Apolo

NEWSLETTER

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Advances in Flexible Perovskite Solar Cells

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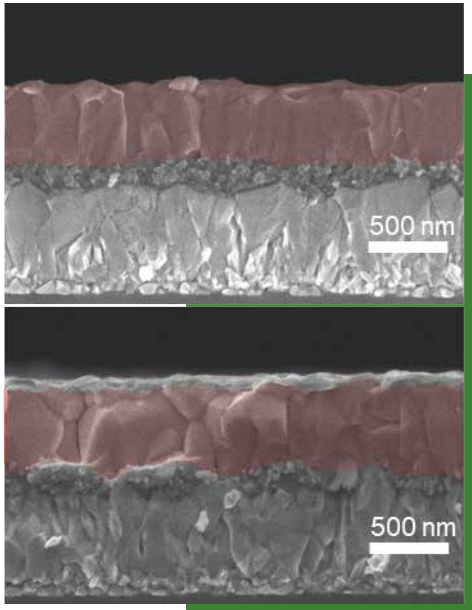
The APOLO consortium is glad to publish its first newsletter. After a bit more than a year, the project presents a summary of the activities performed in the main work packages, especially the technical ones. Activities concentrate on the development of new materials for PSC, on its performance, on its manufacturing, and stability and recycling. We hope you enjoy the reading and learn more about this exciting project.

Work Package 2

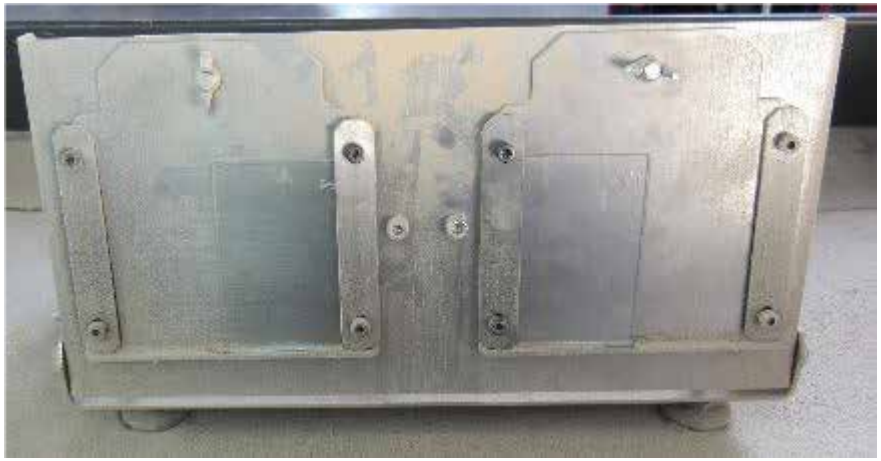
Advanced Optoelectronic Materials for Perovskite Solar Cells (PSC)

New materials for the solar cells are showing good results in terms of performance and stability. For instance, new Hole Transport Materials (HTMs) were developed at the EPFL, such as the benzo [2,1-b;3,4-b'] dithiophene – based and 2D perovskites used as dopant free HTMs. In addition, the consortium is working on the study of the polymerization kinetic and gas barrier properties of the developed encapsulation materials at CEA and ARKEMA.



Moreover, the low-pressure plasma activation parameters on commercial gas barrier films have been studied by Leitat as surface pre-treatment for the deposition of anti-soiling coatings.
After the application of commercial anti-soiling coatings on activated gas barrier films, water contact angle has been characterized and soiling tests have been done.

In the upcoming months, the APOLO consortium will concentrate on the following tasks: the optimization of HTMs and triple cation perovskite absorbers, the modification of the encapsulants with nanoparticles as adhesion promoters, and start formulating coatings/ grafting strategies for the development of anti-soiling coatings.



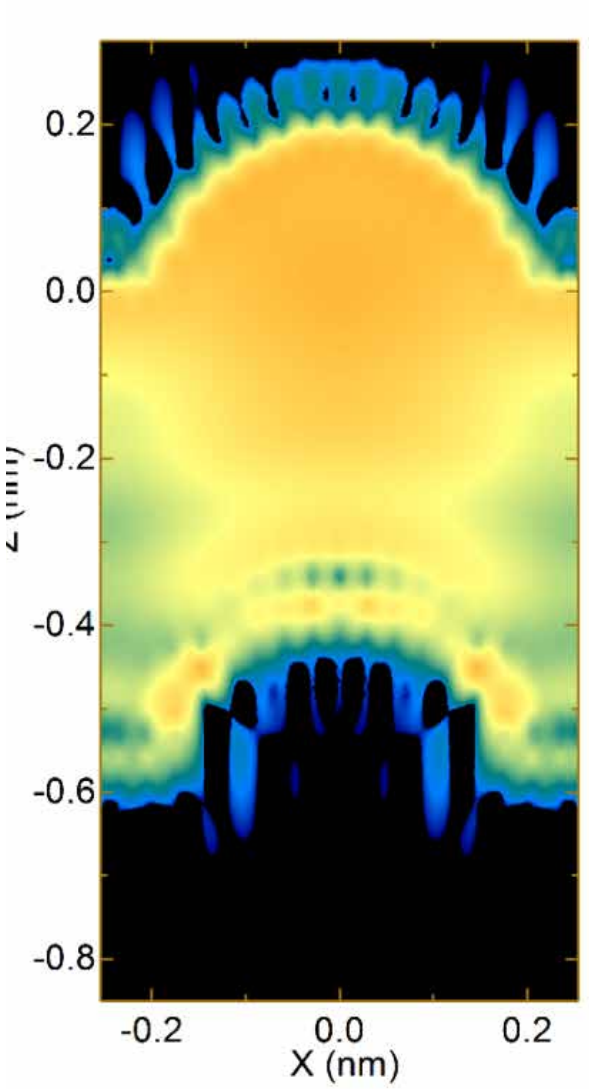
Work Package 3

Modelling focused on high performance PSC and module

In this work package, UNINOVA researchers defined optical optimization of light trapping (LT) structures for reference Perovskite Solar Cells (PSCs) with optically-favorable layer structure.
Full optical and electrical models of LT-enhanced reference PSCs are ready and currently under corroboration. The SpiceGUI tool developed by Fraunhofer Institute for module modelling has been tested with cells produced at UNITOV. In this model the perovskite module is described in terms of a network of elementary cells connected by resistors and it has been used to study the dependence with the cell width and the number of the cells of the tested devices.

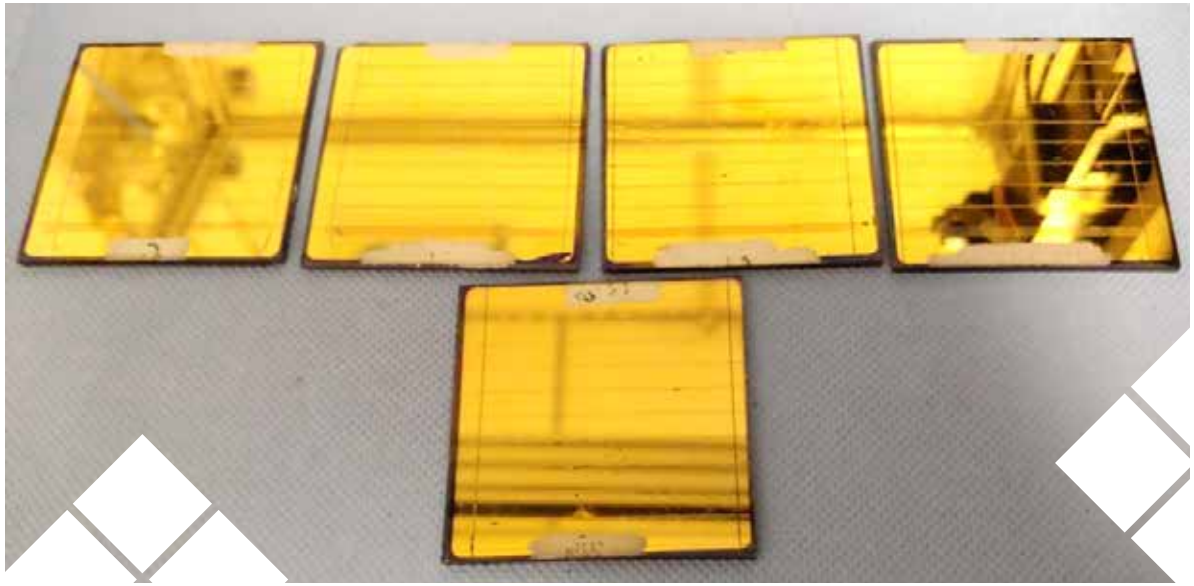
Some actions in progress are the optical optimization of LT structures for PSCs with APOLO layer structures and the respective opto-electronic optimization of LT-enhanced PSCs.

Next steps include to conclude corroboration of full opto-electronic models of PSCs to extract IV (Current-Voltage) and QE (Quantum Energy) curves, to perform opto-electronic optimization of all relevant PSC parameters, to refine model parameters to better match, to modify SpiceGUI or implement ad hoc interface for easier construction of multi-cell arrays and to handle more easily spatially variable cell parameters.



Work Package 4

Printing manufacturing of PSC cells and modules



This part has different activities in progress focused in the optimization of the low temperature processing of the different PSC layers. UNITOV is working on the improvement of the large area spray coating of Electron Transport Materials (ETM) and on the combination of spray coating deposition techniques for large area devices. On other hand Fraunhofer is exploring the use of Atomic Layer Deposition (ALD) for Electron Transport Layer (ETL) production.

Several architectures on glass have been tested at CEA with different absorbers layers and moved to flexible substrates using the same processes at low temperature. The study of solubility of perovskite precursors in non-toxic non hazardous solvents by using Hansen Solubility Parameters (HSP) approach has been started at LEITAT with the comparison and determination of the perovskite HSP using the binary solvent gradient method. With these parameters the first batch of potential green solvents has been determined. Finally, UNINOVA is working on the implementation of the LT structures simulated on WP3 though the study of 2 colloidal lithography approaches for the fabrication of photonic-structured flexible substrates.

Work Package 5

Stability and recycling strategies

The activities in progress in this WP include new trials of encapsulation for rigid and flexible PSCs with different encapsulation procedures (UV curing, vacuum lamination) and materials (sealing materials, gas barrier films, etc..). In the case of polymeric based cells 3 encapsulation process using materials coming from WP2 have been tested at CEA. Other activities such as perovskite stability tests with benchmark adhesives and definition of protocols for sample interchange within the consortium are in progress. Thermochemical modeling of the reference system for APOLO has been carried out by ACCUREC with the thermal decomposition of lead halides for recycling process design. Now they are experimentally validating the process and doing test with evaporation of perovskites..

Work Package 6

Technical, social and environmental assessment

In this work package, a Life Cycle Analysis (LCA) screening was performed of materials and processes associated with reference PSC configurations chosen by the APOLO consortium. For this initial LCA analysis LEITAT defined a preliminary system boundary and functional unit, and inventory data was collected from all partners involved in materials development and processing. The analysis of the received data, and an extensive review of relevant literature, resulted in a comprehensive LCA screening report that identifies environmental hot-spots, as well as the pros and cons associated with each reference cell from an environmental standpoint. These inputs will serve as decision tool for the development and choice of final APOLO materials and processes.

Next steps are the gradual collection of inventory and cost data for the final APOLO demonstrators, to inform the final LCA and Life Cycle Costing (LCC) report.