

[Projects](#) / [Project Search](#) / Efficient solar cells developed from float-zone silicon



Photovoltaics

Efficient solar cells developed from float-zone silicon

Short title:

KosmoS

Funding Number:

0325822A-E

Topics:

Photovoltaics, New materials and concepts

Project coordination:



RCT Solutions GmbH

Running time:



April 2015 bis March 2018



CONTACT PERSON FOR THE PROJECT

 Wolfgang Jooß
 +49(0)7531-58470-17
 RCT Solutions GmbH
 www.rct-solutions.com

 PV Crystalox Solar Silicon GmbH
 www.pvcystalox.com


 PVA Crystal Growing Systems GmbH
 www.pvatepla-cgs.com

 Fraunhofer-Center für Silizium-Photovoltaik CSP
 www.csp.fraunhofer.de

 International Solar Energy Research Center Konstanz e.V.
 <http://isc-konstanz.de/>

ADDITIONAL LINK

Fraunhofer CSP


 [High-Efficiency Silicon Float-Zone Solar-Cells from Low-Cost Feed-Material](#)

RESEARCH REPORTS ON THE PROJEKT

Final report TIB Hannover

 [Kostenoptimierte Hocheffizienz-Solarzellen aus mono-Silizium](#)

Final report TIB Hannover

 [Kostenoptimierte Hocheffizienz-Solarzellen aus sauerstoffarmen n-Typ mono Silizium für die industrielle Massenfertigung](#)

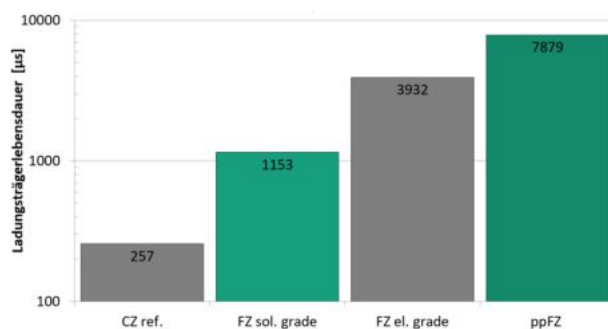
QUINTESSENCE

- Efficient solar cells are manufactured from high-quality float zone crystals. The researchers developed a new cost-effective method for this.
- The efficiency of the developed efficient n-PERT back junction solar cells made of float zone crystals is 21.6 per cent.
- New thinner wires make it possible to cut more wafers from a silicon crystal.
- As a result, the power generation costs of the entire photovoltaic system were reduced by 10 per cent.

Higher efficiencies, for example more output for the same amount of solar irradiation, are the central development goals for new solar cells. In addition to the materials used, the life cycle costs are influenced by the individual components and ultimately the type of solar cell. In the KosmoS project, the scientists researched float zone crystals to produce more effective solar cells and investigated the use of thinner wires to cut more wafers from a silicon block. They were ultimately able to reduce the power generation costs of the entire photovoltaic system by 10 per cent compared to systems that use conventional silicon solar cells (Al-BSF solar cells, short for: aluminium back-surface-field) with screen-printed aluminium paste on the rear side.

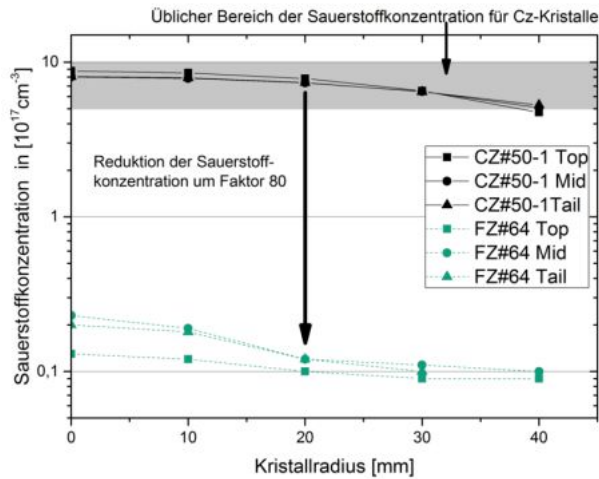
Project context

So-called float zone silicon is suitable as a raw material for particularly efficient n-type solar cells that have negative base doping, i.e. an excess of electrons. This has less contamination and an oxygen concentration that is 100 times lower. Consequently, the output of solar cells increases and the efficiency of the entire photovoltaic system can be improved. Despite these advantages, crystals made of float zone silicon have been little used to date. Compared to the usual Czochralski method, the complex production of the crystals is more costly.



© Fraunhofer CSP - Frank Zobel

Comparative study of the lifetime of charge carriers made of Czochralski standard material and three different float zone crystals; pre-pulled float zone has the best electrical properties.



© Fraunhofer CSP - Frank Zobel

The computer rendering shows the high purity of ppFZ crystals using the example of the oxygen content compared to Czochralski crystals.

Research focus

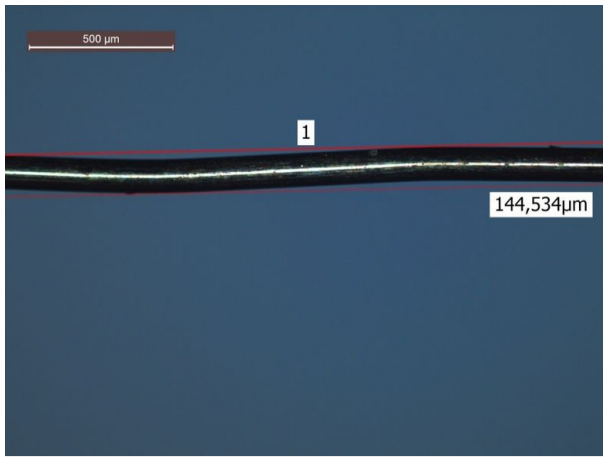
Within the project KosmoS: short for "cost-optimised high-efficiency solar cells made of low-oxygen n-type mono-silicon for industrial mass production", the scientists investigated the silicon raw material along the value chain up to the solar cell. They used float zone silicon for their new concept of a rear side solar cell. This high-quality material is suitable for exploiting the potential of this new n-type solar cell and surpassing the efficiency of bifacial monocrystalline PERC cells and nPERT cells. Both of these types are solar cells that absorb light from both sides.

Solar cells consist of thin silicon slices, the wafers. These are cut from the silicon crystals in special procedures using wire saws. Multiple wire loops cut the crystal block in one sawing step. Thinner wires save material and costs. The researchers therefore investigated the procedure and tested the use of finer wires.

Innovation

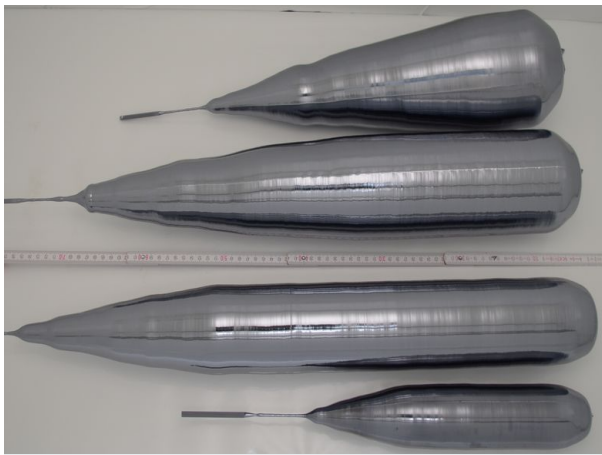
High-purity float zone silicon crystals are produced from stocks of silicon rods. The scientists at the Fraunhofer CSP have developed a cost-effective method to produce these rods - the pre-pulling float zone process.

In the production of solar cells, lasers are used as tools to open the dielectric layers of the solar cell. This can cause damage to the contacts of the solar cells, which can now be determined using a new method. For this purpose, the scientists at the ISC Konstanz have developed an analytical method known as photoluminescence spectroscopy. This enables them to describe not only the damage caused by laser processing but also the recombination of metal contacts applied by screen printing.



© PV Crystalox Solar Solicon GmbH

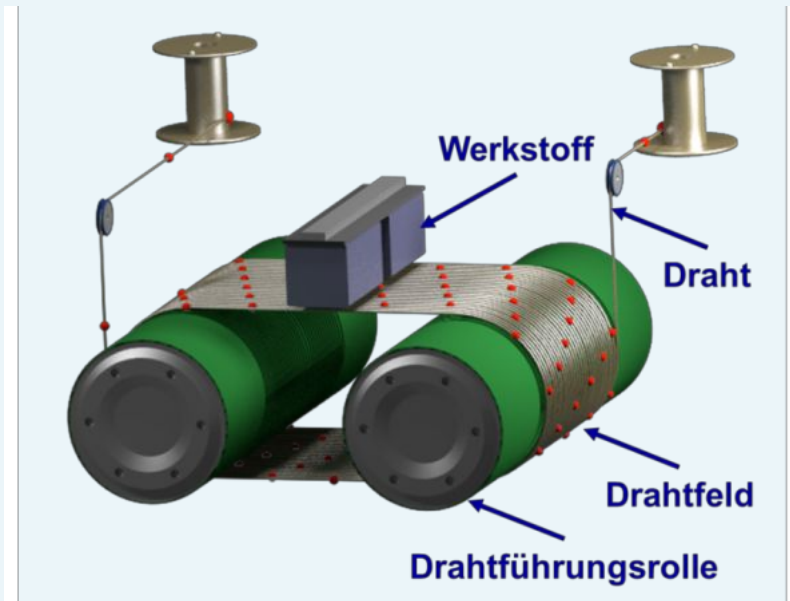
The photo shows a microscopic image of a structured wire.



© Fraunhofer CSP

The photo shows pre-pulled float zone crystals in sizes 3, 4, 5 and 6 inches.

Further image



The figure shows a schematic representation of a multi-wire saw.

© PV Crystalox Solar Solicon GmbH

Results

Within the project, the researchers have developed highly efficient n-PERT back junction solar cells. These bifacial solar cells show a high efficiency of more than 21.6 per cent and have 10 per cent lower power generation costs in the PV system compared to conventional solar cells (Al-BSF solar cells). Their structure and process is similar to the pPERT cell; the substrate, boron emitter and its passivation correspond to the n-PERT cell.

More wafers from one silicon crystal reduce costs

The scientists investigated the multi-wire sawing process with structured wires and cut wafers from monocrystalline float-zone crystals. The aim was to use very thin wires with a diameter of 115 to 100 micrometres so that more wafers could be sawed from one crystal. They achieved good results with 105 micrometre thin wires and have further developed the method to production maturity. Compared to the 120 micrometre thick wires currently in use, the new method saves 15 micrometres of material per saw cut. This allows 5 per cent more wafers to be cut per millimetre of block length.

Further images



The photo shows a wafered silicon block after sawing in the wire saw with an adapted wire field.

© PV Crystalox Solar Solicon GmbH



The optical microscope image shows the cross-section of a local emitter area formed by aluminium paste when aluminium paste is printed across the entire surface.

© ISC Konstanz e. V.



The optical microscope image shows the cross-section of a local emitter area formed by aluminium paste. The lateral diffusion of silicon is reduced during the melting phase. This results in the formation of a deeper emitter region during the recrystallisation phase.

© ISC Konstanz e. V.

Practical transfer

ISC Konstanz is continuously refining the bifacial n-PERT Back Junction solar cells and offers the manufacturing process for licensing. RCT Solutions will incorporate the n-PERT Back Junction solar cells into a new production line as part of its technology solutions.

Last updated: 13.12.2019



Among other things, EnArgus, the central information system for energy research funding, contains a database of all energy research projects - including this project.