 and H2020 European projects, including UltraWire, NanoLeap, OYSTER, M3DLoC, Genesis and nTRACK. Also in UK Government InnovateUK funded projects, such as UltraMAT and GRAPHOSITE He is also a leader of a private Nano-Carbon Enhanced Materials (NCEM) consortium.



Joan Galí (APOLO Partner)  
**LEITAT.de Innovació 2**  
08225 - Terrassa  
Spain

After many years on the communications world, **Joan Galí** is the new communication and dissemination manager of Leitat. He has a large background on the events world organizing many different kind o dissemination activities.



Dr Stéphane CROS (APOLO Partner)  
**CEA**  
INES, 50 avenue du lac Léman  
73372 Le Bourget du Lac  
France

**Dr Stéphane CROS** has a Ph.D. in physico-chemistry in 2002 from the University Paris VI, working nanocomposite organic/inorganic materials. After a first experience in the field of polymer processing, he joined the CEA in 2004 to develop the thematic of encapsulation, gas barrier measurements and barrier materials in the Organic PV team. Since 2005, he is working in the Department of Technological Research within the French National Institute for Solar Energy (CEA/INES) He is now in charge of the stability issues regarding Perovskite based PV technologies (single junction and tandem with silicon).



Lukas Wagner (APOLO Partner)  
**Fraunhofer Institute for Solar Energy Systems ISE**  
Heidenhofstrasse 2  
79110 Freiburg,  
Germany

**Lukas Wagner** carries out research on perovskite solar technologies at the Fraunhofer Institute for Solar Energy Systems (ISE) in Freiburg, Germany. He studied Electrical Engineering and Information Technology (B.Sc. 2013) and Optics and Photonics (M.Sc. 2015) at the Karlsruhe Institute of Technology (KIT) in Karlsruhe, Germany. Lukas worked on organic solar cells at the Georgia Institute of Technology in Atlanta, USA, and developed highest efficiency III-V photovoltaic devices for optical power transmission at the Fraunhofer ISE. Before moving to Freiburg, he was with the French National Research Center for Solar Energy (CEA-INES), developing flexible perovskite solar cells. For his PhD at Fraunhofer ISE on printed, up-scalable perovskite photovoltaic technologies, he received a scholarship of the German Federal Environmental Foundation (DBU).



Bruno Charrière (APOLO Partner)  
**Arkema France**  
420 rue d'Estienne d'Orves  
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France

**Bruno Charrière** graduated from Chimie ParisTech in 1982. After three years research in Materials Science at the University of Bath (UK), he joined Total chemical branch as an R&D chemist. He joined Total's adhesives business in 1994, where he held a number of positions in R&D and later in marketing. He was head of R&D and Innovation at Bostik from 2004 to 2015. He has held the position of Scientific Director, Adhesives & Chemistry at Arkema's corporate R&D since 2016.



Prof. Francesca Brunetti (APOLO Partner)  
**University of Rome Tor Vergata – CHOSE**  
Via del Politecnico 1  
Rome,  
Italy, 00133

**Prof. Francesca Brunetti** is associated professor at the University of Rome Tor Vergata. Cofounder of the Centre for Hybrid and Organic Solar Energy (CHOSE), her current research is focused on the analysis, design and manufacture of electronic and optoelectronic devices through the use of nanomaterials (carbon nanotubes and graphene), organic semiconductors and perovskites realized on rigid and flexible substrates, including paper. Recently, she started an activity on the realization of supercapacitors on flexible and recyclable substrates, among which paper. She was the European coordinator of the Go-NEXT project on Graphene based Organic Solar Cells and she is currently the local coordinator of two H2020 European Projects (APOLO-SmArt Designed Full Printed Flexible RObust Efficient Organic HaLide PerOvskite solar cells and WASP-Wearable Applications enabled by electronic Systems on Paper) and the principal coordinator of a national project founded by the Italian Space agency (Perovsky-Perovskite and other printable materials for energy application in space). She authored more than 100 publications among paper and conference proceedings, and she holds 7 patents.



Luca Sorbello (APOLO Partner)

**Greatcell Solar Italia srl**  
Viale Castro Pretorio 122  
00185 Roma  
Italy

**Luca Sorbello** has been associated with activities of the Greatcell Solar group since 2008. Since 2010 Luca Sorbello is the Sales and Marketing Manager for the group. He is now also the Managing Director for Greatcell Solar Italia. In December 2002 he was awarded a Master of Arts in “business organization and management” in the engineering management school at University of Tor Vergata in Rome. At Tor Vergata, he has been since 2004 an adjunct professor and in 2008 completed his Ph.D. in industrial management.



Rafael Pardo Lloría (APOLO Partner)

**Flexbrick SL**  
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08781 Els Hostalets de Pierola  
BARCELONA  
SPAIN

**Rafael Pardo Lloría** is Chief Technical Officer at FLEXBRICK SL. Architect graduated at Universidad Politécnica de Valencia. Réhabilitation et mise en oeuvre, Le projet et les nouvelles technologies de l'information at Ecole d'Architecture de Marseille-Luminy. Master's degree, specialized in Technology, in Compulsory Secondary Education and Baccalaureate, Professional Training and Language Teaching at Universitat Jaume I Castellón. Worksite manager for international projects for WOODCOM GLOBAL SL. General coordinator of business activities for ADVENTIA INGENIERÍA. Responsible of Public Works Tendering Office at GILABERT MIRO, SA. Technician for South Tarragona Area at BUREAU VERITAS building branch. Teacher at secondary education, CFP Universidad Politécnica de Valencia and other institutions. Sportsman and musician.



Mikel Onandia Ruiz (APOLO Partner)

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**Mikel Onandia Ruiz** is International Sales Director at FLEXBRICK SL. Business graduated at Facultad de Ciencias Económicas y Empresariales del País Vasco. Holder of the Scholarship of the Program for the Internationalisation of Companies (foreign trade) provided by the Spanish Government. International Trade Specialist and Business Developer. Worksite International Sales Advisor at the Spanish Trade Embassy in Peru. ICEX-CECO (Training Executive Direction of ICEX Spanish Exports and Investments. Business development Canalisation/ Energy/ Mining at Saint-Gobain PAM- Peru. Export Area Manager at Inibsa Group Product Manager: Asia Pacific/ Middle East - Africa - Latin America – Oceania.



Dr Ana Mouquinho (APOLO Partner)

**CEMOP/UNINOVA.**  
CENIMAT/I3N, Departamento de Ciência dos Materiais,  
Faculdade de Ciências e Tecnologia, FCT, Universidade Nova  
de Lisboa,  
Caparica,  
Portugal, 2829-516

**Dr Ana Mouquinho** received her PhD in 2019 by the Nova School of Science and Technology. In the past 5 years, she is author of 5 publications in scientific journals and conference proceedings. Currently, she is a postdoctoral researcher at the Apolo project working with colloidal lithography to develop flexible substrates for efficient light matter interaction.



Ugur Deneb Menda (APOLO Partner)  
**Cenimat i3N- Universidade NOVA de Lisboa**  
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Portugal

**Ugur Deneb Menda** is a postdoc researcher working in Nanophotonics & Energy Lab, directed by Prof. H. Aguas and Prof. M. Mendes, developing perovskite solar cells with different perovskite structures and device combinations. I am responsible of synthesis of the layers, materials and device characterizations.



Laura Miranda Perez  
**Oxford Photovoltaics- Oxford PV**  
Unit 7-8 Oxford Industrial Park  
Mead Road  
Oxford OX5 1QU  
United Kingdom

**Dr. Laura Miranda Perez** is been heading the materials and characterisation department at Oxford Photovoltaics since 2015. With more than 15 years of experience on perovskite materials, Laura's expertise covers a broad range of materials and processes together with strong fundamental understanding on complex systems.

### 3. APOLO Open Day 2021 – Partner Organisations

#### LEITAT

Web: [projects.leitat.org/](http://projects.leitat.org/)



**LEITAT** is a private technical institute with more than 110 years of experience in industrial innovation processes. We transform technological and scientific results into economic and competitive value for our clients and collaborating entities. Over 1500 customers benefit from our talent, creativity and strong commitment. We bring knowledge and innovation to our customers through applied research and technical testing in the fields of chemistry, energy, environment, materials, engineering and life sciences. We rely upon our 330 highly skilled team members who deliver flexible solutions to face any industrial challenge.

#### The “École Polytechnique Fédérale de Lausanne” (EPFL)

Web: [www.epfl.ch/labs/lsmo/](http://www.epfl.ch/labs/lsmo/)



The “**École Polytechnique Fédérale de Lausanne**” (EPFL) is one of the two Swiss Federal Polytechnical Schools. A multi-cultural institution at the cutting edge of science and technology, EPFL fosters innovation and excellence. EPFL has a unique organisation that stimulates interdisciplinary research and fosters partnerships with other institutions and companies, with both theoretical and applied research being carried out. With more than 350 laboratories and research groups on campus, EPFL is one of the Europe’s most innovative and productive technology institutes and is also renowned for the quality of its teaching and training programmes. In 2014 the Shanghai Jiao Tong ranking placed EPFL third in Europe and 19th worldwide in Engineering/Technology and Computer sciences, and many other global comparisons place it among the top European universities.

## **Arkema**

Web: [www.arkema.com](http://www.arkema.com)



**Arkema** is an international company with sales in the field of Specialty Chemicals. The company was created in 2004 as a spin-off of Total, a multi-national company in the field of Oil Extraction, Refining, Distribution, and Petrochemistry. Since 2004, Arkema has specialized in Industrial, and Specialty Chemicals, as represented by its three main poles: High Performance Materials, Industrial Specialties, and Coating Solutions. At present, Arkema is considered as one of the most innovative companies in the world (Thomson Reuters list of the 100 most innovative companies in the world). In 2013, Arkema’s sales were of around 6,5 billion €. The company employs near 14000 people in 40 countries, and 85 industrial facilities. Arkema and its subsidiaries account for 10 R&D centers worldwide.

## **CEA**

Web: [www.cea.fr](http://www.cea.fr)



The “**Commissariat à l’Energie Atomique et aux Energies Alternatives**“ (**CEA**) is an internationally recognized research organization in the domains of energy, information and health technologies and defense. Its LITEN Institute (Lab. for Innovation in New Energy Technologies and Nanomaterials, 1000 people, 770 patents) is a major partner of fab to lab R&D with 350 collaborative research contracts running this year. The laboratory of PV modules technologies develops printed cells and modules, reaching world level efficiency. The laboratory is involved in the scaling up of these technologies using industrially compatible technologies (Inkjet and roll to roll printing). Stability studies is also an important theme of research with appropriate facilities enable to measure PV parameters in various accelerated climatic conditions and the development of home-made technics particularly in the field of gas barrier and encapsulation characterization.

## **ACCUREC**

Web: [www.accurec.de](http://www.accurec.de)



**ACCUREC**, founded in 1995, is a technology-based treatment company to manage secondary raw materials. At its plant in Germany ACCUREC has installed several of its unique and own developed innovative treatment techniques, dedicated to the recycling of used batteries. This European battery recycling center enables ACCUREC to recycle every modern type of industrial and consumer rechargeable battery with the best available technology at zero emission.

## **Fraunhofer-Gesellschaft**

Web: [www.ise.fraunhofer.de](http://www.ise.fraunhofer.de)



The **Fraunhofer-Gesellschaft** is the leading organization for applied research in Europe. Its research activities are conducted by 69 institutes and research units at locations throughout Germany. The Fraunhofer-Gesellschaft employs a staff of 24,500, who work with an annual research budget totalling 2.1 billion euros. Of this sum, 1.9 billion euros is generated through contract research. More than 70 percent of the Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and from publicly financed research projects. International collaborations with excellent research partners and innovative companies around the world ensure direct access to regions of the greatest importance to present and future scientific progress and economic development.

## **The University of Rome “Tor Vergata”**



Web: [web.uniroma2.it](http://web.uniroma2.it)

The **University of Rome “Tor Vergata”** is based on a campus of 600 hectares with 43000 students and 19 Departments. The University has established in 2006 together with the Lazio Region the “Centre for Hybrid and Organic Solar Energy” (CHOSE). The centre's objectives are the research and development for the industrialization of organic and hybrid organic-inorganic technologies via three main steps: define a technological process for organic/hybrid cells, develop fabrication processes for industrialization, foster technology transfer towards SMEs. CHOSE has the main laboratory has a surface of 650m<sup>2</sup> with over 300sqm of class ISO7 clean room facilities with all the equipment necessary to carry out research on photovoltaic technology.

## **UNINOVA Research Institute**



Web: [www.uninova.pt](http://www.uninova.pt)

**UNINOVA Research Institute** is a multidisciplinary, independent, and non-profit research organization devoted to the development and application of new technologies, being organized in centers of excellence, involving more than 150 scientists and technologists. It was founded in 1986 by the Faculty of Sciences and Technology of the University Nova de Lisboa. UNINOVA will participate in the APOLO project through CEMOP – Center of Excellence in Microelectronics and Optoelectronics and Processes (Centro de Excelência de Microelectrónica e Optoelectrónica e Processos). The CEMOP areas of expertise are thin-film technologies and development of advanced materials, i.e., semiconductors, photonic material, transparent conductors, thermoelectric and electrochromic materials and devices.

## **Greatcell Solar Italia SRL**



Web: [www.greatcellsolar.com](http://www.greatcellsolar.com)

**Greatcell Solar Italia SRL** (formerly known as Dyesol Italia srl) is an Italian SME member of the Greatcell solar group of companies (formerly known as Greatcell Solar), the world leader in commercialisation of DSC and PSC Cells. Greatcell solar Italia supplies laboratory manufacturing and testing equipment for research and development of DSC & PSC cells and devices. The Greatcell Solar Italia team has a long history of collaborative development programs within the EU and Swiss and Italian communities and for industrial concerns. Greatcell Solar Italia develops new products, devices, components and materials in the DSC / PSC domain. Greatcell Solar Italia provides a complete turnkey design for DSC and PSC prototyping and product manufacture. Greatcell solar Italia has a wide expertise and patent portfolio, with particular reference to: DSC & PSC cells and module design, DSC and PSC manufacturing and testing equipment.

## **Flexbrick**

Web: [www.flexbrick.net](http://www.flexbrick.net)



**Flexbrick** is a company owned by Piera Ecocerámica y Cerámica Malpesa, dedicated to the manufacture of a new construction system. This new system consists of a woven metal mesh in which mainly ceramic pieces of different sizes, shapes and textures can be inserted, but also other types materials such as glass, metals, stone, wood, etc. Flexbricks' versatility and features allow you to “play with the design offering a wide variety of aesthetical solutions. Flexbrick has applications for both facades and floors, roofs, pergolas, false ceilings, and more. Flexbrick is an industrialised construction system that combines technological innovation with traditional materials and makes it possible to use small pieces to carry out large-scale projects.

## **Cambridge Nanomaterials Technology Ltd (CNT)**



Web: [www.cnt-ltd.co.uk](http://www.cnt-ltd.co.uk)

**Cambridge Nanomaterials Technology Ltd (CNT)** is an innovation management and nanotechnology consulting company based in Cambridge, UK. The CNT Ltd helps companies, academic and government institutions to develop world-class innovative solutions for nanomaterials related R&D and IPR strategy, partnership, products, technologies, funding and markets. CNT Ltd is specialised in carbon nanomaterials R&D consulting and collaborative R&D project management, including exploitation and dissemination management, consortium and supply chain building. CNT has done a number of patent landscaping and market research analysis studies regarding production and use of various nanomaterials helping to link inventors and technology developers with end-users and investors.

# 4. APOLO Open Day 2021 – Participating Organisations

## **Oxford PV**

Web: [www.oxfordpv.com](http://www.oxfordpv.com)



**Oxford PV** is a SME focused on the commercialisation of perovskite/Si tandems. Oxford PV R&D centre is located in Oxford, while the factory site is placed in Brandenburg, Germany. Oxford PV is starting commercialisation of PVSK/Si tandem cells in 2022.

## **University of Cambridge**

### ***Department of Materials Science and Metallurgy***



Web: [www.msm.cam.ac.uk](http://www.msm.cam.ac.uk)

The **Department of Materials Science & Metallurgy** has a large and vigorous research school, with about 100 research fellows, postdoctoral scientists and visiting scientists, and more than 140 research students studying for the postgraduate degrees. The growth in our research activities over the past twenty years has been almost exponential, with a current research income of more than £10 million per year. Although our research has always been closely linked with industrial needs and supported in large part by industry as well as government, recent trends have seen the development of larger-scale working relationships with major research sponsors. Similarly,

our wide range of international contacts which bring visiting researchers to Cambridge has been extended through formal collaboration agreements with institutions from around the world.

### **StranksLab**

Web: [www.stranks.oe.phy.cam.ac.uk](http://www.stranks.oe.phy.cam.ac.uk)

The **StranksLab** is a research group led by Dr. Sam Stranks, based jointly in the **Department of Physics and Department of Chemical Engineering & Biotechnology**. We have a team of about 40 researchers including PhD students, postdoctoral scholars, undergraduate and masters students and our research focuses primarily on the optoelectronic properties of emerging semiconductors (mainly halide perovskites) for various light harvesting and light emission applications. Besides fabricating devices like solar cells, LEDs and photo (and X-ray) detectors, our group routinely uses optical spectroscopy to understand material and device photophysics on a range of length and time scales, and relate these characteristics directly to local chemical, structural, and morphological properties through multimodal measurements.

### **Horizer**

Web: [www.horizer.tech](http://www.horizer.tech)



**Horizer** aims to fragmentize and democratize the energy market by providing every person with the means to have clean, mobile energy accessible, shareable, and tradeable anywhere. Companies with a vehicle fleet and vehicle owners use Horizer's solar module and energy app to reduce fuel consumption, lower cost, and CO2 emissions.

### **CHOSE, University of Rome Tor Vergata**

Web: [www.chose.uniroma2.it/en](http://www.chose.uniroma2.it/en)



**The Centre for Hybrid and Organic Solar Energy (CHOSE)** was founded in 2006 from the will of the Lazio Region and the University of Rome Tor Vergata to create a center of excellence in the field of next-generation photovoltaics. CHOSE is distributed across several laboratories, both within the University Campus of Tor Vergata and the Technopole Tiburtino. The latter consists of a 400 square meter laboratory that houses equipment for the fabrication and characterization of organic, hybrid, dye sensitized and perovskite photovoltaic cells, modules and panels and 150 square meters of office space for the incubation of spin-offs generated from research at CHOSE. The other laboratories, totalling roughly 300 square meters in extension, are located within different departments of Tor Vergata. At CHOSE there work more than 30 researchers including graduate students, postdocs and staff. CHOSE has also many collaborations at the regional, national and international levels. The main objectives of CHOSE consist in the development of fabrication processes for organic and hybrid organic / inorganic solar devices, the definition of a process for the industrialization of these innovative photovoltaic technologies, the technological transfer of these and the development of photovoltaic applications in collaboration with companies at both the domestic and international level.

## **TEKNIKER**



Web: [www.tekniker.es](http://www.tekniker.es)

TEKNIKER was founded in 1981 as a non-profit Spanish technology center and legally became a foundation in 1996, based on a statutory commitment aimed at upgrading the competitiveness of the industry and its services via technological support. Tekniker defines itself as a center of mechatronics, manufacturing technologies and micro technologies, in areas such as industrial products, design and consumer goods. At the end of 2013, Tekniker counted 265 experienced researchers. TEKNIKER has participated in 32 FP6 projects and 55 FP7 project and in a high number of national and regional projects. IK4-TEKNIKER is member of the IK4 Research Alliance, one of the top 10 private R&D corporations in Europe with over 1,430 professionals, 23% of the staff are PhD holders, and an overall income exceeding 103 M€. IK4 has 152 patents in force and has set up a total of 71 new technology-based companies employing about 750 people.

## **ÁBACO Estudios y Proyectos**



Web: [www.abaco.biz](http://www.abaco.biz)

**ÁBACO Estudios y Proyectos** carry out their activities within the fields of construction, urbanization and industry, offering technical support for the design and calculation of facilities

## **EDILIANS**



Web: <https://edilians.eu/>

EDILIANS is the new name of IMERYS Roof Tiles, a long-established terracotta tile manufacturer and market leader in France. Over the course of its development, our company has successfully brought together a range of prestigious, iconic brands of terracotta tiles: Doyet, Gélis, Huguenot, Jacob, Phalempin, Poudenx, Sainte Foy and Sans, some of the greatest brands of terracotta tiles in the region, are all part of the EDILIANS heritage. EDILIANS is an Industrial company with 1000 people and 300 M€ turnover, Its main activity in roofing products for building industry. Clay tiles – photovoltaic modules and systems

## **BIREN**



Web: [www.biren.es/en/home](http://www.biren.es/en/home)

**BIREN** is an Engineering & architecture company. Development of renewable energy projects integrated in buildings and urban environments through technical studies, product development and digitalization. BIREN works to meet several of the sustainable development goals such as reducing emissions, the drive towards a circular economy and energy efficiency, and the fight against energy poverty.

## University of Sheffield



### **EPMM group**

Web: <https://epmm.group.shef.ac.uk/>

The **Electronic and Photonic Molecular Materials (EPMM)** group is based in the Department of Physics and Astronomy at the University of Sheffield. We have a long-standing interest in many aspects of the physics and technology of solution processable semiconductors and optoelectronic devices. Current research programmes includes detailed study into perovskite and organic photovoltaic devices, organic field-effect transistors and organic and hybrid-semiconductor photonic devices. My particular sub-group focus on research towards stable, scalable and high efficiency perovskite solar cells.

## Helmholtz-Zentrum Berlin



Web: [www.helmholtz-berlin.de](http://www.helmholtz-berlin.de)

**Helmholtz-Zentrum Berlin (HZB)** has existed since 2009. Its roots go much further into the past, given that HZB arose from the fusion of two older research institutions, the former Hahn-Meitner-Institut (est. 1959) and BESSY GmbH (est. 1979). With approximately 1,100 employees, HZB is now one of the largest non-university research centres in Berlin, and a member of the Helmholtz Association. HZB conducts research at two locations, in Wannsee and Adlershof. Materials for a sustainable energy supply and operation of the electron storage ring BESSY II – those are the cornerstones of HZB and its research. Both of these fields complement each other, since questions arising from research continually drive the advancement of the experimental environment at BESSY II and vice versa; the possibilities that BESSY II offers accelerate energy research enormously.

## Dr. Babasaheb Ambedkar Marathwada University Aurangabad



Web: [www.bamu.ac.in](http://www.bamu.ac.in)

**Dr. Babasaheb Ambedkar Marathwada University (BAMU)**, formerly Marathwada University, is located in Aurangabad, Maharashtra, Republic of India. It is named after Bharat Ratna "Babasaheb" Ambedkar, an Indian jurist, political leader, academic and the chief architect of the Indian Constitution. This university was established primarily on the initiative of Babasaheb Ambedkar so as to fill the huge lacuna of higher education facilities in western Vidarbha, Marathwada and North Maharashtra region. The university was established on August 23, 1958. This university has contributed to the progress of adjoining regions and people in innumerable ways. Since its inception, the university has around 428 colleges affiliated to it, which come under four districts (Aurangabad, Jalna, Beed and Osmanabad) of Maharashtra State. The student population exceeds 4,44,336.

## IMOMECE, associated laboratory of IMEC

Web: [www.uhasselt.be/IMO](http://www.uhasselt.be/IMO)

[www.imec.be](http://www.imec.be)



**IMOMECE (Institute for Materials Research in MicroElectronics)** is an **IMEC** associated research lab in Diepenbeek, Belgium. We have an intensive collaboration with IMO (Institute for Materials Research at the University of Hasselt). While most of the more fundamental research is carried out at IMO, the largest part of applied research and collaborative projects (with industry) are concentrated within IMOMECE. Our joint activities focus on wide band gap materials, organic synthesis, organic and hybrid materials for electronic applications, precursors for nanomaterials, biosensors, nanophysics and electrical, physical and chemical characterization.

## **KU Leuven**



Web: [www.biw.kuleuven.be/m2s/cmacs](http://www.biw.kuleuven.be/m2s/cmacs)

### ***CMACS – Centre for Membrane Separations, Adsorption, Catalysis and Spectroscopy for Sustainable Solutions.***

**CMACS** forms an interdisciplinary and international team that pioneers research in catalysis, energy, spectroscopy and separations. A molecular understanding of physical and chemical phenomena during synthesis and application of catalysts, sorbents and membranes is central to allow molecular and structural design of novel materials and directed engineering of applications.

The **Roeffaers lab** develops cutting-edge microscopy tools for the determination of nanoscale structure-function relationships of catalytic and energy materials. These insights are used to direct the synthesis of materials (zeolites, supported metal catalysts, cluster-based phosphors and perovskites) with improved performance.

## **Green Energy Park (IRESEN)**



Web: [www.greenenergypark.ma](http://www.greenenergypark.ma)

**Green Energy Park** is a solar energy testing, research and training platform located in the green city of BenGuerir. It was developed by the Research Institute for Solar Energy and New Energy (IRESEN) with the support of the Ministry of Energy, Mines, Water and Environment as well as the OCP Group. This first platform in Africa, a unique model, allows on the one hand, the creation of synergies and the pooling of research infrastructures to create a critical mass and achieve excellence, and on the other hand the acquisition of knowledge and know-how by the various partner universities as well as industrialists.

## **FLUXiM AG**



Web: [www.fluxim.com](http://www.fluxim.com)

**FLUXiM AG** provides simulation software and measurement hardware for research and development of displays, lighting, and photovoltaic cells in industry and academia. Design and optimization of organic, quantum dots and perovskite solar cells and LEDs are possible with our products.

## **Saule Technologies**



Web: [www.sauletech.com](http://www.sauletech.com)

**Saule Technologies** is a high-tech company that develops innovative solar cells based on perovskite materials. We have pioneered the use of inkjet printing for the production of flexible, lightweight, ultrathin, and semi-transparent photovoltaic modules.

## **Chulalongkorn University**

### ***Metallurgy and Materials Science Research Institute, MMRI***



Web: [www.material.chula.ac.th/en](http://www.material.chula.ac.th/en)

Established in 1986, MMRI serves as one of the key materials research institute in the country devoted to the development and utilization of materials technology that foster the advancement of sustainability and manufacturing efficacy of the industries and local communities.

Furthermore, with strong teams of research staff, MMRI's determined to develop high-impact research of academic interests, as well as to contribute in the development of university students and human resources in various fields.

## **Cicci Research**



Web: [www.cicciresearch.it](http://www.cicciresearch.it)

Core business of **Cicci research** are advanced testing platform (ARKEO) for opto-electronic devices, especially hybrid organic-inorganic photovoltaics. Activity started 2016 with more than 60 international publications reporting Arkeo results. Involved in StableNextSol COST action regarding degradation mechanisms in such photovoltaic technologies.

## **Power Roll Ltd**



Web: [www.powerroll.solar](http://www.powerroll.solar)

Power Roll has invented a fundamentally new way to generate and store energy.

Our technology is based on a flexible film patterned with thousands of microgrooves. The grooves are a few microns thick - smaller than a human hair.

## **Justus Liebig University Giessen**

### ***Center for Materials Research (ZfM/LaMa)***



Web: [www.uni-giessen.de/en](http://www.uni-giessen.de/en)

The **Center for Materials Research (ZfM/LaMa)** is a cross-departmental institution of the **Justus Liebig University Gießen**, which is open to all JLU groups working in the field of materials science. The Center for Materials Research supports and networks these JLU groups, coordinates materials science research and promotes teaching in the field of materials science. The work is focused on the development of cooperative research projects, their coordination and the establishment of a sustainable network with external academic and industrial partner institutions.

## **PEROVSKIA**

PEROVSKIA is a start-up based in Switzerland. It is a supplier of customizable perovskite solar cells to OEMs.

## **Radiocoax sp. z o.o.**

Web: [www.radiocoax.pl](http://www.radiocoax.pl)



Radiocoax is a medium size company with portfolio includes projects and products applicable in the wider defence sector, public transport and telecommunications. Radiocoax since its inception operated as an integrator of ICT solutions in civil and military sector. The Company continuously perform research and development, production / assembly wires low and high frequency of the use of copper conductor and fiber. We use components of world leaders in technology.

## **University College London**

### ***Institute for Materials Discovery***



Web: [www.ucl.ac.uk/institute-for-materials-discovery](http://www.ucl.ac.uk/institute-for-materials-discovery)

The UCL Institute for Materials Discovery (IMD) has relationships across the 3 faculties within the BEAMS school: The Faculty of Mathematical and Physical Sciences (MAPS), the Faculty of Engineering Science, and the Bartlett, and also with the NIHR Biomedical Research Centre. UCL's world-leading research in new materials and related areas that span a wide range of disciplines across the institution;

- to integrate fundamental chemistry, physics, materials, engineering and biological principles across the disciplines
- to create new opportunities in materials creation, discovery and exploitation for the development in clean energy, nanotechnology, engineering and biomedicine technologies.
- to accelerate and integrate materials discovery, together with sustainable and economical processing into novel products and applications.

## **Northumbria University**



Web: [www.northumbria.ac.uk](http://www.northumbria.ac.uk)

Northumbria is a research-rich, business-focused, professional university with a global reputation for academic excellence. It is based in the heart of Newcastle upon Tyne, which is regularly voted the best place in the UK for students. The University has its origins in the Rutherford College, founded in 1880. Today, by putting students at the heart of an outstanding experience, and with world leading research and award-winning partnerships, Northumbria is a new kind of excellent university. Northumbria is top ten in the UK for the number of graduates entering professional employment and nine out of ten of our graduates are working or studying six months after graduation. We are ranked 21st out of 111 universities in the 2014 Times Higher Education Student Satisfaction Survey.

## **Cenimat i3N- Universidade NOVA de Lisboa**

Web: [www.cenimat.fct.unl.pt](http://www.cenimat.fct.unl.pt)



**CENIMAT|i3N** is a national scientific research center sponsored by the Ministry of Science, Technology and Higher Education, through the Foundation for Science and Technology. This center has been evaluated by a panel of international experts in the field of Materials Science and Engineering since 1996, who classified it as EXCELLENT. This grade reflects the high technical and scientific merit of the R&D activity carried out by CENIMAT researchers, translated by the quantity and quality of the scientific publications produced and the high number of scientific and technological projects. This same panel of experts also recognized that CENIMAT could be considered at a National level as “a model of excellence in the field of Materials science and engineering”.

## **Institut for Solar Energy Research Hamelin**

Web: <https://isfh.de/en/>



Research institute with ~160 members for solar energy research. We are cooperating with the industry, with other research institutions, and with universities. ISFH is associated with the “Leibniz Universität Hannover”.

## **Institut des Matériaux Jean Rouxel (IMN)**

### ***Armor Solar Power Films***

Web: [www.cnrs-imn.fr/index.php/en/the-institute/the-institute](http://www.cnrs-imn.fr/index.php/en/the-institute/the-institute)



The **Institute of Materials** was created in 1988 by the renowned French chemist Jean Rouxel. Drawing together chemists, physicists and materials engineers from the CNRS and the University of Nantes, with over 150 researchers and support staff it now represents one of the largest materials research centres in France. Research projects are diverse, including collaborations with industry, and other national and international research organisations.

## **The University of Sydney**

### ***The Perovskite Research Group***

Web: <https://anitagroup-perovskite.sydney.edu.au/>



THE UNIVERSITY OF  
**SYDNEY**

The **Perovskite Research Group** is a dynamic research group based at the Sydney Nano Hub with laboratories for material synthesis, device fabrication and characterization, and solar cell and module testing at the University of Sydney. We are conducting research on Building Integrated Photovoltaics, Photovoltaic Driven Water Splitting for Clean Hydrogen, Stabilising Perovskite Solar Cells, and High-Performance Multi-Junction Cells.

Specific to metal halide perovskite solar cells, our aim is to achieve breakthroughs by improving the performance and stability of hybrid and inorganic perovskite single junction and tandem solar cells through innovative cell designs, scalable and cost-effective process engineering supported by advanced characterizations.

The group is also expanding its activities to optoelectronic devices such as LEDs, Sensors, and Nano-lasers.

## **Metalgrass LTD (Perovskite-Info)**



Web: [www.perovskite-info.com](http://www.perovskite-info.com)

**Perovskite-Info** is a news hub and knowledge center born out of keen interest in the wide range of perovskite materials.

## **Swansea University**



Swansea University  
Prifysgol Abertawe

Web: [www.swansea.ac.uk](http://www.swansea.ac.uk)

Swansea University is a research-led university established in 1920 and located in Swansea, Wales. Research into Photovoltaics is carried out at Swansea through the SPECIFIC Innovation and Knowledge Centre. SPECIFIC was established in 2010 in the emerging technology area of functional industrial coatings with a £20M grant from EPSRC, Innovate UK, the Welsh Government and industrial partners (Tata Steel, NSG Pilkington and Akzo Nobel). Its ultimate purpose is to nucleate and accelerate the creation of a new UK industry in disruptive coating technologies that can be applied to Buildings such that they can capture, store and release energy. The core focus is to develop the “Active Building” concept where new energy technologies are integrated into the building fabric to create an overall positive energy balance. This has been achieved in collaboration with established and nascent UK businesses by creating a critical mass of research and innovation expertise and establishing a National Centre of Excellence in Functional Coatings. One of the primary research activities at SPECIFIC is the scale-up and testing of 3rd generation photovoltaics. The initial research focus on solar energy materials at SPECIFIC since 2011 has been considerably reinforced in later years with a £7m investment (Sêr Solar) from the Welsh Government creating a strategic partnership with Imperial College and expanding the academic team on solar PV at Swansea. Swansea University hosts a doctoral training centre in functional coatings (The materials and manufacturing academy), is a partner for the EPSRC Supersolar hub and is becoming the nucleation and focal point for the UK's printed PV scale up activity. This is now followed with a EPSRC funded program grant (ATIP) led by SPECIFIC with Imperial College and Oxford University as academic partners.

## **Onyx Solar**



Web: [www.onyx-solar.es](http://www.onyx-solar.es)

**Onyx Solar** is the world's leading manufacturer of transparent photovoltaic (PV) glass for buildings. Onyx Solar uses photovoltaic glass as a material for building purposes as well as an electricity-generating material, with the aim of capturing the sunlight and turn it into electricity. The panes are made of layers of heat-treated safety glass which can provide the same thermal and sound insulation as conventional architectural glass, not to mention the fact that they also let natural light go through in the same way as conventional glass. Thus the photovoltaic glass glass panes could be installed replacing conventional glass on building facades, curtain walls, atriums, canopies and terrace floors, among other architectural applications. These glass panes could additionally be installed on a wide variety of existing buildings and facilities, therefore contributing to their enhancement both from an aesthetic and energetic point of view.

## **COATEMA**



Web: [www.coatema.de](http://www.coatema.de)

For more than 40 years the innovative equipment manufacturer from Germany provides flexible and efficient lab2fab solutions for coating, printing and laminating. Our business strategy and value proposition has been focused on innovations for growing markets with new coating technologies requirements, such as printed electronics, sustainable packaging, membranes, renewables and medicine. Our product portfolio covers the full range from tabletop solution up to production lines. In our 1200 sqm R&D center our customers can perform basic research, process development and the production of pilot and small production quantities, using 13 different machine platforms with over 20 application systems.

## **AIMPLAS**



Web: [www.aimplas.net](http://www.aimplas.net)

**AIMPLAS** is a technology centre with 30 years of experience in the plastics industry. We provide solutions to companies throughout the value chain, from raw material manufacturers to plastic processors and end users. AIMPLAS facts and figures (2020 data): +180 Professionals; +2,600 Customers; +700 Member companies; €14.6M Turnover; 218 R&D&I projects; 5,129 Technological services; 158 Training activities. Over 10500 m<sup>2</sup> of facilities with cutting-edge technology. Over 30 pilot plants are available to test all plastic processing applications, including thermoplastic, thermoset and composite processing. Our laboratories have the highest number of accreditations for plastics according to the UNE-EN ISO/IEC 17025 standard.

## **Heliatek GmbH**



Web: [www.heliatek.com/en](http://www.heliatek.com/en)

**Heliatek** was spun-off from the Technical University of Dresden and the University of Ulm in 2006. The company is one of the technology leaders in Organic Photovoltaics (OPV) through both its in-house development of organic photoactive materials and the production of OPV films based on small molecules. Heliatek operates two roll-to-roll manufacturing lines in Dresden, Germany. The lines produce flexible OPV foils in a vacuum process. Main achievement is the first volume production of flexible OPV foil on 1.3 m wide web. Heliatek maintains a total staff of ~200 specialists at its facilities in Dresden and Ulm, Germany. Investors in Heliatek include leading industrial and financial companies such as innogy, BNP-Paribas, Aqton and others.

## **Meyer Burger Research AG**



Web: [www.meyerburger.com/en](http://www.meyerburger.com/en)

**Meyer Burger** combines innovative cutting-edge technology with tradition and courage to create unique photovoltaic systems and production facilities. For almost 70 years, we have been the technological backbone of the industry and set standards - from diamond wire saws and industrial PERC solutions to precision measurement technology for solar modules. The vast majority of solar modules produced worldwide today are based on technologies developed by Meyer Burger.