A silicon solar cells lamination plant and a process carried out with this plant

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PATENT STATUS: Granted

PRIORITY NUMBER: 102018000006351

PUBLICATION: 03/07/2020

PUBLISHED AS: IT

Invention

Mono and polycrystalline silicon solar cells exhibit considerable mechanical fragility. Cracks in silicon photovoltaic modules can originate during production, installation or use of the modules.

The object of this invention is a plant for the lamination of silicon solar cells which allows to obtain photovoltaic modules of improved efficiency thanks to the reduction of the impact of the phenomenon of silicon cracking.

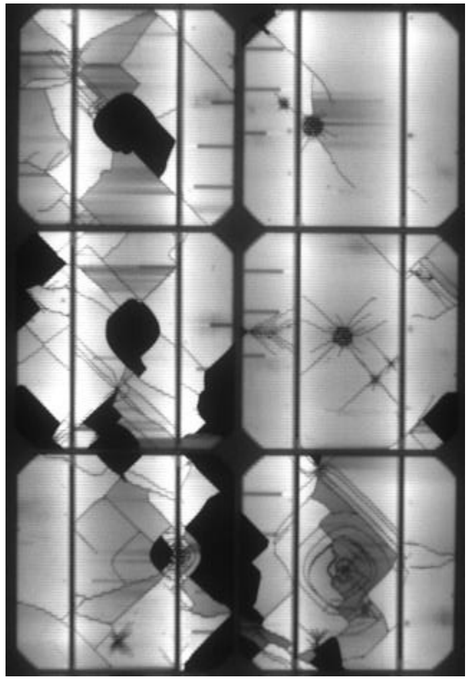
The proposed technique is estimated to allow photovoltaic modules **to produce 25% more solar energy** than existing ones, over their entire lifespan.

The invention applies an innovative pre-tensioning system of the rear protective sheet (or back-sheet) during the lamination phase of the photovoltaic module, so as to increase the residual compression stresses in the adjacent silicon cells. Lamination parameters (pressure and temperature profiles) are kept unmodified as compared to the standard ones.

The resulting increased compressive stress in the silicon solar cells makes the photovoltaic module less sensitive to the electrical power losses caused by cracking.

The proposed technology was designed using advanced numerical models to optimize the pre-tensioning level during the production phase of the photovoltaic module. It was validated in the laboratory on modules equipped with cells specifically damaged to evaluate the technique effectiveness. Experimental tests based on the electroluminescence technique on damaged photovoltaic modules, before and after the proposed treatment, have provided clear evidence that the electrically fractured portions of the solar cells return to produce electricity.

Drawings
& pictures



Cracks in silicon photovoltaic modules
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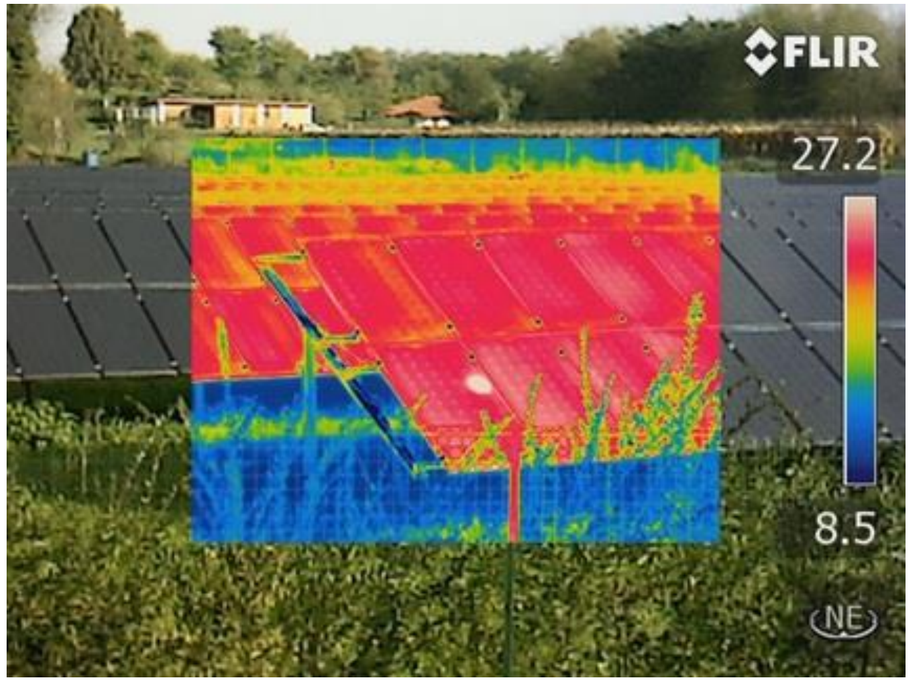

Infrared image of a hot spot in a damaged photovoltaic module
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Industrial applications

The application sector is the **energy** one and, more specifically, it impacts on technologies and systems for the production of sustainable energy. The invention applies to the production of new silicon photovoltaic modules.

Advantages

- Photovoltaic modules produced with this innovative technique have a **higher yield** in the production of electric energy
- Treated photovoltaic modules have a **longer lifespan** as compared to the standard ones available on the market
- The proposed process, based on an appropriately modified laminator, requires **just a single change** to the industrial production line of photovoltaic modules
- Assuming a production of about 30 MWh for the entire lifespan of 1 kWp photovoltaic modules (conservative estimated production capacity), we evaluate a profit gain of approx **60 Euro/kWp as compared to existing solutions**

Possible developments

The invention can be **transferred or licensed**. Transfer or license could be functional to the **creation of a dedicated spin-off** aimed at valorizing the patent.

We are highly interested in collaborations with companies. In particular, we aim at founding a spin-off with corporate venture and venture funds.

The actual state of the technology is between **TRL 3** and **TRL 4**. Further experimental research is in progress, in order to apply this technology also to retrofit and repair damaged or end-of-life photovoltaic modules.

This invention was developed in the framework of EU research projects: FP7- ERC Starting Grant «CA2PVM» G.A. n. 306622 and H2020 ERC Proof of Concept «PHYSIC» G.A. n. 737447.

We are seeking funds for further validation, prototyping, product development and production and commercialization.

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