Objectives

The overall objective of LIMA project is to **translate recent advances in light-matter interaction for application in the photovoltaic industry**. The **goal** is to develop a high efficiency IBC cell using novel concepts to **enhance baseline cell efficiency by 10%**.

Scientific objectives

- Analysis of lost mechanisms of Si-QD layer
- Design of optimum plasmon layer
- Interaction between plasmonic and Si-QD layers
- Modelling tool for the design of Si-QDs
- Modelling IBC solar cells

Technological objectives

- Develop and implement Si-QD layer
- Design and fabricate the plasmonic particle layer
- Develop novel IBC back contact cell for integration of novel layers
- Integrate novel layers on top of IBC solar cell with compatible processing
- Final integrated cell with increase in 10 % efficiency improvement with respect to baseline cell

Partnership

Valencia Nanophotonics Technology Center

Valencia Nanophotonics Technology Center
Universitat Politècnica de València

ISC
International Solar Center
Konstanz

ARC Photovoltaics Centre
of Excellence
UNSW

FONDAZIONE BRUNO KESSLER
Advanced photonics and
photovoltaics group
Bruno Kessler Foundation

nanophotonics.csic.es
Insituto de Óptica
CSIC

Nanoscience laboratory
Department of Physics
University of Trento

isofotón
Isofotón, S.A.

www.limaproject.eu

FP7-248909-LIMA

Improve Photovoltaic efficiency by applying novel effects at the limits of light to matter interaction

lima

www.limaproject.eu

ICT-2009.3.8. Organic photonics and other disruptive photonics technologies.

Period: 01/01/2010 – 31/12/2012

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Universitat Politècnica de València

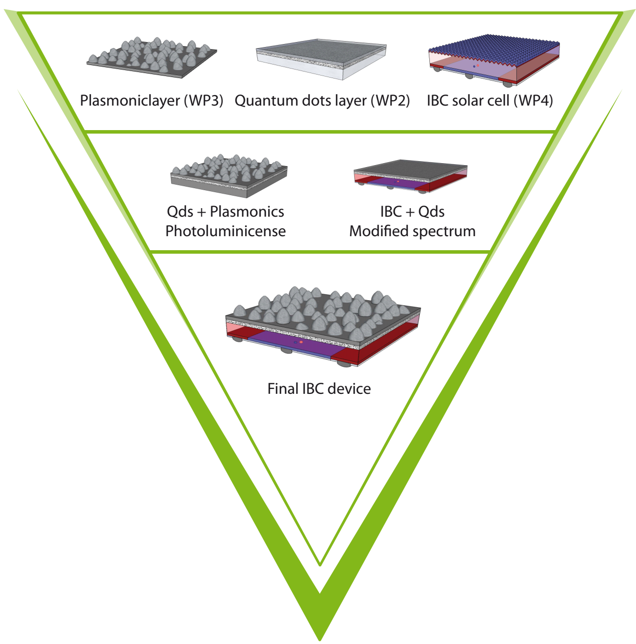
SEVENTH FRAMEWORK PROGRAMME

Project Concept

The **LIMA project** exploits cutting edge **photonic technologies** to enhance **silicon solar cell** efficiencies with new concepts in nanostructured materials. These new concepts focus on the modification of optical and electronic properties of materials.

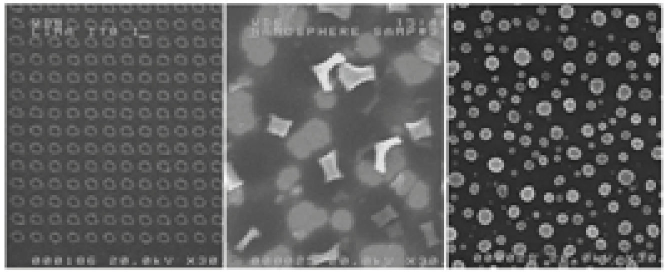
It incorporates **nano-structured surface layers** (plasmonics and Si-QDs) on the front of an **Interdigitated Back Contact (IBC)** solar cell designed to increase light absorption.

The project investigates this elegant device solution designed to separate carrier generation in the front surface from carrier collection in the junction region near the contacts. This has the additional obvious advantage of reducing shading losses while improving the light-matter interaction.

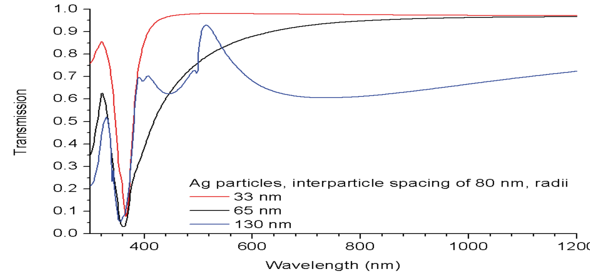


Main Achivements

Four manufacturing methods have been developed: Electron beam lithography (EBL), UV lithography, nanoparticle self-aggregation (NSA) and nanosphere lithography (NSL). A theoretical **simulation assisted study** has been performed.

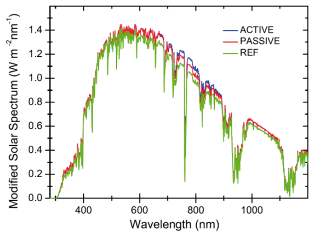


SEM pictures of fabricated EBL, NSL and NSA samples fabricated at NTC



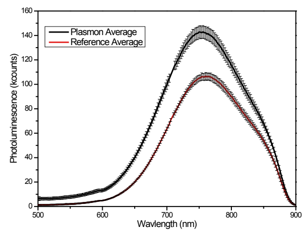
Optimum particle size and distribution calculated by IO-CSIC

Investigation of the **Si-QD downshifting properties** on the integrated Lima device. A solar cell efficiency model including downshifting conversion has been developed.



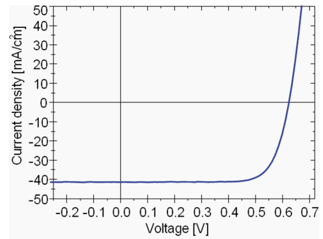
Modified spectrum calculated at UNITN

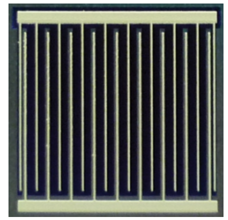
Simulations on the basis of **experimentally observed downshifting** have lead to a **projected efficiency enhancement of 10% relative.**



Photoluminescence of a Si-QD sample with and without plasmonic layer (FBK, UNITN, NTC)

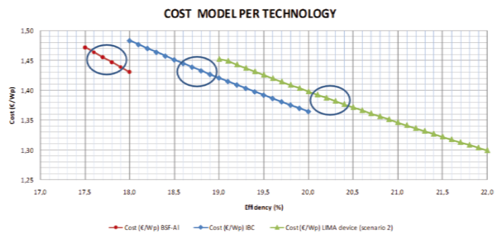
Screen printed IBC solar cells with boron emitter have been fabricated. An **efficiency of 19.6%** has been achieved. This design will be used as a baseline for the integrated Lima device.

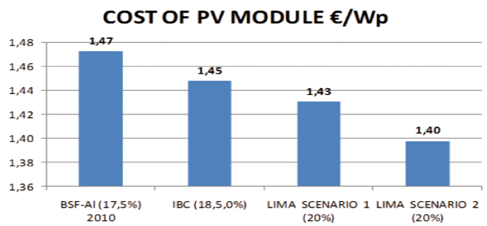




Illuminated IV-curve and picture of the best IBC cell with an efficiency of 19.6% (Voc=624mV, Jsc=41.4mA/cm2; FF=75.7%) (ISC Konstanz)

A cost model has been developed for the Lima device. An efficiency of 20% for the Lima concept has been found to be economically viable at a module level.





M. A. Vázquez, O. Cubero, G. Sánchez, J. P. Connolly, G. Daly, V. D. Mihailetchi, R. Kopecek, G. Pucker. "Cost model for Lima device". 1st Silicon PV Conference, 17-20 April 2011, Freiberg (Germany)