

CHEER-UP

Low Cost High Efficient and Reliable UMG PV cells

Project duration: from 02.2020 to 01.2023

Report submitted: 04.2022

Publishable Summary

Upgraded Metallurgical Silicon (UMG) is an ecological alternative to solar-grade silicon in terms of energy payback time (50% less) and CO₂ emissions (70% less). It also has the potential to reduce the cost of raw material (around 25%). For all this, making UMG a commercial product is an opportunity to re-build European technological leadership in the photovoltaic sector by innovating upstream in the value chain.

CHEER-UP will demonstrate that UMG multicrystalline silicon is a competitive alternative for polysilicon to produce high efficiency solar cells, in terms of economics and environmental impact. This scope will be addressed with a Passivated Emitter and Rear Cell architecture (PERC) that incorporates black silicon texturization.

The project's approach is the following:

- Defect engineering techniques based on phosphorus diffusion gettering are explored to improve the bulk quality of UMG.
- Black silicon is implemented to help increase the solar cell efficiency, designing this texturing process so that the gettering and surface passivation effects are maximized.
- PERC is the cell architecture used to assess the efficiency of UMG, conveniently adapting and tailoring an industrial manufacturing process to the specificities of the material.
- Degradation mechanisms are assessed to evaluate how apparent they are in UMG solar cells, proposing degradation recovery techniques if needed.
- Advanced solar cell architectures are tested on UMG wafers to further evaluate the potential of the material beyond PERC.

The project will result in the achievement of higher than 21% UMG multicrystalline PERC solar cells, an efficiency target that is accompanied by a reduction in the cost of silicon and a reduction in the environmental impact of silicon technology.

The project started in February 2020, and will last three years, conducted by a consortium of four partners. It is coordinated by the Solar Energy Institute at Universidad Politécnica de Madrid (Spain), which brings to the project its expertise in defect engineering approaches for Si and in solar cell process development. Valencia Nanotechnology Centre at Universidad Politécnica de Valencia (Spain) will lead the research in advanced texturing, coordinate the cell development and study the degradation mechanisms, GÜNAM at Middle East University (Turkey) is running its Photovoltaic Line, which is devoted to full size PERC processing in pilot scale with its compatible

infrastructure and flexible processing sequence. Aurinka PV is a Spanish company with large experience in the whole chain of PV, from feedstock to installations, including key aspects of this project as the refinement of UMG and the characterization of the material and the devices.

Project consortium

Coordinator and all contact details:

Full name of organisation	Universidad Politécnica de Madrid
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Participating countries and financing:

Country	Number of organisations involved	Project costs in EUR	Public funding in EUR
Spain	3	398'300	322'980
Turkey	1	194'063	194'063
<i>Total</i>	<i>4</i>	<i>592'363</i>	<i>517'043</i>

Funding agencies involved and contracts

Funding Agency	Contract N° and Title
AEI	<ul style="list-style-type: none"> • PCI2019-111834-2, CELULAS FOTOVOLTAICAS CON SILICIO UMG DE BAJO COSTE, ALTA EFICIENCIA Y FIABILIDAD • PCI2019-111903-2, LOW COST HIGH EFFICIENT AND RELIABLE UMG PV CELLS
CDTI	<ul style="list-style-type: none"> • EXP 00128093/ SERA-20201003 CÉLULAS FOTOVOLTAICAS UMG FIABLES DE BAJO COSTE Y ALTA EFICIENCIA
TUBITAK	<ul style="list-style-type: none"> • 219M029, 'CHEER-UP' DÜSÜK MALİYETLİ, YÜKSEK VERİMLİ VE UZUN ÖMÜRLÜ UMG FV HÜCRELER