THE EUROPEAN SOLAR VALUE CHAIN RAISES CONCERNS OVER LACK OF POSITIVE SIGNALS FOR THE INDUSTRY IN THE GREEN DEAL

The coalition ‘Solar Europe Now’, which has been officially launched on May 5th, is calling for the recognition of solar energy as a key driver to deliver on the European Green Deal ambitions. This coalition which gathers currently over 100 actors from the European solar value chain is concerned that the current lack of financial and R&D impetus to the sector will hinder its development, halt EU’s industrial sovereignty in strategic technologies and limit the EU’s effectiveness in achieving decarbonation throughout the continent.

Sun-generated energy is widely-recognised as crucial to build a secure and sustainable energy system, at the European and global level. All future energy scenarios developed by the EU to achieve climate objectives by 2050 foresee a key role for solar photovoltaic energy. Yet, the communication from the European Commission on the Green Deal, which constitutes the roadmap for EU authorities to encourage energy transition in the coming years, mentions the crucial role of renewable energy in the phasing out of coal and the decarbonation of Europe, but does not mention solar energy, contrary to offshore wind energy which is recognised as a key driver.

There is however a lot of potential in Europe for developing a strong solar industry. Photovoltaics currently cover 3% of total EU electricity demand, with a potential estimated at 15% in 2030. European research centers are dedicated to developing cutting-edge industrial solutions along the photovoltaic value chain. These new cutting-edge solutions provide the ground for a renaissance of globally competitive European industrial PV production. The overall annual global turnover of the European PV industry is currently estimated at 5 billion euros, but much of its potential remains untapped with high capacity for economic growth and job creation.

For Roch Drozdowski-Strehl, CEO of IPVF, a world-renowned photovoltaic research institute based in France, initiator of the coalition, scaling-up of research and innovation investments in the sector is key to fostering the development of this strategic industry and untap its full potential. “Together with the world leading research centres in Europe, Europe can lead the market of high-end PV cells and modules. In Europe, major institutes have positioned themselves strongly in the competitive race for new technologies. European institutions should support this by any way possible”.

Prof. Andreas Bett, Director of Fraunhofer ISE, Germany adds: “Some of the world’s most advanced technologies, such as tandem solar cells surpassing the efficiency values of silicon solar cells, as well as sustainable production technologies including cradle-to-cradle and recycling, are currently being designed in European research centers. Encouraging investments in these key technologies at EU level will provide unique opportunities for innovation breakthroughs and intellectual property developments while opening up space for newcomers”.

Stimulating R&D in the sector would not only reinforce the EU’s industrial sovereignty, with countries such as China which still produces 97% of the world’s solar panels, and strengthen its leadership in key strategic technologies, but also give positive signals to the manufacturers.

Edyta Witkowska-Grześkiewicz, Managing Director of Bruk-Bet Solar, Polish manufacturer of photovoltaic modules, testifies: “Thanks to advances in process automation and industry 4.0, it could be possible to manufacture PV materials and modules in Europe at a competitive cost. Such a European manufacturing industry will benefit from the technological innovations developed by the world-leading European research ecosystem, and it will deliver high-quality and low-carbon footprint solar panels to the fast-growing European market”.

Members of the Solar Europe Now coalition are calling on the European institutions to better recognise the strategic value of solar PV in upcoming climate, research & innovation and sustainable finance initiatives. The development of solar capacity is necessary to achieve the EU’s 2050 climate neutrality objective, and Solar Europe Now is committed to working alongside European decision-makers to discuss opportunities to shed some sunlight on the Green Deal and stimulate the European solar manufacturing capacity.

Roch Drozdowski-Strehl concludes: “Such a dynamic market provides the basis for revive the European solar manufacturing industry as well as creating more than 100,000 jobs across the value chain. The European Green Deal offers an opportunity to expand sustainable and job-intensive activities in the areas of low-emission technologies, thus compensating for the reductions in employment in the fossil fuel sector and in carbon-intensive processes. It is essential that we create a fitted policy and the financing framework to revive the European PV manufacturing capacity”.

Call to action Solar Europe
https://www.ipvf.fr/sen/
INFLUENCE OF ENVIRONMENT AND LIGHT-STRESS ON THE OPTOELECTRONIC PROPERTIES OF TRIPLE-CATION PEROVSKITE THIN FILMS

Operational stability is the main issue hindering the commercialisation of perovskite solar cells. In particular light and air/moisture exposure were proven to be responsible for the drastic reduction in device performance. In this study we report on the transport properties of triple-cation halide perovskite thin films and their evolution when exposed to air or vacuum and after light-soaking.Transport parameters were investigated by steady-state dark and photocurrent methods as well as by the steady-state photocarrier grating experiment (SSPG) from which the ambipolar diffusion length of thin film materials is estimated. Combined with other characterization measurements, such as photoluminescence and Fourier transform photocurrent spectroscopy, these techniques demonstrate that air plays an important role in the passivation of the surface trap states of the perovskite films. The competition between passivation and degradation of the films under light-soaking was deeply investigated. We demonstrate that the degradation of the transport parameters upon light-soaking could be linked mainly to a degradation of the carrier mobility instead of their lifetime. https://doi.org/10.1021/acs.ami.0c01732

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PHOTOLUMINESCENCE SPECTRA OF PEROVSKITE THIN FILMS OBTAINED WITH DIFFERENT LASER WAVELENGTHS IN DIFFERENT ENVIRONMENTS. IN (a,b), A 470 NM WAVELENGTH LASER ILLUMINATES PEROVSKITE FILMS UNDER AIR AND VACUUM, RESPECTIVELY. IN (c,d), A 670 NM WAVELENGTH LASER WAS USED FOR PEROVSKITE FILMS PL EXCITATION UNDER AIR AND VACUUM, RESPECTIVELY.

EFFECTS OF COPPER SUBSTITUTION BY ALKALI METALS ON THE PROPERTIES OF CHALCOPYRITES FOR TANDEM APPLICATIONS: INSIGHTS FROM THEORY

The effect of the copper substitution by alkali metals on the properties of chalcopyrite type materials for tandem applications in photovoltaics is investigated at the first-principles level. Since the target values of the band gap for tandem applications should be comprised between 1.5 and 1.8 eV, one part of results concerned the variation of calculated band gap values under the effect of substitution. A systematic study of the effects of Li, Na, K, Rb and Cs on the structural, electronic and thermodynamical properties of Cu(Ga,In)(S,Se)₂ has been performed. The evolution of the crystallographic cell with concentration of alkali metals turned out to be of two types: i) the substitution of Cu with Li and Na in CuInS₂, irrespective of concentration, leaves the underlying chalcopyrite structure unchanged, affecting only the lattice parameters; ii) the substitution of Cu with Na (except CuInS₂), K, Rb and Cs at sufficiently high concentration brings about a phase transition. In all cases, the band gap increases with the alkali concentrations, whereby only the indium-based chalcopyrites reach the above mentioned target values. The static stabilities of the substituted materials have been discussed in terms of substitution and formation energies. The comparison with the experimental situation and the impact of the novel predictions is discussed. https://pubs.acs.org/doi/abs/10.1021/acs.jpcc.0c01767

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SPATIAL DISTRIBUTION OF HOT CARRIER TEMPERATURE IN INGAAS MQWS

Hot carrier transport provides rich information about thermalization and thermoelectric properties of hot carrier absorbers. A hyperspectral luminescence system takes 3D images of radiation from materials, which can be applied to investigate hot carrier properties in semiconductors. Figure (a) shows a 3D image of a concentrated laser beam on an InGaAs multi-quantum well (MQW) structure held at 80 K (-193°C). Via studying photoluminescence (PL) spectra emitted from different areas across the sample, it is possible to determine the spatial distribution of hot carrier temperature in the system. The spatial distribution of hot carrier temperature with respect to the emitted PL and laser beams are plotted in Figure (b). It is observed how the hot carrier temperature changes around the concentrated laser light. Via this contact-less measurement, it is possible to investigate hot carrier properties of an absorber material for hot carrier solar cell applications.

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SLOT-DIE COATED PEROVSKITE CELLS AND MODULES

Sequential slot-die-coating, a wet-deposition technique recently developed at IPVF, allows for deposition of homogeneous perovskite films up to 5 x 10 cm². Devices fabricated using this industrially viable process reached power conversion efficiencies up to 16 % for single cells (0.09 cm²) and 14 % for mini modules (6 cells, 12 cm²). The figure shows a schematic overview of the slot-die coating process as well as the J-V curves for a single cell and a mini-module respectively.

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ALD-ZnO:Ti AS EFFICIENT TRANSPARENT CONDUCTIVE OXIDE IN SILICON NANOWIRE SOLAR CELLS

Within the development of functional materials at IPVF and the efforts to replace indium-tin-oxide (ITO), Ti-doped zinc oxide (TZO) thin films have been synthesized by atomic layer deposition (ALD) and the first application of ALD-TZO as an n-type transparent conductive oxide (TCO) was reported. Several process parameters were optimized. A growth mechanism has evidenced the insertion modes of titanium and identified the impact of the precursor introduction on the film growth mechanism and final properties. Resistivity as low as 1.2 x 10⁻³ Ω cm and transmittance > 80% in the visible range were obtained for 70-nm thick films. TZO films were successfully implemented as top electrodes in silicon nanowire solar cells developed at LPICM (M. Foldyna). The unique properties of TZO combined with conformal coverage realized by ALD technique make it possible for the cell to show almost flat EQE response, surpassing the bell-like EQE curve seen in devices with sputtered ITO top electrode. ALD-TZO shows the great potential to work as effective TCO electrode, particularly for nanostructured solar cells. For more details: https://dx.doi.org/10.1021/acsami.9b22973

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HIGHLIGHTS FROM THE RESEARCH PROGRAM

MODELING OF OPTICAL PROPERTIES OF BUTTERFLY WINGS

Lots of living organisms have colours which are due to periodic arrangements of micro or nanostructures, such as bird feathers, butterfly wings or some insects. In some cases, these structures are photonic crystals and have a photonic gap for certain wavelengths. For some species, these optical properties depend on the direction from which they are observed. In addition to these characteristic colours, insects must draw their energy from the environment. Solar cells face the same problem of temperature. Both efficiency and life time are concerned since solar conversion efficiency decreases with solar cell operating temperature. We study wings of * Asterope Leprieur* (fig. 1). This butterfly presents structural colours with iridescence. The SEM observations show that a photonic structure composed of a lattice of rectangular air holes seems to be responsible of these structural colours (fig. 2). To characterize the iridescence, angular spectroscopy and diffuse reflection were realized. Lots of spectra are obtained and then chromaticity diagrams CIE may be traced (fig. 3). We can observe that the colour is not exactly the same when the incident light is at normal incidence and when this same incident source is inclined at an angle of 45°, for example, with respect to normal. Based on these observations we designed a periodic lattice of rectangular air holes and obtained the spatial distribution of the electric field |E|² for different wavelengths (fig. 4). Thermal characterizations have also been initiated to combine both thermal regulation and photonics. Thanks to these characterizations and simulations, we will propose an innovative structuration of the surface of the solar cell that will help improve their aesthetic appeal while reducing their temperature under operation. This may open new markets and will increase their service life.

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PUBLICATIONS


CONFERENCES TO COME

**Online International Conference on Hybrid and Organic Photovoltaics**  
25-28 MAY 2020  
[www.nanoge.org/OnlineHOPV20/home](http://www.nanoge.org/OnlineHOPV20/home)

**47th IEEE: Photovoltaic Specialists Conference, Virtual Meeting**  
15 JUNE - 21 AUGUST 2020  
[www.ieee-pvsc.org/PVSC47/](http://www.ieee-pvsc.org/PVSC47/)

**Virtual Chalcogenide PV Conference 2020**  
25-28 MAY 2020  
[www.helmholtz-berlin.de/events/pvconf2020/index_en.html](http://www.helmholtz-berlin.de/events/pvconf2020/index_en.html)

**IPVF Scientific Day**  
25 JUNE 2020

**37th EU PVSEC**  
7-11 SEPTEMBER 2020, LISBON  

**200 Anniversary of Edmond Becquerel**  
7 DECEMBER 2020  
[www.ipvf.fr/edmond-becquerel-symposium/](http://www.ipvf.fr/edmond-becquerel-symposium/)

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### ONLINE CONFERENCES

**Daniel Suchet**  
Photovoltaïque:  
État des lieux, ordre de grandeur et perspectives  
[https://www.youtube.com/watch?v=q9dofx0FUoc](https://www.youtube.com/watch?v=q9dofx0FUoc)

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