BLACK
Black Silicon and Defect Engineering for Highly Efficient Solar Cells and Modules

Project duration: from 04.2015 to 02.2018
Final report submitted: 05.2018

Publishable Summary

This project consortium included leading academic groups and industrial partners from different sections of the photovoltaic (PV) value chain. The goal of the project was to test whether we can apply the previously obtained academic level research results into industrial scale and thus take a step towards commercial applications. One of the main goals was to fabricate a prototype PV panel with atomic layer deposited alumina coated black silicon (b-Si) surface that has been demonstrated to have superior performance in lab-scale cells.

In this project we demonstrated that high quality black silicon surface is indeed easily applicable in industrial-scale solar cell process, namely in Passivated and Emitter Rear Cells (PERC), the cell architecture which is now becoming the new commercial standard within the high-efficiency silicon PV industry. Our results showed that black silicon surfaces are not a hindrance for the cell processing and module assembly in an industrial scale, e.g. the handling of the nanostructured substrates during cell processing does not result in deterioration of the nanostructures properties. Within the project frame, we successfully fabricated and tested the performance of several black silicon PV panels.

An additional benefit of the nanostructured surfaces, previously not observed at a wafer level, consisted in the elimination of the power conversion degradation of the solar cells when exposed to light. The so-called light-induced degradation (LID) is a severe problem decreasing the power output of solar cells in the field. Several post-processing treatments have been devised in academia and industry to mitigate the degradation; however, their downside is the increase in the time and interaction with the thermal budget during the full cell processing sequence. Our approaches studied in the project have shown suppression of the conversion efficiency degradation, likely via the enhancement of the gettering of the substrate bulk, i.e. the performance of the bulk is improved by suppressing and inactivating the LID-inducing mechanisms and impurities such as trace metals.

Project consortium

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Participating countries and financing:

Country	**Number of organisations involved**	**Project costs in EUR**	**Public funding in EUR**
Finland	6	864’618	381’000
Germany	1	304’773	152’386
Spain	1	75’000	75’000
Total	*8*	*1’244’391*	*608’386*

Funding agencies involved and contracts

Funding Agency	**Contract N° and Title**
TEKES	40329/14 Black silicon and defect engineering for highly efficient solar cells and modules
MINECO	PCIN-2014-055 Black silicon and defect engineering for highly efficient solar cells and modules
Jülich	0325834 “Black Silicon” Oberflächenstruktur und “Defect Engineering” für Hocheffizienz-Solarzellen und Module
TEKES	1434/14 Mustan piin paneelit