SPHELAR POWER

unique technology in the world

Spherical Solar Cell(Sphelar®)

SphelarPower Corporation

Invite the sun

e-mail：inquiry@sphelarpower.com
Website：http://www.sphelarpower.jp/

Company Profile

Company Name	Sphelar Power Corporation
Established	May 17, 2012
Address	6-310,93 Chudoji Awatacho Shimogyo-ku, Kyoto
Capitals	99.077 million yen
President	Soichiro Imoto
Employee	12 members
URL	http://www.sphelarpower.com
Business Objectives	Development, Manufacturing and Sale of spherical solar cells and the application products

Kamisunagawa Operation (Hokkaido)
・module production

Eniwa Operation (Hokkaido)
・cell production
・module production

Head Office (Kyoto)

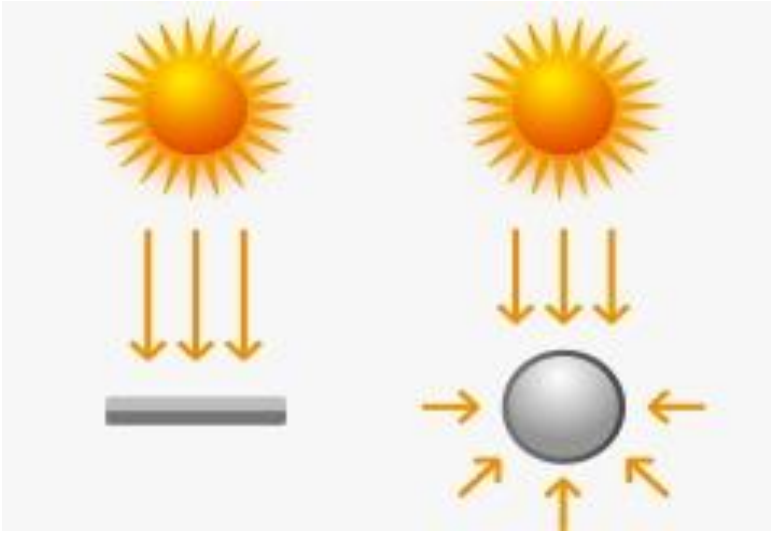
Development Motive and Aim of Sphelar®

“Why do solar cells need to be flat ?”

Light does not fall in a uniform manner in the natural world.

Capturing rays from all directions, Sphelar® cell can receive sunlight more effectively and constantly than conventional flat solar cells.

Available Sunlight



Flat solar　　Spherical solar

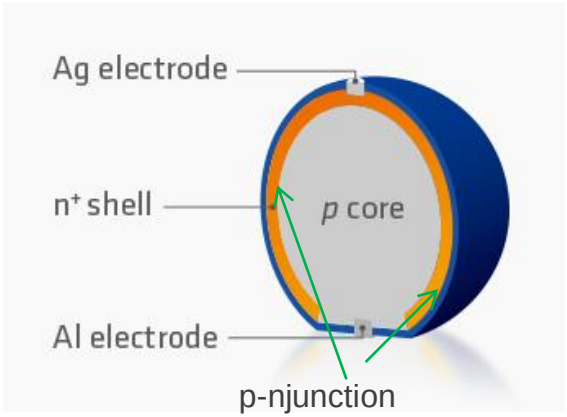
What is Sphelar®？

球状太陽電池

Spherical Solar＝Sphelar®

Many international patents

Cells（Enlarged photo）
1.2/1.8mm

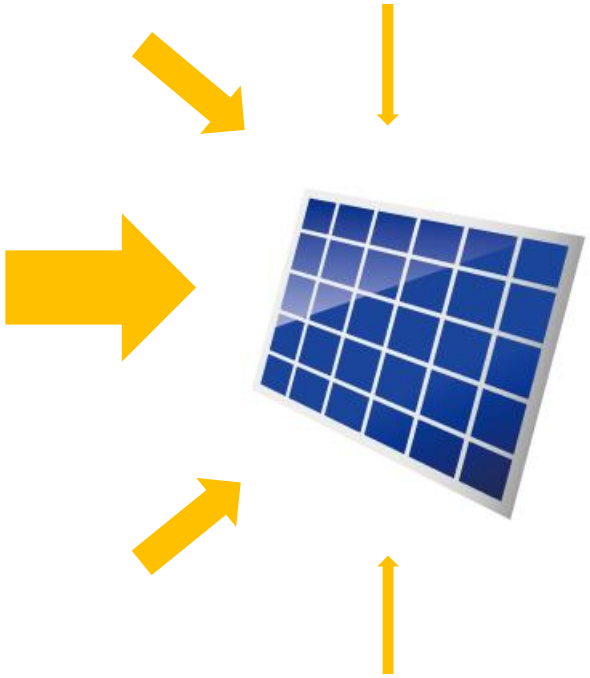


Cell (cross section)
electrode is counter electrode

A spherical solar cell is a solar cell in which the surface of a crystalline silicon sphere is a pn junction surface (light receiving surface).
It is characterized in that a pair of positive and negative spot electrodes face each other on the center line of the sphere.

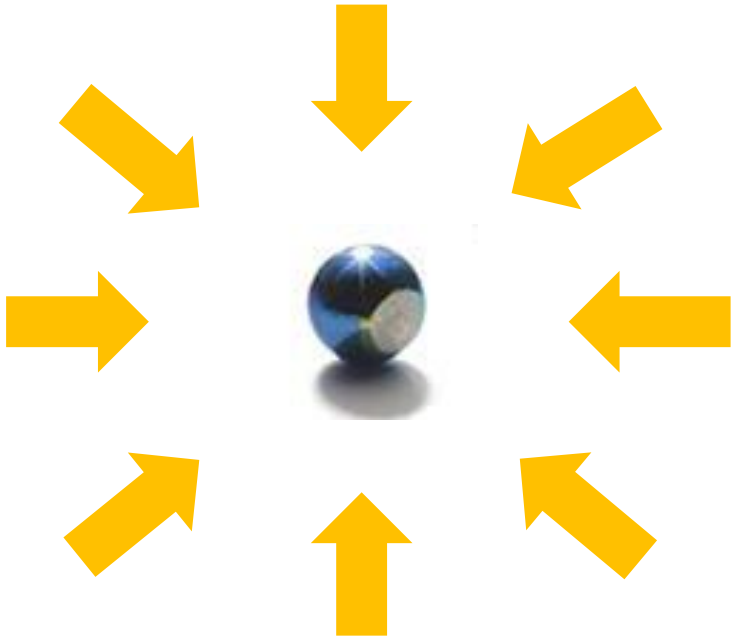
Features of Sphelar®: Characteristics unique to a sphere

Flat solar cell



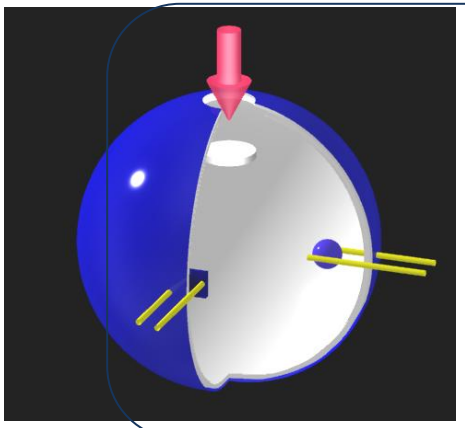
・Power generation on one side
・Power generation decreases depending on the angle
・Cannot generate electricity on the back side

Spherical solar cell Sphelar ®



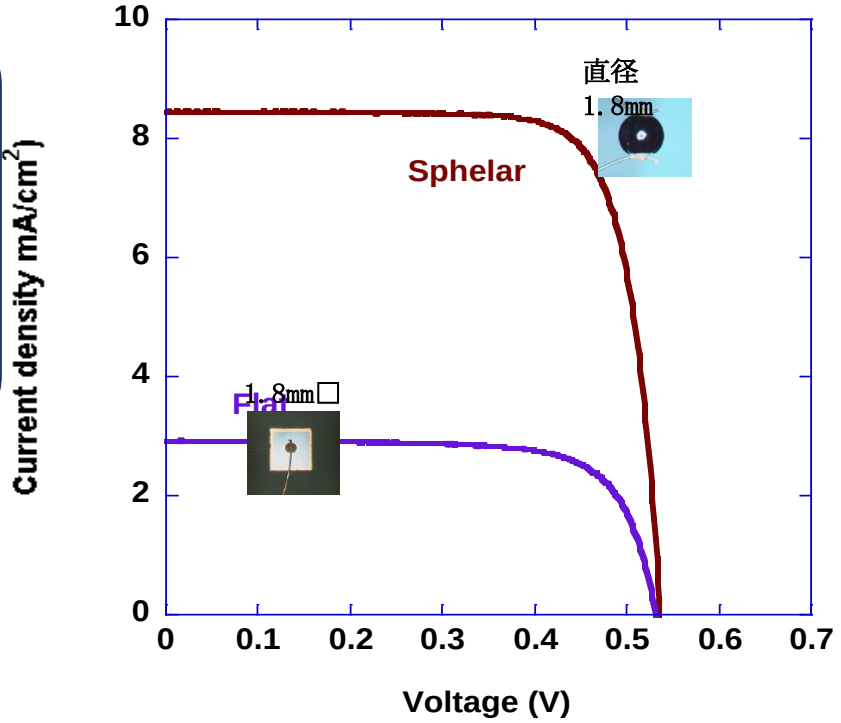
・360 ° power generation is possible
・Stable power generation regardless of angle
・Power can be generated on the entire surface

The light receiving capacity of the Sphelar® cell is about 3 times of a flat solar cell



A device that irradiates uniform pseudo-sunlight from all directions

Integrating sphere

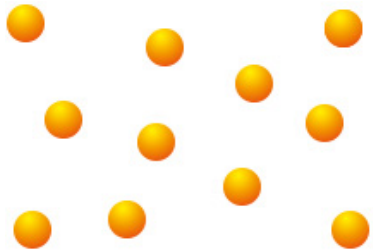


Comparison of output characteristics measured in the integrating sphere

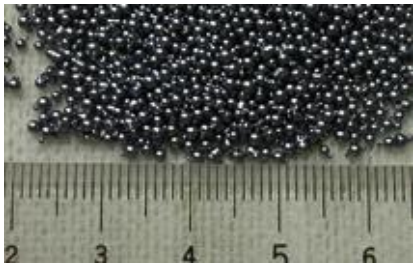
The measurement method of Sphelar ® with an integrating sphere is decided to be listed in the JIS standard.

Manufacture of Sphelar®

1. Material
Uses crushed silicon generated in the manufacturing process of wafers, etc.

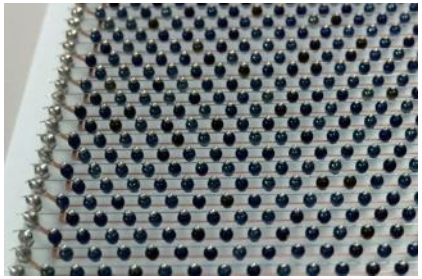


2. Melt
Melt silicon as a material and make it spherical by surface tension



3. Granulation
Spherical silicon crystals are used as raw materials for cells

4. Cell manufacturing
A pn junction is formed on the surface of spherical silicon, and electrodes are attached above and below.

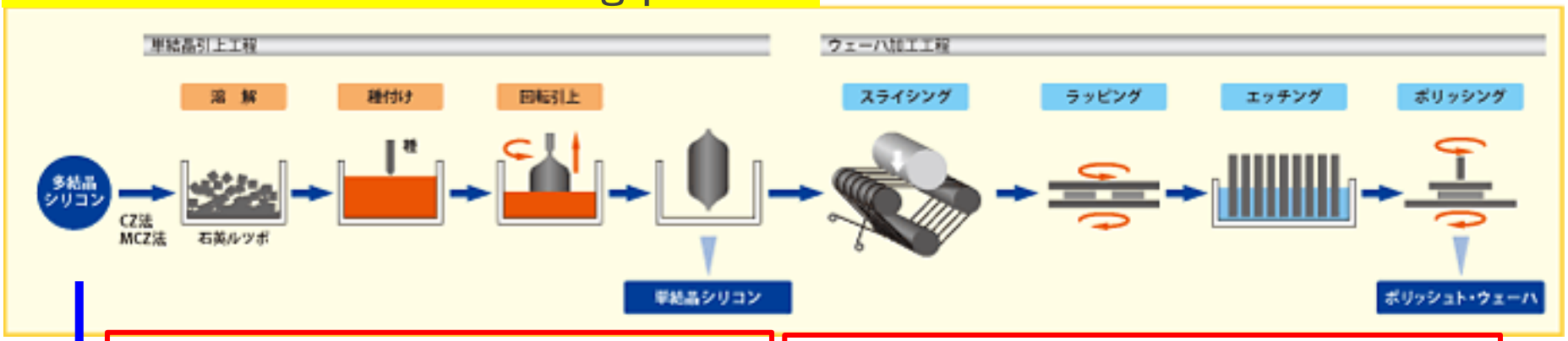


5. Module manufacturing
Assemble the cells into a mesh structure into a unit of easy-to-use size

6. Finish
Completed as a see-through solar cell by laminating with a transparent material such as glass

Features of Sphelar®: Simple manufacturing method, raw material saving, energy saving

Silicon wafer manufacturing process



High power consumption
1420 ℃ x tens of hours

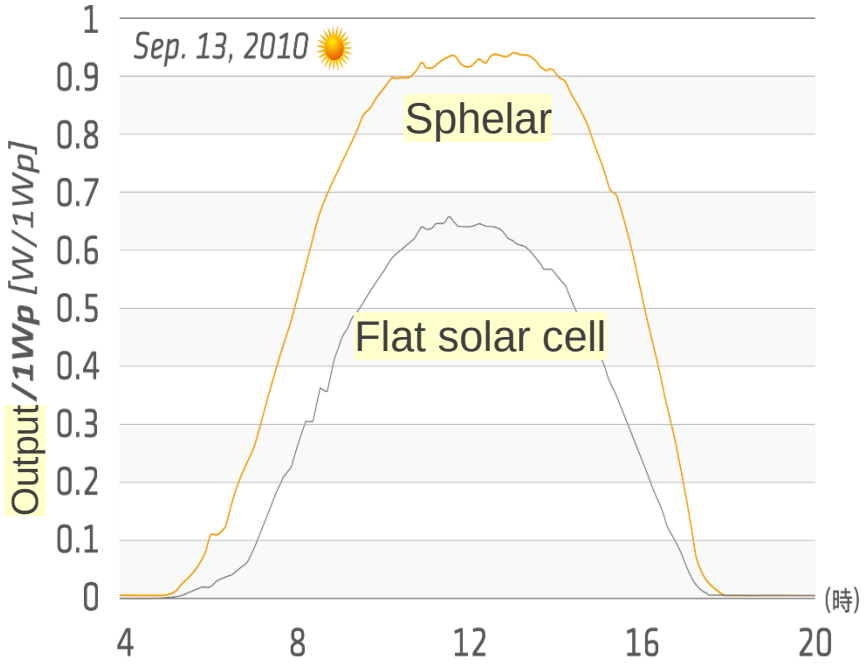
Large loss due to cutting
(1/3 of the crystal is lost)

Sphelar® spherical silicon manufacturing process

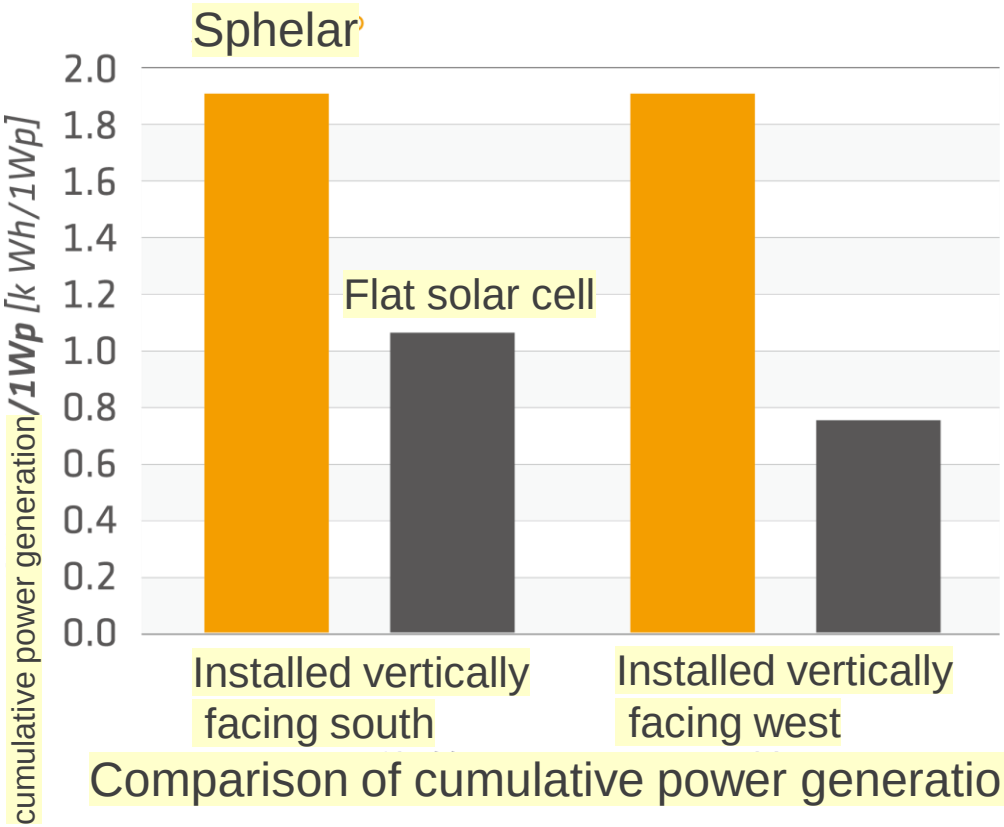
Spherical crystal melting / solidification /
Low power consumption: 1420 ℃ x about 40 minutes

Partial polishing of the end face
(Material loss is extremely small)

Features of Sphelar®: Characteristics unique to spheres



Changes in output throughout the day



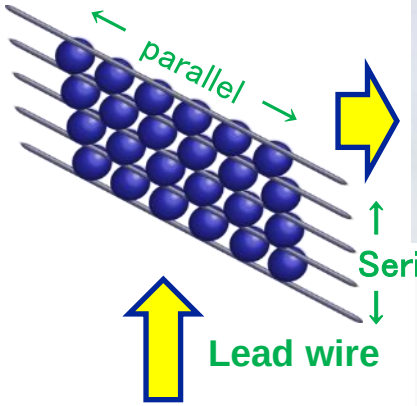
Comparison of cumulative power generation

Stable power generation independent of incident angle

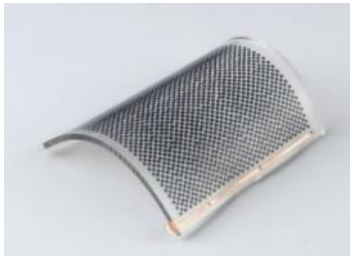
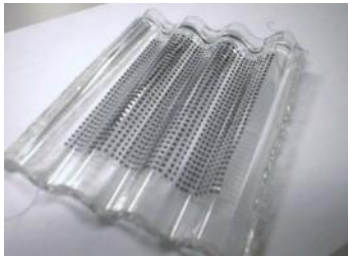
Cumulative power generation is about twice that of flat solar cells

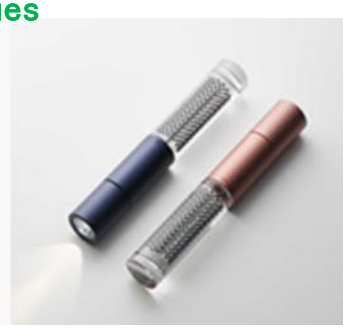
Features of Sphelar®:Various designs are possible

Sphelar® can be freely mounted in series and parallel
The number of cells in series and parallel can be selected according to the required output voltage and current.
The cells can be arranged in various patterns.
Flexible mounting is possible.

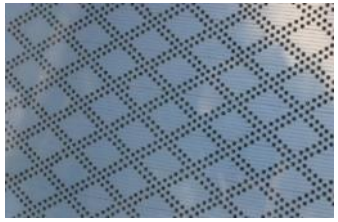
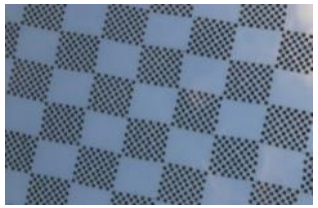
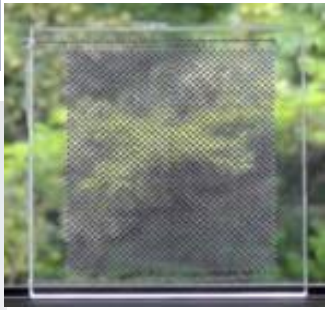
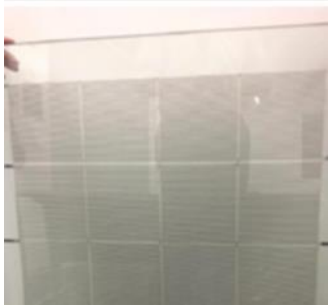


Sphelar®cell

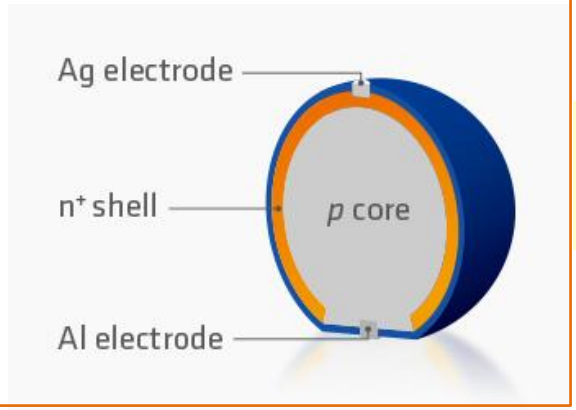




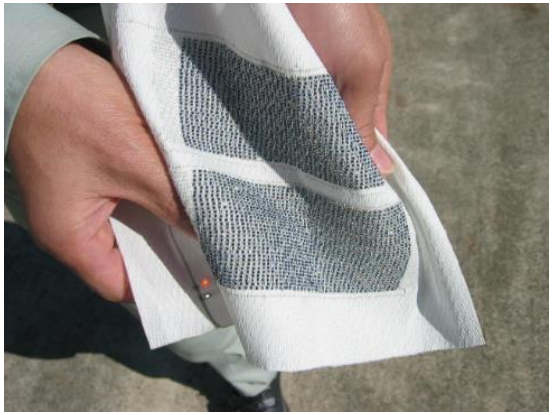
Features of Sphelar®: Unprecedented free installation style

Sphelar®
1.2/1.8mm

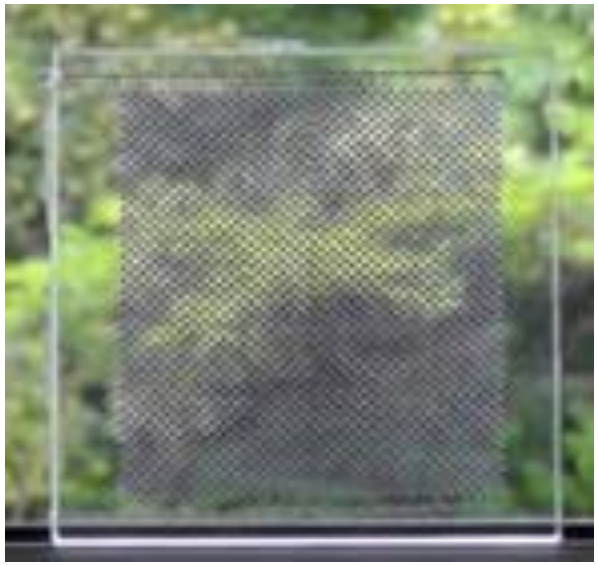


- Design
- Functionarity

Sign



Textile



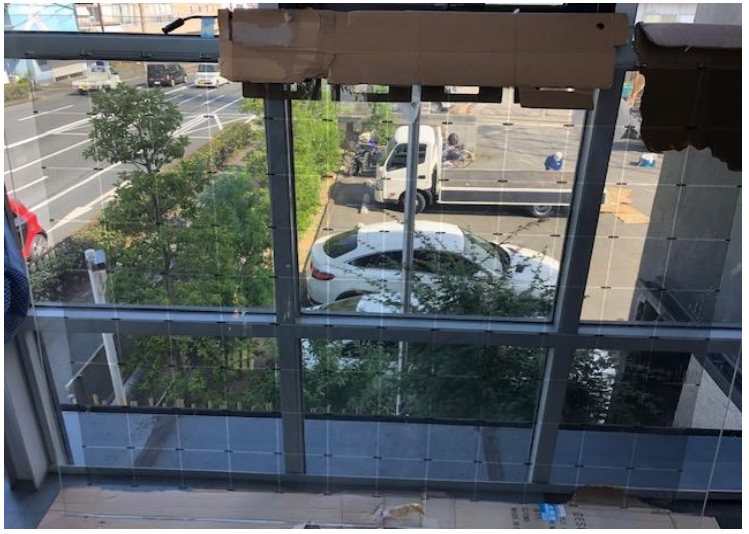
Glass module

Module for low power

Features of Sphelar®: Can be integrated with building

Installed in Kamisunagawa Town New Government Building
(December 2020, under construction photo)

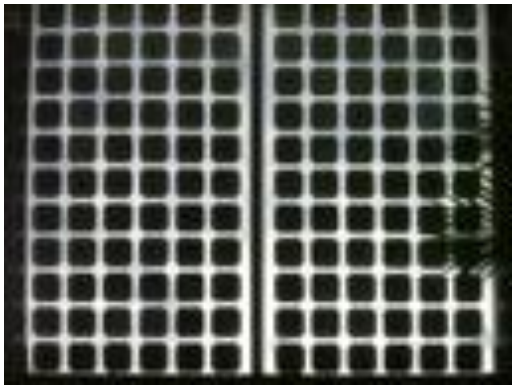
Prototype of high-transparency
Sphelar glass module



Both function as a window
and function to generate electricity

Features of Sphelar®: High see-through property that does not make you aware of solar cells

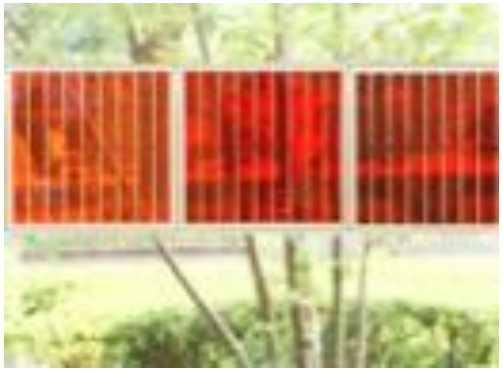
SPHELAR



Mono crystalline

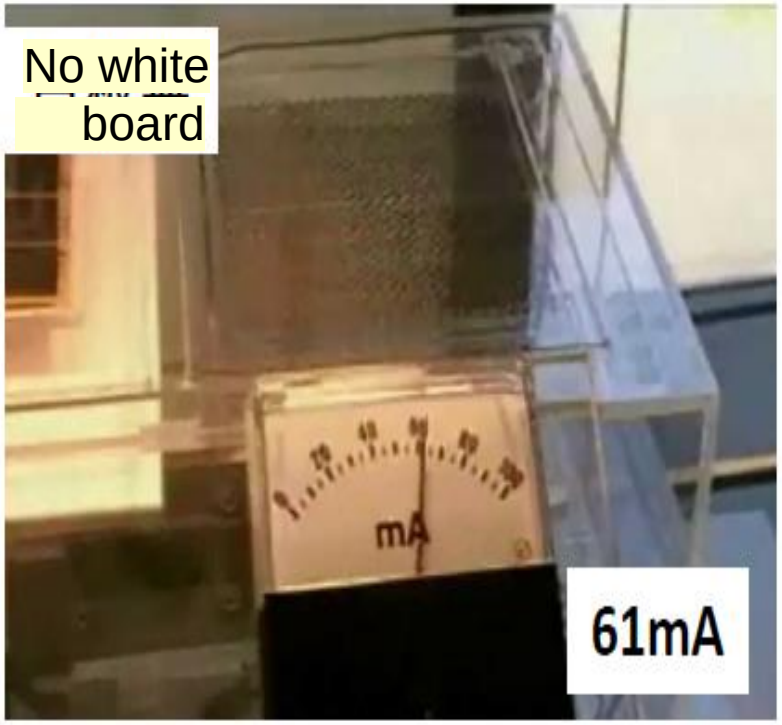
a-Si thin film

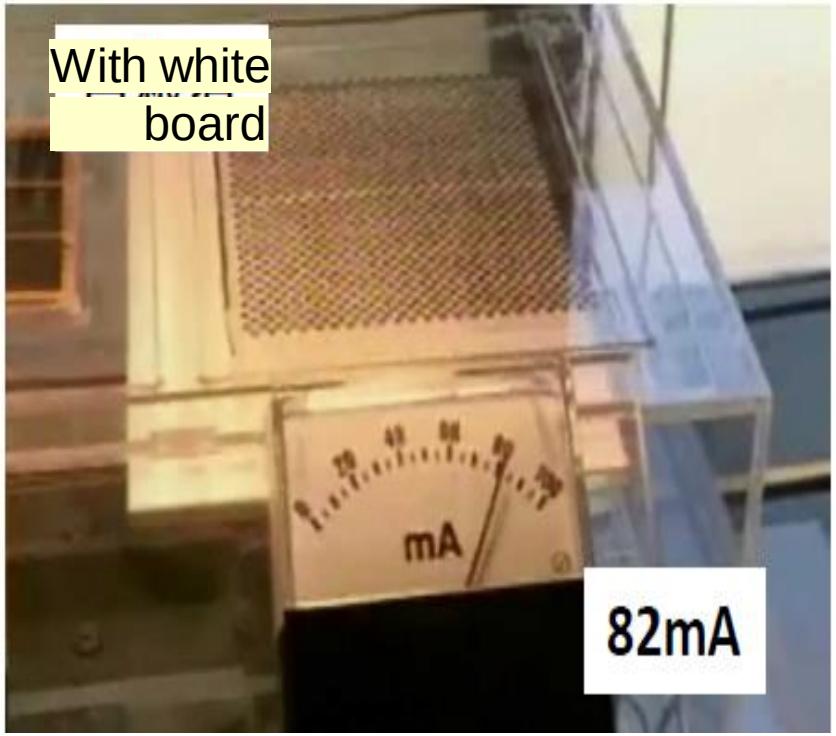
Organic thin film



Dye sensitized

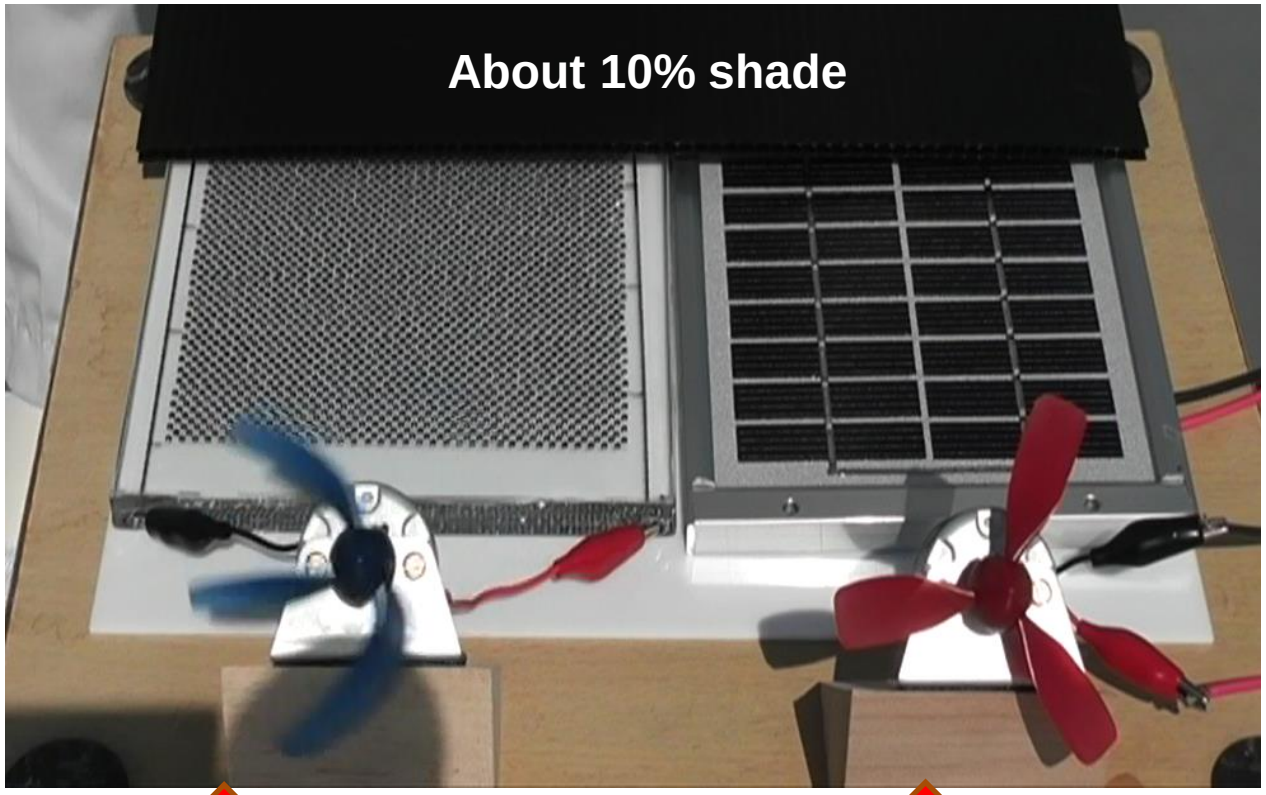
Features of Sphelar®: Generates electricity even with backside reflected light





Power generation increases just by placing a white reflector on the back side

Features of Sphelar®: Power generation does not stop even in partial shade



Propeller rotates

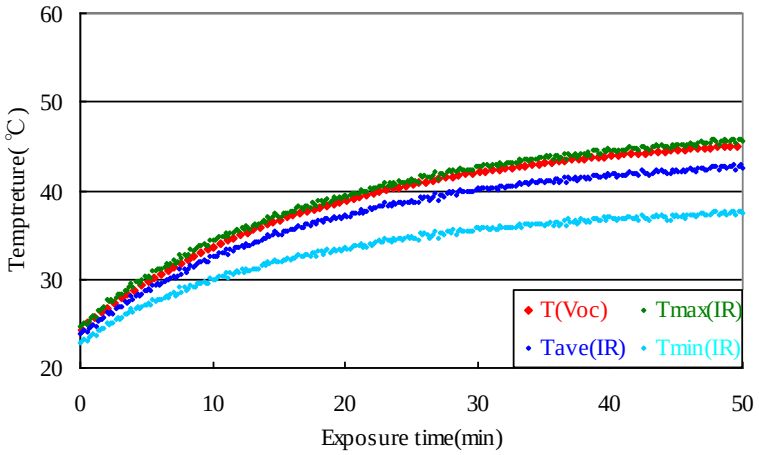
Propeller stops

Sphelar ® loses electricity in proportion to the shaded area

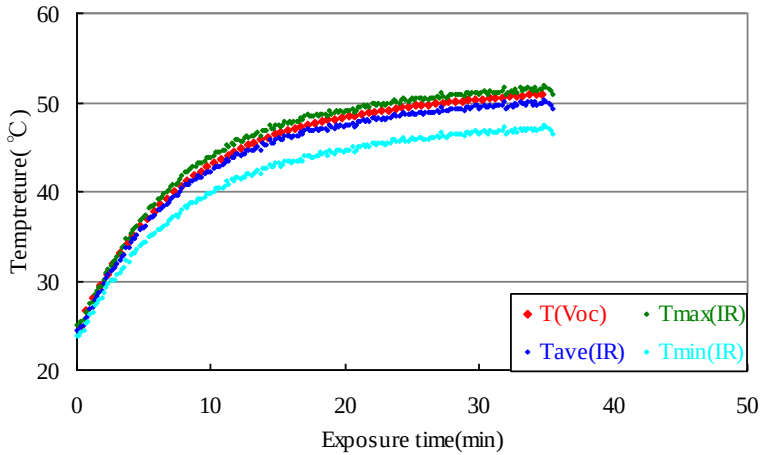
Flat-plate solar cells stop generating electricity when one cell (equivalent to 10%) is shaded.

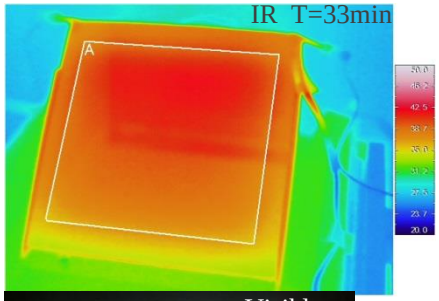
Features of Sphelar®: Temperature does not rise in summer

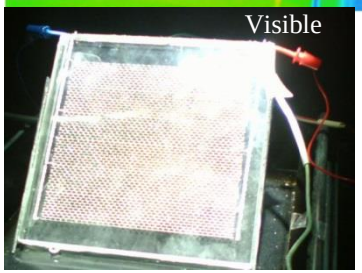
Sphelar® Module



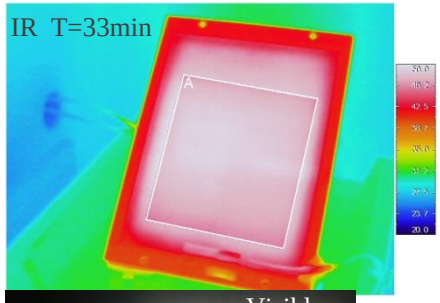
Flat solar cell





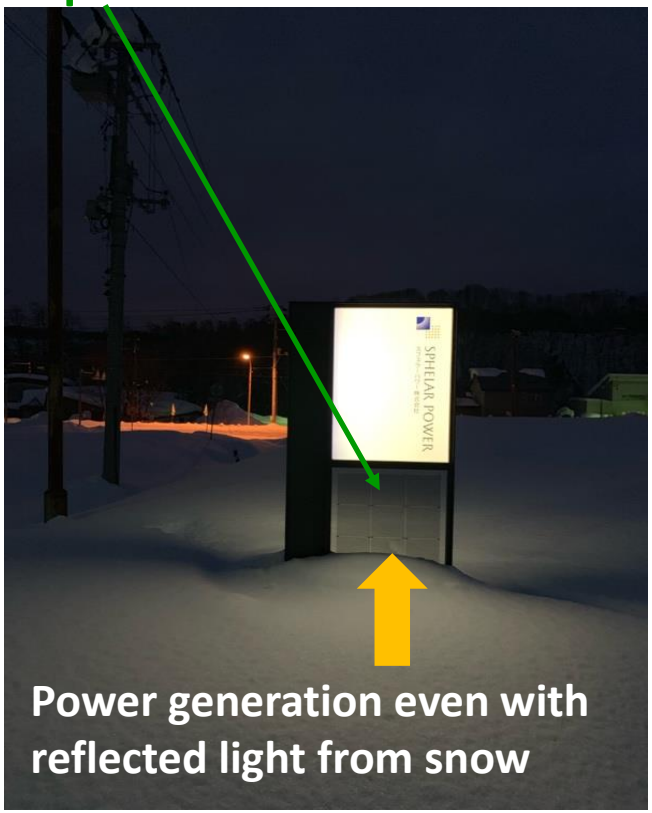


Sphelar® module has less output decrease due to temperature rise in summer



Features of Sphelar®: Can be used even in areas with a lot of snow

Sphelar® module without snow



Flat solar cell during snowfall
(does not generate electricity)

(Sphelar®Sign)

Sphelar® module that generates electricity even during snowfall

Features of Sphelar®: Reused

Flat solar cell
Thin and weak in strength

Difficult to recycle
because it breaks easily

Spherical solar cell Sphelar®
Since the sphere is strong
and does not break,
the sphere itself can be
used semi-permanently.

Sphelar® can be
collected and reused
even after the life of
the wire has expired.

Problems of mega solar with flat solar cells

1）Mega solar is expensive

・Land cost

・Transmission line fee (about 200,000 yen / meter)

(The cheaper the land, the higher the transmission cost)

Transmission loss (60% or more)

2） Mega solar has many risks

Collapse due to strong wind, electric shock, fire

Causes a landslide

Collapse of power lines

3）Other problems

Destruction of landscape and nature due to large-scale development

Light pollution (dazzling, insects do not approach, crop growth.　There is a case that has developed into a compensation problem)

→BIPV using Sphelar® solve the problem

Sphelar® application products：Sign board shines at night

2016 Hokkaido Energy Conservation and New Energy Promotion Grand Prize New Energy Category Grand Prize

Daytime

Nighttime

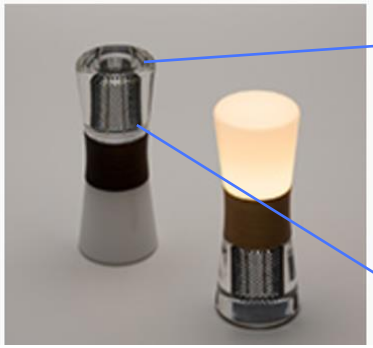
Mr. Yoshimoto, the mayor of Ine town, the chairman of the Most Beautiful Villages in Japan, praised it as a solar cell product that does not harm the landscape.

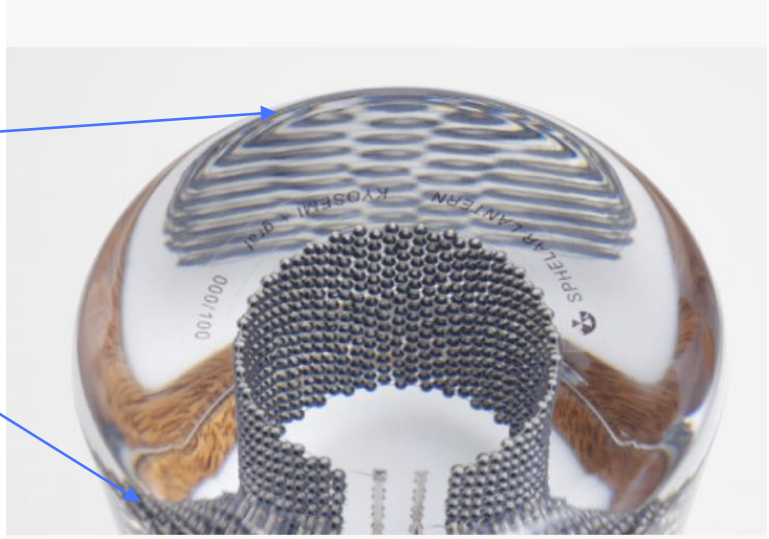
Funaya, Ine Town
(Area where flat solar cells are prohibited)

No power supply work required, stylish sign that is kind to the landscape

Sphelar® application products : Sphelar®lantern

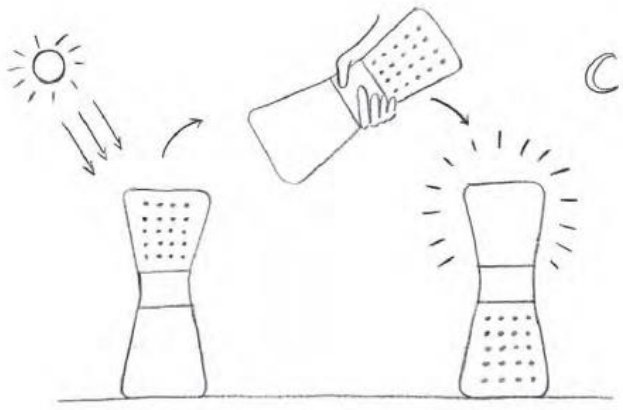
Selected for Kyoto Design Award 2018





Sphelar®lantern Power Generation Department

(CIlecting light from all directions to generate electricity)



Sphelar® application products：Sphelar®stick

Kyoto Design Award 2018 Kyoto Chamber of Commerce President's Award

June 2019 At the G20 Energy and Environment Ministers' Meeting
Sphelar®stick was adopted as a gift for the ministers of each country.

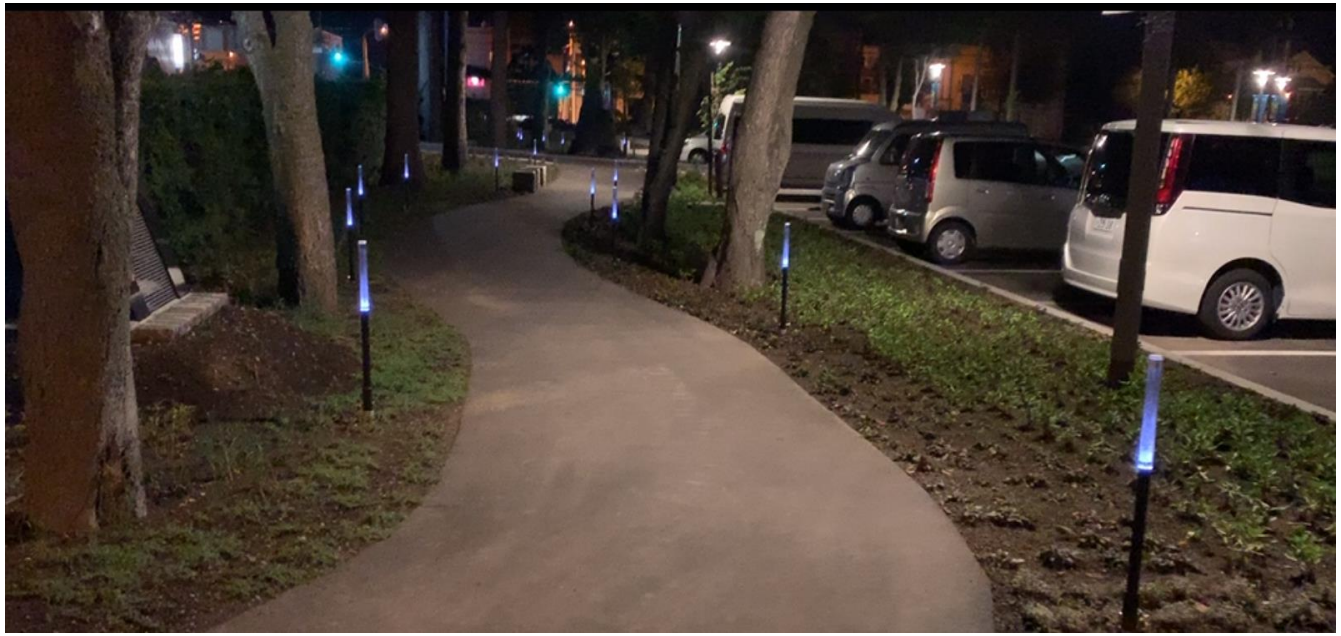
Sphelar® application products：Sphelar®gardenlight

Electricity (power transmission) construction, no electricity bill required

No special skills required for installation

Cost reduction possible

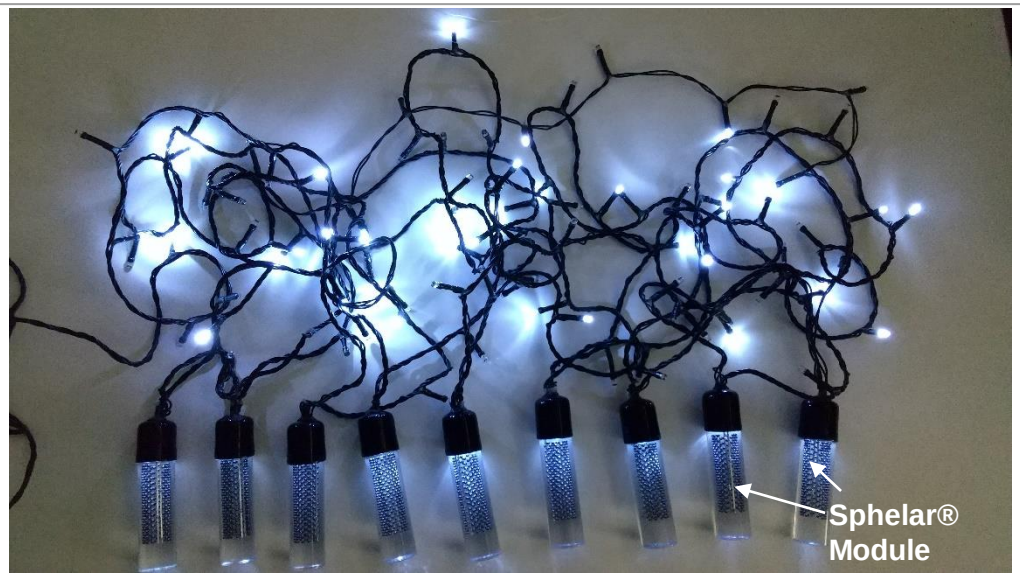
Ideal for lighting evacuation taxiways



Sphelar®gardenlight

Introduced as a street light on the promenade of "Hana no Komichi" in Higashikawa-cho, Hokkaido

Sphelar® application products : Sphelar®illumination



Power is generated by the daytime module, and the stored electricity is used.

The LED flashes automatically at night. The module itself also flashes.

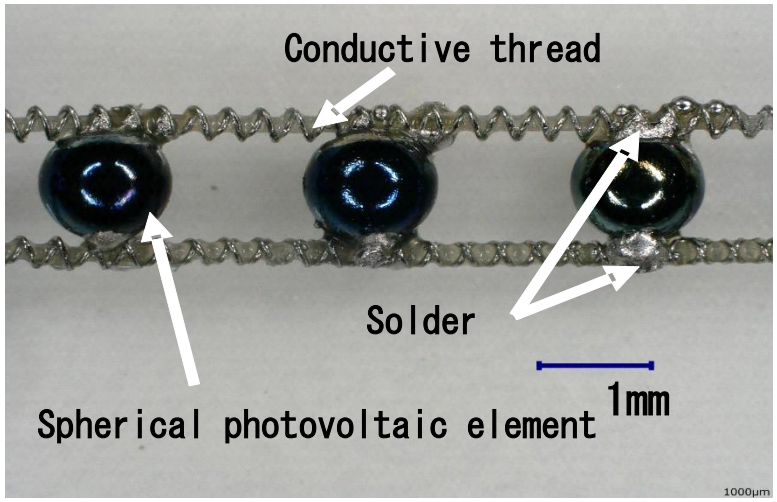
Electricity (power transmission) construction, no electricity bill required

No special skills required for installation

Cost reduction possible

Introduced as an illumination of the Higashikawa-cho memorial tree in Hokkaido

Sphelar® application products：Sphelar®textile

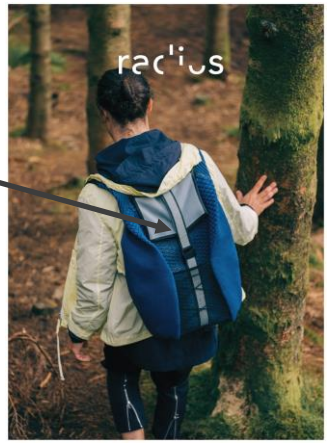


Photovoltaic yarn with Sphelar® connected to conductive yarn

Light, thin and flexible photovoltaic textiles woven using photovoltaic yarn

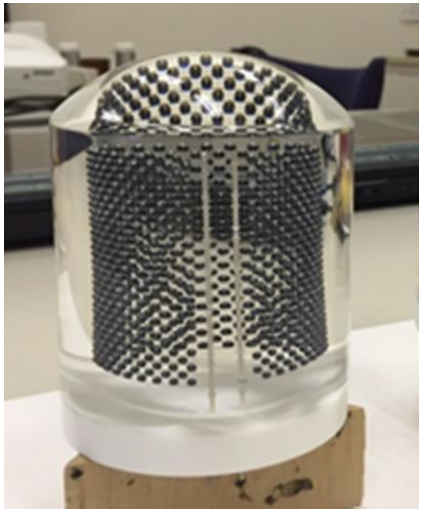
Photovoltaic textiles using Sphelar®

As a wearable power supply



Appearance of photovoltaic tent using Sphelar®

Sphelar® application products : Sphelar®beltsylindermodule



As a sensor power source for the sea, rivers, mountainous areas, etc.

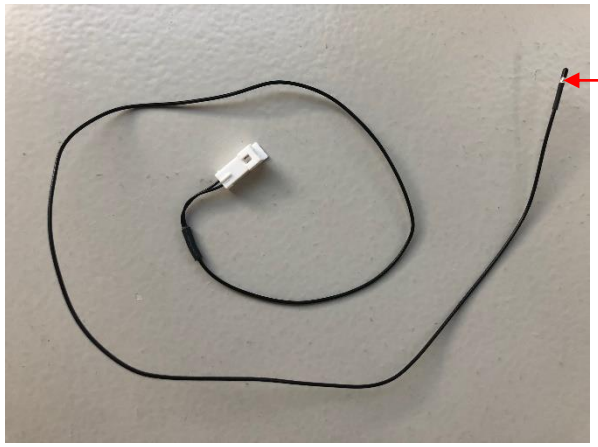
- Greatly reduced directivity, enabling light reception from a wide angle
- Long effective power generation time per day
- Even if the tree is shaded, the output of only the shaded area decreases.
- Power can be generated even in harsh environments such as snow, dirt, and wind pressure.

Sea aquaculture raft sensor power supply

River flow meter sensor power supply

Beast damage countermeasure sensor power supply

Sphelar® application products：Expansion to medical applications



Built-in 1 sphelar® cell

Can be inserted into the affected area through a catheter

One-cell module for heavy ion beam measurement

It has become possible to measure the heavy particle dose for heavy ion beam cancer treatment, which was previously impossible to measure.

Reduction of heavy ion beam irradiation → Reduction of medical expenses

Prevention of heavy ion beam irradiation on normal parts → Reduction of side effects

The future created with Sphelar® Ideal as a solar cell mounted on a car

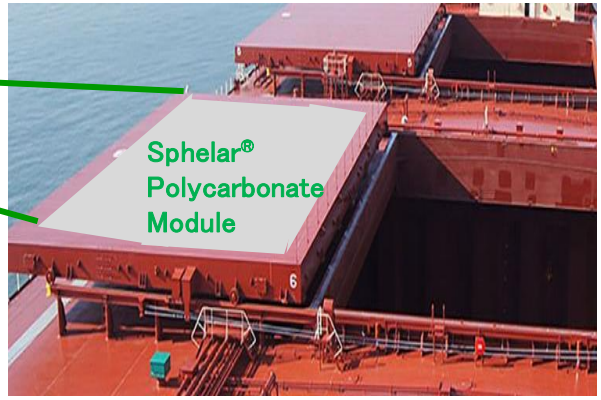
When installing a flat solar cell in a car

→Reinforcement is required as it is easily broken by vibration

→Heavy weight and poor fuel economy

When installing a Sphelar® in a car

- Can be lightened without cracking and without the need for reinforcement
- Ideal for cars that constantly change direction
- Can be bent and applied to curved surfaces



Applicable to large vessels

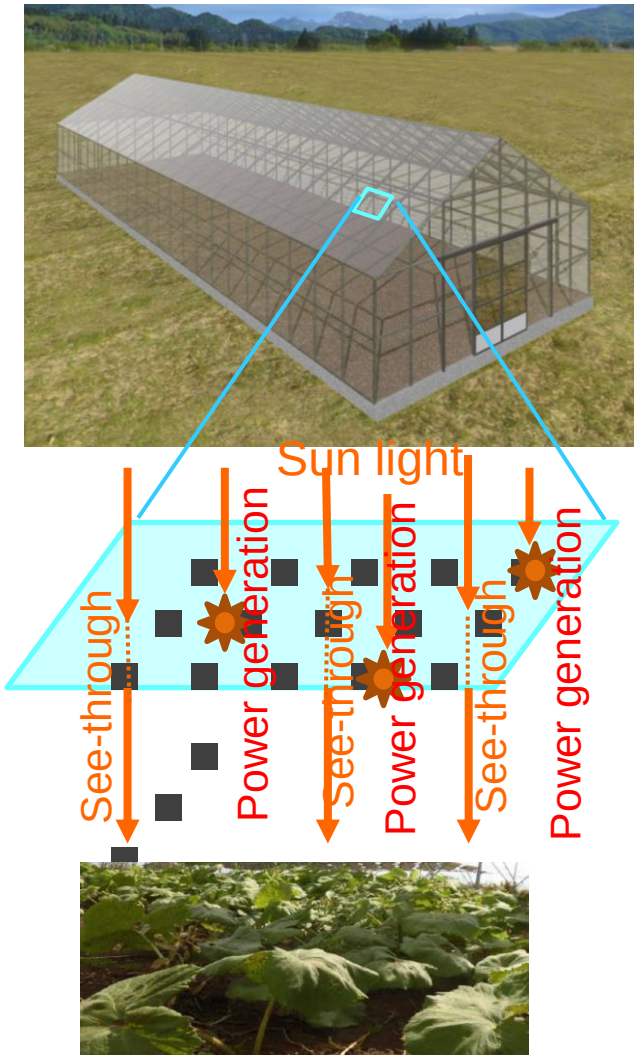
Prototype example of an electric vehicle that integrates Sphelar® with GFRP exterior material

The future created with Sphelar® Ideal for solar farming

Solar farming house with flat solar cells

The light that hits the crops becomes uneven, causing a difference in the growth of the crops.

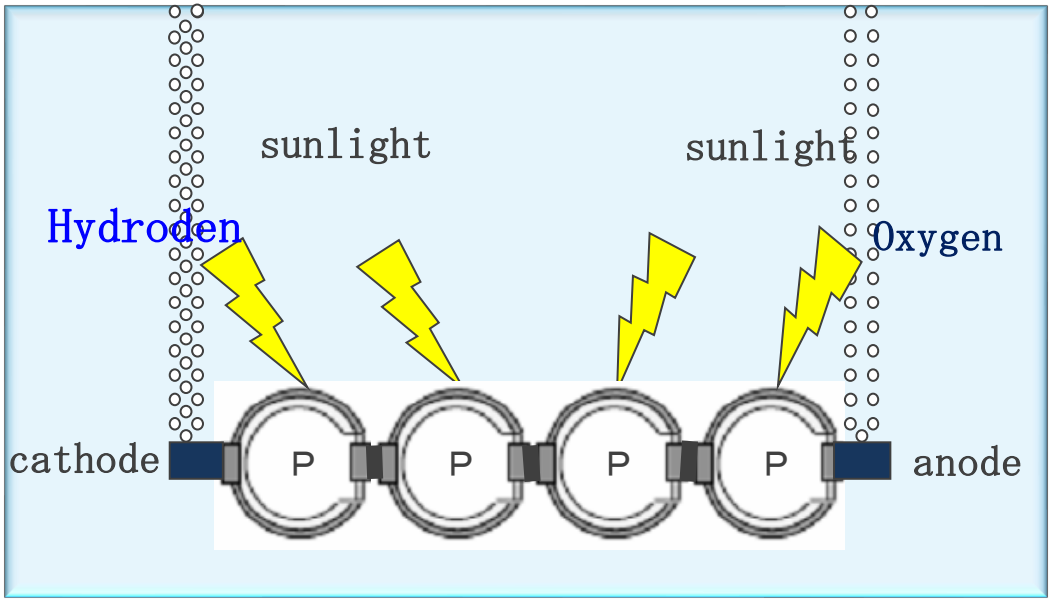
Solar farming house with Sphelar® module



Light hits the crops evenly and there is no difference in the growth of the crops

The future created with Sphelar® Production of hydrogen energy from sunlight

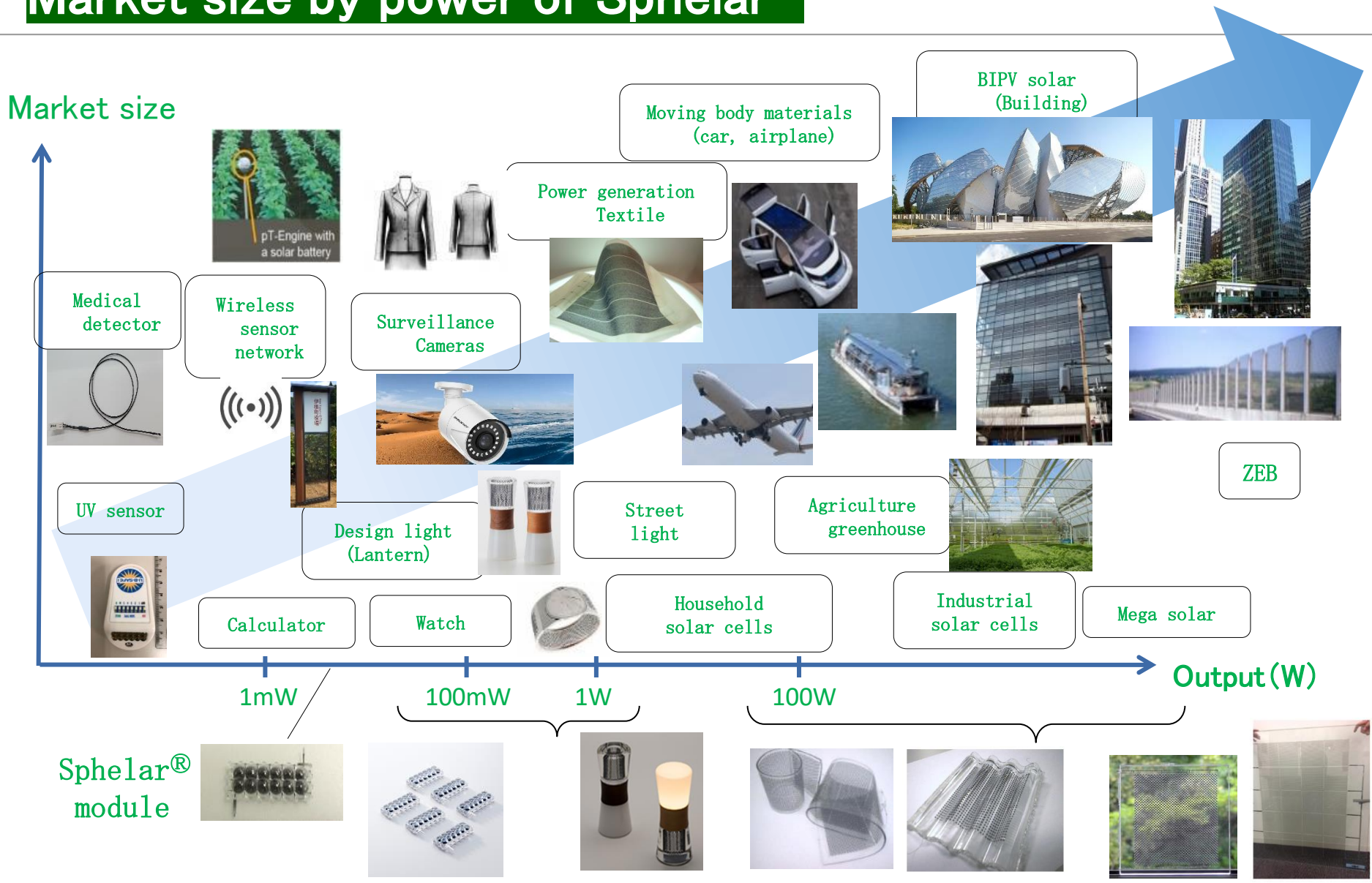
Hydrogen is generated just by exposing it to sunlight



Schematic diagram of a water electrolyzer using a cylinderal module

Energy can be stored not only as a storage battery but also as hydrogen.

Market size by power of Sphelar®



The difference between flat solar module and Sphelar®module

Comparing Items	Flat conventional solar cell	Sphelar® module
Module design and see-through	There is no freedom in design, and no light transmission.	A variety of designs can be matched to the environment, and there is see-through.
Restriction of installation direction	If the solar panel is not facing south and angle is not suitable, the amount of power generation decreases significantly	Vertical installation is possible, and almost stable power generation can be obtained throughout the period.
Partial shade, the effect of snow	Partial bird droppings, fallen leaves, and snow can cause significant reductions in power generation.	Although power generation in the partial shade area falls, it can be maintained in other parts
Total annual power generation per cell area	Set annual accumulated power generation per nominal maximum output power 1 Wp as 1.	Expected 1.82 times (south side) and 2.49 times (east-west side average) of flat conventional solar cells
Easiness of temperature rise at sunshine and power generation	Especially in summer, the temperature becomes high, and the power generation performance drops significantly	Heat dissipation between solar cells is good and temperature rise is small. Little decline in summer power generation performance
Influence of strong wind (safety)	There is a problem that flat solar panels are easily blown away by strong wind. There is also the possibility of an electric shock in dropped products.	There is no problem in strength because it is integrated with the building such as windows of the building
Recycling	It is weak to shock and easily broken by vibration. It is impossible to recycle cells	Spherical silicon solar cells can be taken out and recycled

The difference between flat solar module and Sphelar®module

Comparing Items	Flat conventional solar cell	Sphelar® module
Current & Voltage	Requires a large space for high voltage	Freely in series and parallel, high voltage in small area can be achieved
Integration with other purpose materials and products	It is difficult to reduce the weight because there are many limitations of integration. The reinforcement of independent installation panels and the countermeasures for mounts are required	It is easy to integrate in building materials and other products. The structure is simple, the weight and thickness can be reduced, and the installation cost can be reduced.
Light damage	The reflected light is dazzling, causing light pollution problems in the natural environment	There is no light damage due to glaring reflection.
Low power generation at cloudy weather	The drop in power generation for diffused light on cloudy days is large	There is no light directivity, so it is easy to absorb diffused or scattered light, and there is little reduction in the amount of power generation
Production method	A large amount of energy is used for manufacturing, and raw material loss is large.	Simple manufacturing method that saves raw materials and saves energy
Power transmission	Mega solar has a large construction and operation cost of power transmission equipment. There is a risk that power lines will be damaged by a disaster	No need for power transmission with building integrated materials
Production of hydrogen	Hydrogen is refined from fossil fuels	Hydrogen can be produced only with solar energy

Award winning

2005	The Thesis Award was received at The International Photovoltaic Science and Engineering Conference (PVSEC-15), in Shanghai (Shanghai).
2006	Aimulet LA received the Good Design Award (Ecology Design Award) from Ministry of Economy, Trade and Industry.
2006	Top10 Green Building Products of 2006 was selected (Alternative Energy Division).
2008	“ Spherical solar cell of Sphelar® and solar module using Sphelar® “ certified as the Management Innovation Plan Approved Company (Kyoto Prefecture).
2015	Sphelar®Stick selected as The Wonder 500 of Ministry of Economy award.
2015	“ The development of solar Textile” received the Excellence Award at the Annual Conference of the Japan Society for The Implementation of Electronics.
2016	“The development of solar sign system” win Hokkaido New Energy Promotion Grand Prize.
2017	Sphelar®Penguin win Kyoto Design Award.
2018	Sphelar®Stick win Kyoto Chamber of Commerce and Industry Association Head Award, and Sphelar®Lantern win Kyoto Design Award.
2019	“The solar Textile” selected as Kansai Monozukuri Shinsen 2019, at Kansai Bureau of Economy, Trade and Industry.
2019	Spherical solar cells and Sphelar-stick and Sphelar-lantern using them are certified as Kyoto smart products.
2020	Sphelar-lantern was selected for JIDA Design Museum Selection Vol.21
2020	Double award of ″Best Award″ and ″Audience Award″ at ″MITANI Business Contest 2020″

Important Paper and Patents

1 .Important technical Papers

(1) J. Nakata:”Spherical Cells Promise To Expand Applications for Solar Power”, Asia Electronics Industry (AEI) October 2001, pp. 44.
(2) K. Taira, N. Kogo, H. Kikuchi, N. Kumagai, N. Kuratani, I. Inagawa, S. Imoto, J. Nakata and M. Biancardo: “New Type of Standard Measurements of Transparent Sphelar Modules”, 15th Int. PVSEC-15, Shanghai 2005, Tech. Dig., pp. 202.
(3) K. Taira and J. Nakata:“Catching rays”,Nature Photonics, 2010, 4, pp.602.
(4) J. Nakata and K. Taira: “The potential of Sphelar® cells for building components”, engineered transparency, Int. Conf. at glasstec, Dusseldorf, Germany 2012, pp.673.

2 . Important Technologies and Japan Patents (Patented in 10 overseas countries）

(1) Technology for continuous manufacturing of spherical crystals which diameter of 1~2mm with high quality
(2) Technology for forming the pn junction in place of the spherical crystal（Japan Patent NO.3262174）
(3) Technology for forming the microdot electrodes which have a pair of positive and negative at the opposite end of the spherical crystal（Japan Patent No.3262174）
(4) Two automatic assembly technologies to choose from the series/parallel connection method in a mesh shape using the thin conductors and the series connection method on a transparent film substrate connected in parallel（Japan Patent No.3904558）