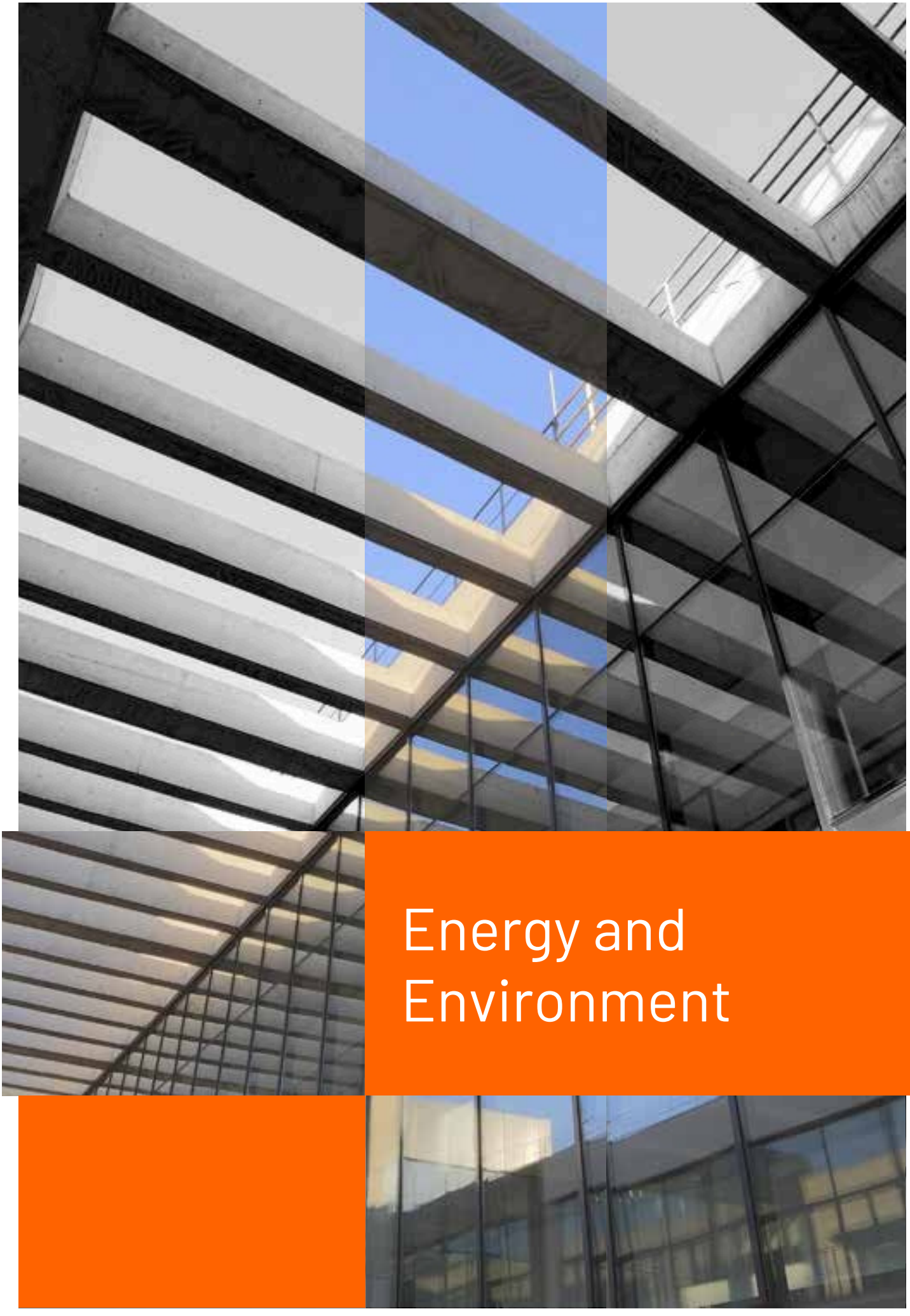

Energy and Environment

Contents

Energy and Environment · 11 inventions

ODTÜ-44	Viscoelastic Vibration Damping Device for Wind Turbine Towers	3
	Energy Storing Modular Building Elements	4
ODTÜ-100	Privacy Camera System Algorithm and Design	5
ODTÜ-127	Water-Harvesting, Self-Cleaning Anti-Reflective Aerogel Coating on Glass for Solar Panels	6
ODTÜ-129	Monolithically Series Connected Solar Modules Formed by Using P1 and P3 Scribes With No Additional P2 Scribing Operation	7
ODTÜ-130	IBC Silicon Solar Cell Fabrication Facilitated by Ion Implant and Screen Printing	8
ODTÜ-131	A Screen Printing Based Patterning Method for the Fabrication of Interdigitated Back Contact (IBC) Solar Cells	9
ODTÜ-135	Metallization Screen Design For Si Based Solar Cells	10
ODTÜ-138	Novel Front and Back Passivating Contact Crystalline Silicon Bottom Structure for Two-Terminal Perovskite/Silicon Tandem Solar Cells	11
ODTÜ-175	Full Recycling of Perovskite Solar Cells	12
ODTÜ-190	Well-Type Solar Collector	13

Viscoelastic Vibration Damping Device for Wind Turbine Towers

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ViscoLink-Wind

It is a vibration control system/device for wind turbine towers that can potentially occupy less volume inside the tower, add a lesser weight to the total weight of the tower while achieving similar vibration mitigation performance compared to dynamic mass dampers, which are frequently used to reduce vibration in wind turbine towers.

Advantages

Vibration Control Efficiency: The wind turbine tower has the potential to increase the amount of vibration damping on both longitudinal and lateral vibration modes simultaneously.

Wide frequency range: Conventionally used dynamic mass dampers have to be designed separately for each vibration mode. With the invention, damping effect can be created simultaneously in all critical vibration modes of the tower.

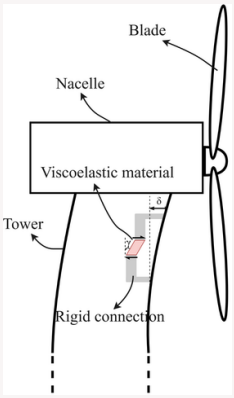
Compact design: It is expected to take up less space in the radial direction in the tower section compared to conventional dynamic mass dampers, which are often used to reduce vibration in wind turbines. Dynamic mass absorbers are placed in one or two locations within the tower, while ViscoLink-Wind has the potential to not occupy much volume locally as it is applied in a distributed manner along the length of the tower.

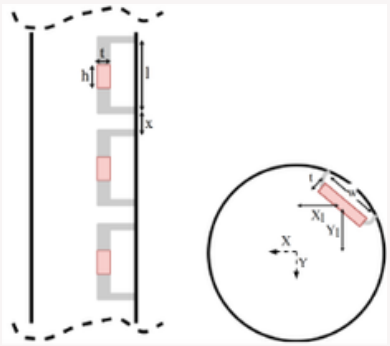
Lightweight: Since the vibration damping effect is not created by using resonance behavior such as conventional dynamic mass dampers, which are often used to reduce vibration in wind turbines, the same vibration damping effect can be achieved by increasing the tower weight less.

Ease of Construction: The vibration dampers, which are the subject of the invention, which will be attached to the inner surface of the tower, can be mounted during the production of the components of the tower and the need for assembly in the field can be eliminated.

A novel design that prolongs fatigue life of wind turbine towers by supressing wind-induced resonant vibrations in wind turbine towers.

The present invention consists of a viscoelastic material component with a specially determined geometry in the wind turbine tower and rigid fasteners to connect this material into the tower. The basic working principle of the invention is that while the wind turbine tower vibrates horizontally or vertically (dynamically changing shape) in critical vibration modes under the action of wind or sea induced loads, the parts of the vibration damping device made of viscoelastic material, which is the subject of the invention, make use of the relative displacement difference of two points in different places on the tower and damping tower vibrations by converting the dynamic tension energy resulting from this displacement difference into heat energy. The viscoelastic material to be selected can be connected to the wind turbine tower with rigid connections in different ways as determined in the invention and can show desired amount of vibration damping performance. Using multiple viscoelastic fasteners throughout the tower will provide more effective vibration damping performance.





ODTÜ-44

Energy Storing Modular Building Elements

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Concrete Battery

It is an invention for both strengthening the structural system and promoting the use of renewable energy sources in housing.

Advantages

Use of Renewable Energy in Houses: It provides uninterrupted energy production in houses.

Economic: Energy storage with concrete, which is one of the cheapest known building materials, has very economical results.

Efficient:A more efficient system is obtained by using the concrete material, which is already used in houses, in heat storage at the same time.

Compatible with Housing Architecture: Since the invention is a reinforced concrete element, it is no different from any other element in buildings.

Environmentally Sensitive: Unlike lithium-ion batteries, when the battery life is over, it can be used as a filler material without the need for a special recycling process.

It is possible to store the energy obtained from renewable energy sources in concrete structural elements

The energy storing modular elements can either be built into the framing system of new buildings or integrated into the external frames of existing buildings for retrofitting or switching to renewable energy sources by means of anchors. The invention is made up of nested layers. The innermost layer will contain high temperature resistant concrete heat stores for storing heat energy.

The intended use of the invention is to store the energy obtained from renewable energy sources in concrete structural elements and to realize energy production from this battery when the renewable energy source is not accessible. In addition, it can be used both for retrofitting existing buildings with inadequate earthquake performance and for new buildings to provide earthquake performance.

Thanks to its modular structure, it has the ability to be replaced when the battery is damaged or its life is over. In addition, its modular structure also allows it to be applied to existing buildings.

Privacy Camera System Algorithm and Design

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PrivCam-HDR

Balance between security and privacy

Advantages

Reversibility: The ability to reconstruct the original face data in case of authorized criminal investigation situations

Smart privacy filters: The ability for an operator to understand the content of the video without revealing the identity of individual faces

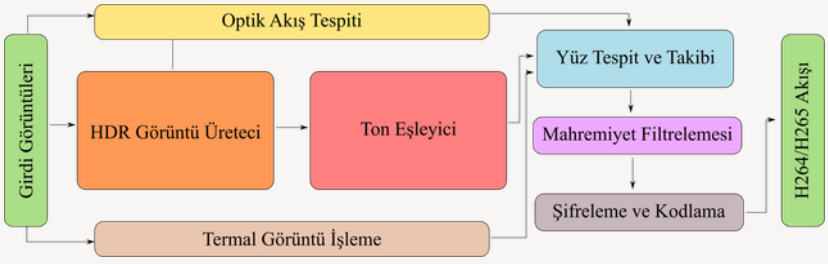
High performance under difficult lighting: The ability to perform surveillance and privacy protection under difficult lighting situations (including intense backlighting) due to the use of HDR imaging and video processing techniques.

Automatic face detection and tracking: The ability to automatically detect and track human faces, which can be extended to other objects such as human bodies, vehicles, and tag plates

Real-time performance: The ability to perform the entire processing in a real-time manner for a full-HD (1920x1080) resolution video

To allow security cameras perform surveillance without compromising visual privacy

Automatic detection of faces that enter the camera view by using state-of-the-art deep learning face detectors. The ability to perform face detection under difficult lighting conditions thanks to the use of HDR imaging techniques. Automatic filtering and privacy protection of faces based on user controllable smart filters. Storage of the original face data in a compressed and encrypted manner, which is reversible in case of criminal investigation situations. Fast and accurate face detection thanks to the usage of stereo and thermal video processing techniques.



ODTÜ-100

Water-Harvesting, Self-Cleaning Anti-Reflective Aerogel Coating on Glass for Solar Panels

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Water-Harvesting and Self-Cleaning Anti-Reflective Aerogel Coating

Water harvesting, self-cleaning, anti-reflection

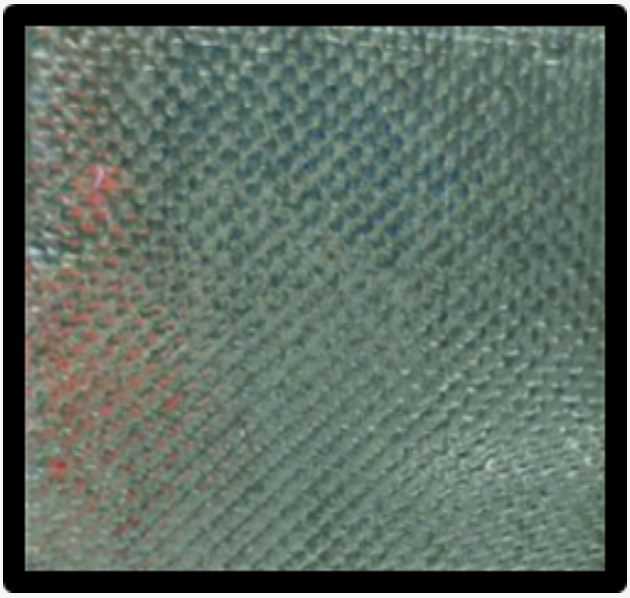
Advantages

- Low cost
- Easy production
- Scalable to industrial size
- Multifunctional
- Adaptable to different materials



Combines three functions with low-cost production

A low-refractive-index aerogel coating with hydrophilic/hydrophobic patterns created using a UV-blocking photomask



ODTÜ-127

Monolithically Series Connected Solar Modules Formed by Using P1 and P3 Scribes With No Additional P2 Scribing Operation

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P2'less Thin-Film Solar Module

Interconnection between the cells without use of P2 scribes

Advantages

Fabrication time decreases owing to the cancellation of one scribing step.

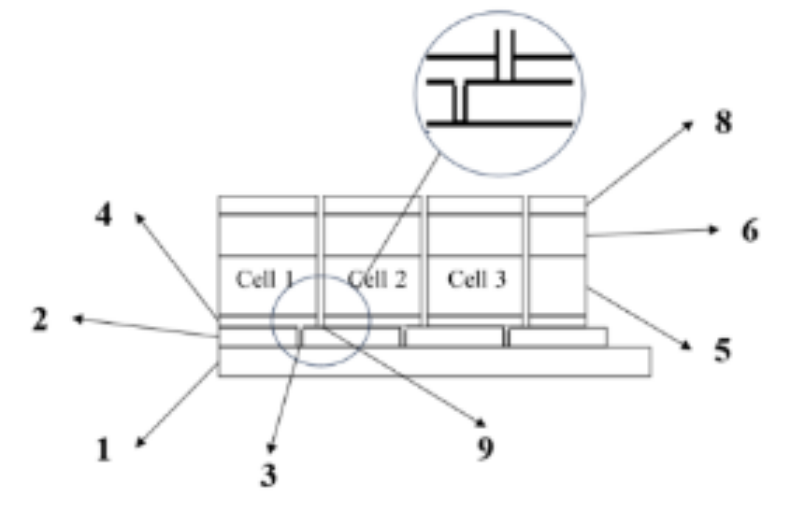
Avoiding the exposure of possibly toxic vapours (Pb, Cd, metals etc.)

Enhancing the stability of especially organic-based solar cells since the direct contacting of metals to photoactive layers through P2 scribes may accelerate degredation in the photoactive layers.

Providing serial interconnection between cells without the need for P2 line

Enabling the interconnection of the adjacent cells in thin-film solar modules without the need for P2 scribes

Conversion of solar cells at interconnection region into resistors by reverse breaking down under reverse biasing



IBC Silicon Solar Cell Fabrication Facilitated by Ion Implant and Screen Printing

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Simplification of IBC manufacturing complexity

Advantages

Process simplification of IBC production

Reduced workload

Potentially lower production cost for IBC

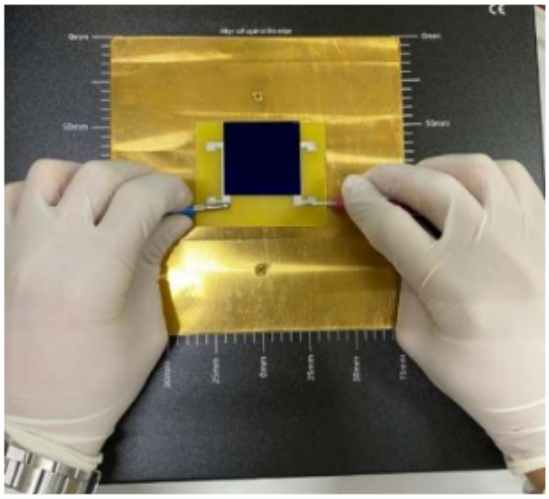
IBC has a big advantage for higher efficiency than other designs due to lack of metal at the front side.

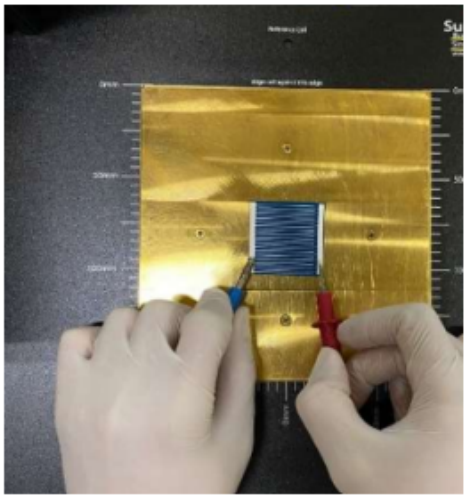
Porposed method can be adapted to PV lines by including ion implnater only.

Single side and patterned metallization by screen printing in the same process flow.

Using the ion implantation method at least for doping one polarity since it provides single side and patterned doping. Also, screen printing will be in the same process flow for further simplification of the entire production.

Single side and patterned doping by ion implantation for n+ and p+ regions, or at least one of them. Single side and patterned metallization by screen printing in the same process flow.





A Screen Printing Based Patterning Method for the Fabrication of Interdigitated Back Contact (IBC) Solar Cells

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This invention makes it possible to produce low-cost IBC cells in industrial lines

Advantages

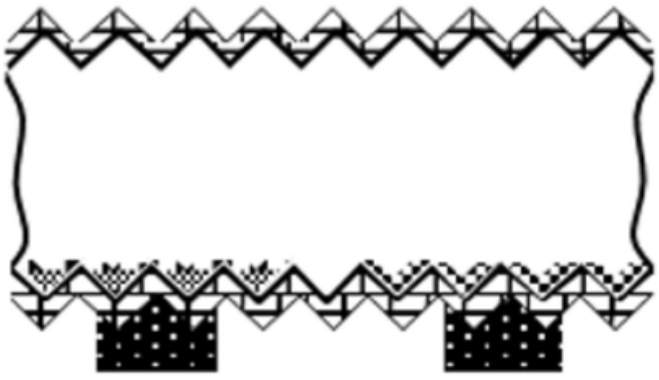
It is easily adaptable and applicable for the currently available industrial lines

No need for an additional investment

Its being an alternative method against two other IBC production methods

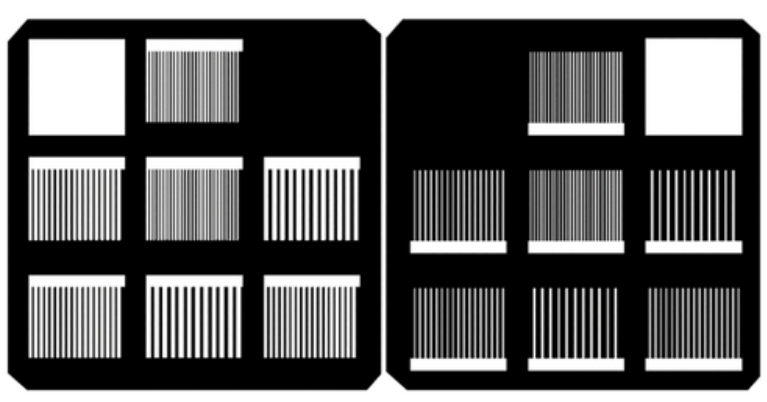
Its being relatively cheaper and easier production mehtod

Its high throughput capability



Screen printing-based patterning step

This invention offers a simple and easy-adaptable production method for IBC cells



Metallization Screen Design For Si Based Solar Cells

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Metallization Screen

In nested IBC cells, joints are provided at the ends of the cell to ensure the connection between the metallic regions and wide solder points are designed to allow flexibility in cell measurements.

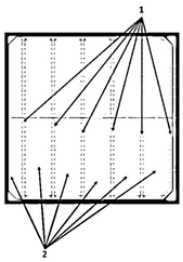
Advantages

Insulation material used to prevent the contact areas of different polarities from contacting each other is not required

Making it suitable for industrial production with screen printing

Shortening the distance of the current that the metals must carry

Reducing the series resistance



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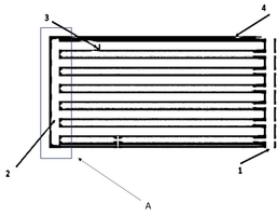

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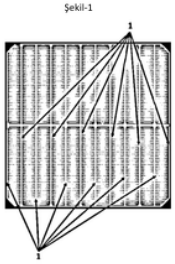

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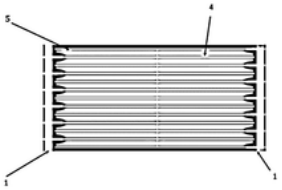

Şekil-4

Highly efficient and inexpensive cell production without the use of insulating material in the metallization process

A screen designed for high efficiency and cheap cell production without the use of insulating material in the metallization process, which is the last link in the production of IBC type solar cells.

In nested IBC cells, joints are provided at the ends of the cell to ensure the connection between the metallic regions and wide solder points are designed to allow flexibility in cell measurements.

Novel Front and Back Passivating Contact Crystalline Silicon Bottom Structure for Two-Terminal Perovskite/Silicon Tandem Solar Cells

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Crystalline Silicon Bottom Structure for Two-Terminal Perovskite/Silicon Tandem Solar Cells

The invention aims to solve the problems and provide a novel bottom cell structure based on p-type crystalline silicon for Perovskite/Silicon tandem solar cells.

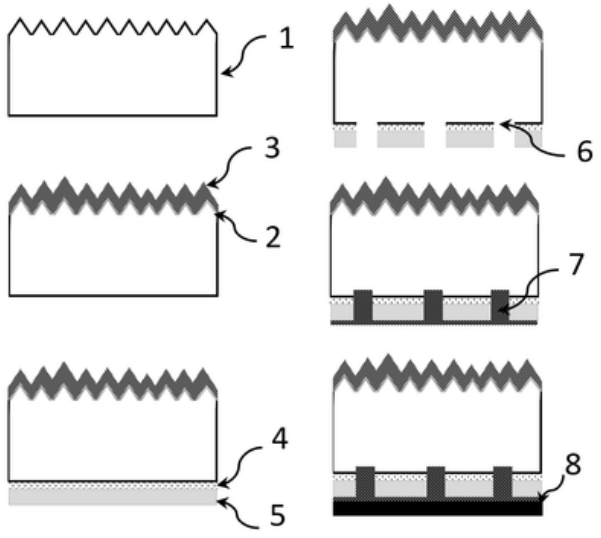
Advantages

Reduce number of process steps to realize bottom silicon structure for silicon/perovskite tandem

Reduce material used (water, chemicals, silicon)

Eliminate the need of one high temperature process

Eliminate direct metal-silicon contact



Unlike available Patents and literatures with p-type bottom cell structure with either diffused phosphorus emitter and/or direct local metal at the back and/or screen-printed Aluminum its associated high temperature process to create the back surface field and metal electrode, the hole-selective and passivation layer is prepared at room temperature. The back electrode is prepared at room temperature. The hole-selective and passivation layer as well as the back electrode can be prepared in sequential processes in a single fabrication tool and a single step. The presence of hole-selective and passivation layer in contact with the p-type crystalline silicon at the back side will prevent direct metal contact with the silicon and therefore passivate the local opening in the silicon (lead to high Voc compared to direct metal-silicon contact), reduce process steps including the need of wet-chemical processes so reduce water and chemical consumption, eliminate one high temperature process and therefore reduce the cost and the need for thick polycrystalline silicon on the front side (reduce silicon material).

The bottom cell comprises from top to bottom is sequentially a heavily phosphorus doped polycrystalline silicon (3), ultra-thin tunneling layer (2), planar or micro textured or nano textured crystalline silicon surface of a gallium-doped or boron-doped p-type crystalline silicon (1), dielectric passivation layer (A) touching the p-type crystalline silicon (4), dielectric passivation B (5), contact opening (6) though the dielectric passivation layer, hole-selective and passivating contact (7), and back metal electrode (8).

Full Recycling of Perovskite Solar Cells

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PVK Loop

A full recycling method that recovers all valuable components of end-of-life perovskite solar cells in a single process without harming the environment.

Advantages

Full recovery: All valuable components are recovered in one process, reducing waste.

Safe lead management: Toxic lead is converted into the PbI_2 precursor and safely separated.

Precious metal recovery: Gold, silver and copper electrodes are recovered at high purity.

Halogen and precursor recovery: Iodine, bromine and methylammonium precursors can be reused in production.

Environmental sustainability: The closed-loop solvent system reduces environmental risks.

A sustainable solution to the toxic lead problem of perovskite solar cells

The method uses pure methylamine, condensed under pressure and operated in a closed loop, as the solvent. It selectively separates the perovskite layer and other components, and metal electrodes such as gold, silver and copper are recovered at high purity.
Toxic lead compounds are converted into PbI_2 and safely separated. Critical halogens such as iodine and bromine, as well as methylammonium components, are also recovered.
Using the solvent in a closed loop reduces chemical consumption and environmental risk, and recovered materials can be returned directly to new perovskite cell production.

Well-Type Solar Collector

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HexaSolar

A solar collector that traps solar energy in a small volume using flat mirrors, producing medium temperatures of 60–200 °C without expensive optics.

Advantages

Easy manufacturing: Built from flat mirrors and a simple geometry, with no special equipment.

Low cost: Standard flat mirrors replace curved mirrors and costly optics.

Easy to use: Its simple design makes installation and operation easy.

High efficiency: The well geometry prevents rays escaping and concentrates energy on the target.

Wide range of uses: Water heating, drying, cooking and process heat at 60–200 °C.

A low-cost, efficient heat source for medium-temperature applications

The collector has a well-shaped geometry whose inner surfaces are lined with flat mirrors. Sunlight entering through the aperture is directed downwards to the target volume by successive reflections on the well walls.

This geometry largely prevents rays from escaping. Using flat mirrors eliminates the precise and costly manufacturing required by curved concentrators.

The concentrated energy heats the working fluid to 60–200 °C for applications such as water heating, drying, cooking and industrial process heat.