InGrid
High efficiency PV modules based on back-contact cells and novel interconnecting grid

Project Duration: 01.2015 to 05.2017
Final report submitted: 10.2017

Publishable Summary

The overall goal of the project is to develop a new module technology for high efficiency rear contact and bifacial solar cells. The cells are interconnected by conductive tracks embedded in the encapsulation material, replacing the ribbon typically used in industry for interconnecting solar cells by soldering. The conductive tracks were produced by screen-printing directly on the encapsulant substrate. To enable this process, conductive inks were developed allowing for a photonic sintering process at low temperatures being suitable for the temperature limitations given by the encapsulant. The printing and sintering process for the conductive ink material as placed on the substrate (EVA, POE), as well as its stability during lamination process, have been critical points within this project. In addition, the high efficiency solar cell concept has been modified to suit the requirements for the conductive inks (as geometrical needs and conductivity) to allow for a reliable and low series resistance interconnection of conductive structure to cell. After different tests, a reduction on the cell area to 1/8 of standard ZEBRA cell size was agreed to minimize the FF losses related with the high resistive losses within the conductive encapsulant and contact areas.

The novel material combination (conductive ink on encapsulant) has been subject to climatic and outdoor testing to prove the concept and longevity of the product. The delivery of the project is a targeted loss in cell-to-module losses of max. 2% as compared to standard modules interconnected by soldering ribbon process due to the superior conduction path reached by printing conductive inks instead of soldering copper ribbon. This target has been achieved after several changes in the design of cell (reduction to 1/8 size), and an increase in the height of the conductive ink tracks.

Regarding the processing technologies, focus has been set on applying conductive inks on flexible substrates and on developing the involved materials to reach the stringent specifications of mechanical strength, electrical serial and contact resistance after a typical lamination cycle. For low series resistance interconnection of IBC cells, the metallization scheme has been adapted for encapsulation foils with integrated conductive layers.

The project “InGrid” combines product and process development and delivers a novel module interconnection technology with superior outcome in terms of application and cell-to-module losses. Long term stability (UV and DH) testing has been satisfactory and only TC and PID has showed lower performance compared to references with soldered ribbons.

Project consortium

Coordinator and all contact details:

Full name of organisation	Specialized Technology Resources España, S.A.
First and family name of coordinator:	David Gómez Espina
Full address:	Parque Tecnológico de Asturias; Parcela 36; 33428 Llanera, Spain
E-mail:	david.espina@stresp.com

Participating countries and financing:

Country	**Number of organisations involved**	**Project costs in EUR**	**Public funding in EUR**
Spain	2	299’889	149’943
Germany	1	184’994	36’999
United Kingdom	1	204’810	122’886
Total	*4*	*689’693*	*309’928*

Funding agencies involved and contracts

Funding Agency	**Contract N° and Title**
Ministerio de Economía y Competitividad (MINECO)	PCIN-2014-142-C02-02 Módulos fotovoltaicos de alta eficiencia con nueva lámina encapsulante conductora
Bundesministerium für Wirtschaft und Energie	0325821 – “Anpassung hocheffizienter n-Typ Rückkontaktsolarzellen für neuartige Verkapselungs-materialien mit leitfähigen Strukturen
Ministerio de Economía y Competitividad (MINECO)	PCIN-2014-141-C02-01 Módulos fotovoltaicos de alta eficiencia con nueva lámina encapsulante conductora
Innovate UK	ERA-SOLAR InGrid 620112