



Solar technology / Photovoltaics | Technology Offer

Optimum passivation of defects in crystalline silicon solar cells

Application area

The efficiency of monocrystalline solar cells that are produced using the CZ method (Czochralski method) decreases under sunlight within a few hours. This effect is called Light Induced Degradation (LID). The decreased level of efficiency is mainly due to the boron-oxygen defects in the Cz silicon solar cells. Methods aimed at passivating these defects are of major economic importance as low production costs and high efficiency potentials make the Cz silicon wafers particularly attractive for the mass production of solar cells.

State of the art

The basic patent of the University of Konstanz on "Regeneration of the LID effect" (Patent number: DE 10 2006 012 920) describes a method which enables the regeneration of Cz silicon solar cells. This method stabilizes the level of efficiency of solar cells during the production process so that it is significantly above the degraded level.

However, process efficiency strongly depends on the achievable regeneration rate or the time needed for defect passivation.

Innovation

Scientists at the University of Konstanz succeeded in showing that the patented method can be carried out at higher temperatures. This leads to greater efficiency when there is hydrogen in the silicon substrate during the regeneration step.

There are various ways of adding adequate amounts of hydrogen to the silicon substrate, including a homogeneous distribution during the production process. One way of doing this would be to use a layer of hydrogenated silicon nitride as a source of hydrogen. The silicon nitride will be restructured during the high-temperature process while releasing hydrogen which can then diffuse into the silicon substrate. Appropriate temperature control, which might be combined with the generation of minority charge carriers (e.g. through illumination or external electricity supply), ensures that an sufficient amount of hydrogen can diffuse into the silicon substrate where it is distributed homogeneously.

During the regeneration process, hydrogen can then be attached to the boron-oxygen defects and deactivate them. The regeneration process can now be carried out at much higher temperatures so that the entire process is accelerated. As a result, the method can now be used for industrial mass production. Solar cells that are produced in this manner have regained a high degree of stabilized efficiency. Moreover, they can be produced at low cost.

Your benefits at a glance

- ✓ Open up the full efficiency potential of solar cells
- ✓ Reduced process times during the regeneration process
- ✓ Increased efficiency in terms of regeneration
- ✓ Cost-effective and easy integration into existing manufacturing processes

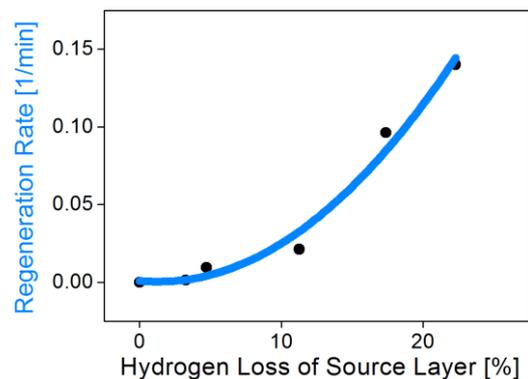


Figure 1: More hydrogen allows higher regeneration rates and the use of higher regeneration temperatures.

Technology transfer

Technologie-Lizenz-Büro GmbH is responsible for the exploitation of this technology and assists companies in obtaining licences.

Patent portfolio

DE 11 2013 005 591 and patents in China, Japan, South Korea and Singapore are granted. Further patents are pending in Europe (EP 13 770 893), Malaysia and USA (US 14/900,004).

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