

This article was issued on "Science and Technology trends" Dec.2005 (published by NISTEP) in the section of Manufacturing Technology Field.

NISTEP is an acronym of National Institute of Science and Technology Policy

Spherical Micro Solar Cell manufactured by Microgravity Environment

In the Japanese garden of World Exposition, Aichi Japan that began through its theme of 'Nature's Wisdom' in March, 2005, the battery-free wireless information terminals were distributed to the visitors until 24, April. Based on the technology relating to space-free optical communication system, they could enjoy contents such as music or poetry every place as they walked. National Institute of Advanced Industrial Science and Technology (AIST) customized this device for the spherical micro solar cells to be incorporated and served as a power supply and a receiver as quite new technology.

A spherical micro solar cell allows light to reach its cell from all directions including reflected light, providing a high level of photoelectric conversion efficiency by 30% higher through the day long as compared with the existing planar solar cells and with 19% at incidence angle of 90 degrees. Because the high intensity of sunlight is an obstacle to infrared communication outdoors, a visible light cut filter is coated on the surface of a spherical micro solar cell. When these spherical micro solar cells are arrayed at the bottom end to receive infrared rays sent upwards from the floor, it is very much epoch-making to convert them simultaneously into communication data and power supply energy to work.

Kyosemi Corporation (headquartered in Kyoto) develops and manufactures this spherical micro solar cell named as "Sphelar" that is registered as a trademark in Japan. They installed a 14m free-fall tube in their Eniwa Operation located in Eniwa city, Hokkaido, Japan. They also developed their original single crystal growth technology based on microgravity condition. In such a state, surface tension causes a droplet of silicon to solidify in a nearly spherical shape with a diameter of 1 to 1.5 mm during about 1.5-second free fall time in a free-fall tube.

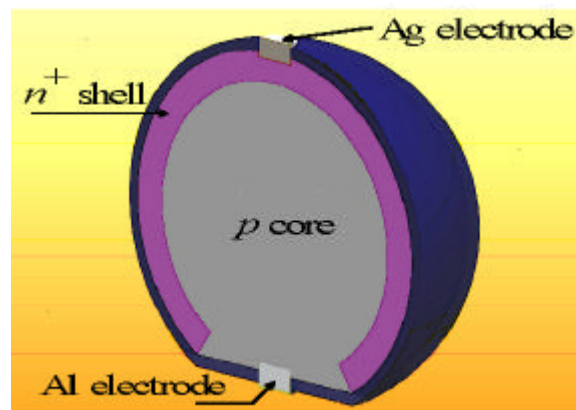
They have continued to research and develop technologies relating to commercialize granular solar cell based on this technology with subsidies from the New Energy and Industrial Technology Development Organization (NEDO) from 2000. Without any curf loss due to sawing as advantageous point of manufacturing, this process can save raw material of silicon and reduce its manufacturing cost as compared with the existing planar solar cells. And furthermore, each element is a sphere and is encapsulated in a thin film so that it can

be turned into any shaped and curved form. The cells can be fixed each other with easily adjusting interval between them in order for light to be passed through them. It may work as “Power Generating Window”.

Its production is still in a pilot plant so that it does not reach 1kg a year in volume, but a range of applications seems to be extremely wide. The company says that they are now putting some improvements into free-fall tube as well as processing facilities to set up mass production line of Si spherical crystals that are equivalent to a volume of monthly 20kW. It is expected that various applied products will be released in order if mass production will be successful.

The company initiated an experiment to make sure of their own idea at an early stage by taking advantage of Japan Microgravity Center (JAMIC) located in Kamisunakawa, Hokkaido. JAMIC fell into disuse afterwards in 2003, but the obtained results eventually came into sight. It can be said that such development examples may lead to review practical uses of microgravity experiment opportunities on ground-based studies by free-fall tower or on the airplane. It just started to be at an entrance to take advantage of Microgravity environment. And so, it is most desirous to create “Manufacturing Technologies” based on microgravity environment through open calls for participants in ground-based studies, advanced application researches, studies to utilize experiment opportunities preceded by International Space Station(ISS),and so on.

Spherical cross sectional view by Kyosemi Corp.



About the author;

The author, Teruhisa Tsujino, is a researcher of Science and Technology Foresight Center(STFC) of NISTEP, Ministry of Education, Culture, Sports, Science and Technology