PV Industry Note
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Prometheus Institute
For Sustainable Development

Spheral Technology in the Photovoltaic Industry

Background information

The use of large amounts of silicon in photovoltaics has prompted the development of innovative technology that aims to decrease consumption of costly raw material while improving usability and adoption of photovoltaic technology.

Spheral solar technology is one such design that offers potentially lower costs, higher flexibility and use, while using less silicon. It allows the use of a versatile substrate (background material holding light-sensitive semiconductors) that can be integrated in different applications.

Technology

The technology used in manufacturing spheral solar cells involves bonding tiny silicon spheres between sheets of thin and flexible substrates (usually aluminum). The front foil acts as the electrically-negative contact and determines the spacing of the spheres, while the back foil acts as the electrically-positively contact to the core of the spheres.

The fabrication of the photovoltaic system involves sphere fabrication, sphere junction formation and finishing, cell fabrication (involving setting up of the spheres between substrate sheets) and assembly of the modules[i].

Solar energy is absorbed by the silicon spheres from different angles as the sun moves over different directions, extending the period of conversion of energy, while using lesser amounts of silicon in the cell manufacturing process.

View video on manufacture of spheral solar cells and modules (courtesy: Spheral Solar Power)

Main Features

Cost

The design of the solar cells using tiny silicon spheres greatly cuts down the cost of the raw material required in manufacturing cells and modules. This achieves improved utilization of silicon.

The substrates used, such as aluminum, are inexpensive. Moreover, no rare elements or additional materials are required in the process of module assembly to interconnect the cells.

Through various research and technological innovations, and limited raw material requirements, the production costs for manufacturing cells and modules with spheral technology are expected to come down to $1.50 per Watt[ii], less expensive than conventional crystalline silicon-based solar cells.

Flexibility and Versatility

The technology of spheral solar cells includes substrates made of lightweight and flexible materials. This ensures adaptability of the solar modules to a variety of applications, surfaces and designs. These modules also do not use glass, unlike other fragile solar products, and as a result are more durable, can be rolled over, walked on, and are protected against breakage during installation, vandalism or inclement weather conditions.

Courtesy: Spheral Solar Power (SSP)

Additionally, by not using materials such as cadmium or rare elements in production, spheral solar cells do not pose any environmental or health hazards.

Efficiency

Energy conversion efficiencies for solar modules based on the spheral technology range between 11-15%. Though some laboratory tests have resulted in efficiencies over 20%, commercial cells based on this technology are expected to have efficiencies around 11%[iii].

These cells are aided in efficiency by the spherical design of the silicon, which allows solar energy to be captured from all directions.

Lifetime

Cells based on spherical technology are currently being tested to improve the lifetime of the silicon. Some studies reveal that they have shorter lifetimes than the regular crystalline silicon-based cells because of the design. Data available at present indicate a cell lifetimes of less than three years.

Integration in manufacturing process

Manufacturing of spheral technology-based cells and modules requires special (patented) technologies that are not readily adaptable with most current manufacturing systems. As a result, these technologies have been adopted by select companies with specific manufacturing processes.

Market share

The present market share for spheral solar technology is not significant with actual production being carried out only by Spheral Solar Power, having an annual production capacity of 20MW.

Research Organizations

ATS Automation Tooling Systems Inc.

Location: Cambridge, Ontario, Canada (weblink)
Highlights: The ATS group is based in North America and produces automated manufacturing and testing systems including metal and plastic precision components. The company purchased Matrix, a USA based company doing research on solar technologies, in 1997, which led to the development of specialized solar technology that the company now manufactures through its subsidiaries based in Canada and France.

Ontario Hydro Technologies (OHT)

Location: Ontario, Canada
Highlights: OHT mainly carries out research on tritium handling and isotope separation. It purchased the spheral solar technology from Texas Instruments in 1995 and has done research on spheral solar manufacturing and stand-alone renewable energy devices.

Companies producing Spheral Solar Cells

Spheral Solar Power

Location: Cambridge, Ontario, Canada (weblink)
Highlights: Spheral Solar Power (SSP) is a division of ATS Automation Tooling Systems, Inc. It was set up by ATS to develop and manufacture photovoltaic components based on spheral solar technology 2003, with an initial annual production capacity of 20MW, expandable up to 40MW, and has over 40 patents on the technology. The company develops solar panels for recreational use, residential and commercial buildings and integrated solar products.

Photowatt International

Location: Bourgoin-Jallieu, France (weblink)
Highlights: Photowatt International is a division of ATS Automated Tooling Systems based in Canada. Established in 1979, it was taken over by ATS and has an annual production capacity of 25MW. The company is presently working on introducing spheral solar technology in its Europe based operations.

Kyosemi Corporation

Location: Kyoto, Japan (weblink)
Highlights: based in Japan, Kyosemi has carried out research on solar technology using spherical silicon, using it to manufacture cells and modules. Its cell prototypes named 'Sphelar' are expected to be commercially produced starting 2005 through its Tokyo-based sales office that was established in March 2005.

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[i] For further information go to Spheral Solar website
[ii] Photon International, February 2002
[iii] Photon International, February 2002