



PHOTOVOLTAICS

NASA Glenn Research Center
Power and In-Space Propulsion



What is a solar cell?

A solar cell is an electronic device that converts sunlight into electrical energy.

How do solar cells work?

Solar cells work according to the principles of semiconductor physics. When a photon of light enters the solar cell, it promotes an electron from the semiconductor into a higher energy state. This electron then produces voltage, which can power an external circuit.

What are the different kinds of solar cells?

Solar cells can be made of many different semiconductor materials. Most solar cells used on Earth are made of silicon—one of the most common elements in Earth's crust.

Solar cells used in space are made of layers of more complicated semiconductor compounds. These compounds include gallium-indium-phosphide, gallium arsenide and germanium.

How sunny does it have to be for solar cells to work?

A solar cell becomes less efficient when there isn't enough light available to convert into energy. NASA has tested solar cells that continue to produce power all the way out to the orbit of Jupiter (the target of the solar-powered Juno mission), where the sunlight reaching the cell is only 4 percent as bright as the sunlight at Earth. This is less sunlight than on a rainy day in Cleveland!

How much do solar cells cost?

The cost of solar cells depends on what technology is used. For the low-cost cells used on Earth, the cost is less than 2 dollars for a cell capable of producing about one watt of power at noon on a cloudless day.

The solar cells typically used in space have many more requirements and are therefore usually more expensive.



What is the difference between solar cells for space and solar cells for Earth?

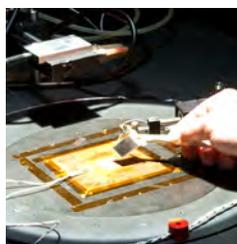
Solar cells on Earth are required to be rugged and cheap so that they can be put in place on a rooftop or in a solar array, which will keep producing power for decades.

Because every kilogram taken into space has to be launched on an expensive rocket, it is most important that space solar cells be very light and very efficient. In space, solar cells have to survive in a very difficult environment, with extreme temperature swings, radiation and ultraviolet light. These cells must be packaged to fit into a rocket, and yet deploy out into solar "wings" that can intercept the maximum amount of sunlight. They must also last for years without any servicing or replacement of broken cells.

What are the benefits from solar cells?

Solar cells produce electrical energy with no requirement for fuel, no emissions and no moving parts. They can create energy anywhere there is sunlight. This is critical for spacecraft since there are no convenient electrical outlets in space and no refueling stations to refill a generator when it runs out of fuel.

Solar cells are now being used on Earth as well, in places that can benefit from clean power produced by sunshine.



From left to right:
Creating solar cells; calibrating test solar cells; observing the testing of solar cells; a solar concentrator, which collects light and focuses it on solar cells.

