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ANALYSIS OF THE BASIC WORKING PRINCIPLE, AUTOMATIC CONTROL SYSTEM AND FUTURE DEVELOPMENT DIRECTION OF SOLAR CELL TECHNOLOGY

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Abstract
Throughout history, people have used readily available energy sources such as wind, water, and muscle power for their daily needs. Solar energy is an inexhaustible source of renewable energy for mankind. In addition, it is clean energy and does not pollute the environment. Among the efficient use of solar energy, the use of solar photovoltaic is the fastest growing and most dynamic research field in recent years, and it is one of the most watched projects. In this article, we will talk about the basic working principle of solar cell technology and the direction and prospects of future development. Solar energy is a type of light energy that needs to be converted into electrical energy using an energy converter. This energy converter that converts solar energy (or other light energy) into electrical energy is called a solar cell.

Keywords: Energy, solar, wind, alternative, environmental, power, energy saving, semiconductor, photovoltaic effect, automatic, regulator, inverter load, controller, CPU.

Research Purpose:
Our research purpose is to analyze the basic principles, automatic control system and future development direction of solar cell technology.

The Main Part
A solar cell or photovoltaic cell is a device that can convert solar energy into electricity. When the junction area of a semiconductor with a junction surface is irradiated with light greater than the energy forbidden limit, electrons and holes are generated, and the internal electric field generated in the junction area transfers

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electrons to the N-type semiconductor and holes to the N-type semiconductor. A P-type semiconductor produces an electromotive force. The electrodes attached to the N-type semiconductor and the P-type semiconductor become negative electrodes and positive electrodes, and direct current can be obtained. Not only silicon, but also gallium arsenide, cadmium tellurium, cadmium sulfide, indium phosphorus, or composites between these materials are used as materials for solar cell semiconductors, but usually silicon is used.

The basic principle of operation of solar cells. The principle of operation of solar cells is based on the "photovoltaic" effect of semiconductor p-n junctions. The so-called photovoltaic effect, simply put, when an object is illuminated, the state of the charge distribution in the body changes to produce an electromotive force and current. When sunlight or other light irradiates the PN junction of the semiconductor, electron-hole pairs are formed and the carriers generated near the P-N junction inside the semiconductor are not recombined and reach the space charge region and the internal electric field attracted by, and electrons flow to n. In the region, holes flow into the p region, resulting in excess electrons being stored in the n region and excess holes in the p region. They create a photo generated electric field opposite to the direction of the potential barrier near the p-n junction. In addition to partially eliminating the effect of the barrier electric field, the photo-generated electric field also makes the p-region positively charged and the n-region negatively charged, forming a thin layer between the n-region and the p-region. electromotive force, which is the photovoltaic effect. When energy is added to pure silicon (say, in the form of heat), it causes a few electrons to break away from their covalent bonds and leave the atom. For every electron that is ejected, a hole remains. These electrons then circle the lattice, looking for another hole to settle into. These electrons are called free carriers and they can conduct electricity. This electric field acts as a diode, allowing (or even pushing) electrons to flow from the p-side to the n-side, rather than the other way around. When light hits the solar cell in the form of photons, its energy releases electron-hole pairs. Each photon with sufficient energy usually ejects one electron and creates an empty hole. If it is close enough to the electric field, or the free electrons and free holes are within its range, the electric field will push the electrons to the N side and the holes to the P side. This leads to further breakdown of electric neutrality and if we provide an external current path, the electrons flow through this path to their original side (P side) where they combine with the holes sent by the electric field and flow process in doing work. Thus creating a current from the

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N-type region to the P-type region. Then a potential difference is created in the PN junction, which forms the power source. Since the semiconductor is not a good conductor of electricity, if electrons flow in the semiconductor after passing through the p-n junction, the resistance will be very large and either 'the loss will be great. However, if the top layer is completely covered with metal, sunlight cannot pass through and no current is generated.

Solar battery types

According to the shape, solar cells can be divided into rigid solar cells and flexible solar cells; according to their crystalline state, they can be divided into two categories: crystalline thin film type and amorphous thin film type, and the former is divided into one. crystal and poly crystal; according to the material, it can be divided into silicon thin film, mixed semiconductor thin film and organic film; according to the different materials used, it can be divided into: silicon solar cells, multi-component compound thin film solar. cells, polymer multilayer modified electrode solar cells, nano crystalline solar cell batteries, organic solar cells. Among them, silicon solar cells are currently the most mature and dominate in applications.

Solar battery automatic control system

The full name of a solar controller is a solar charge and discharge regulator. It is an automatic control device used to control the multi-channel solar cell array to charge the battery and the battery to supply power to the solar cell in the solar power generation system. Inverter load. It regulates and controls the charging and discharging conditions of the battery, and controls the power of the solar cell components and the battery to the load according to the power demand of the load. It is the main control part of the whole photovoltaic power supply. Almost all battery-powered solar power generation systems desperately need a solar charge and discharge controller. The role of the solar charge and discharge controller is to regulate the power delivered from the solar panel to the battery. Overcharging the battery will at least significantly shorten the life of the battery, at worst it will damage the battery to the point where it cannot be used normally. The solar controller adopts a high-speed CPU microprocessor and a high-precision A/D analog-to-digital converter, and is a microcomputer data acquisition and monitoring control system. It can not only quickly collect the current operation status of the photovoltaic system in real time, get the operation data of the PV

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station at any time, but also collect the historical data of the PV station in detail, which can provide an accurate and reliable solution. It is a sufficient basis to assess the rationality of the PV system design and the reliability of the quality of the system components. In addition, the solar controller also has the function of serial communication data transmission, which can centrally control and remotely control multiple photovoltaic system substations. Solar controllers usually have 6 rated voltage levels: 12V, 24V, 48V, 110V, 220V, 600V. Currently, the controller is becoming multi-functional, and there is a tendency to integrate the traditional control unit, inverter and monitoring system.

The future development direction of solar cells

Thin film solar cells are the most promising new generation solar cell technology, which saves the use of silicon raw materials and silicon wafer production processes. Compared with the current ordinary silicon wafer solar cells, the amount of silicon used in silicon thin film. Solar cells are only 1% of the previous %, which can reduce the cost of solar cells from 2.5 USD to 1.2 USD per watt. In addition, this high-tech new product can be combined with building roofs and wall materials. glass curtain walls that can be connected to the grid to generate electricity and save energy. Building materials, landscaping. The third-generation concentrated solar power (CPV) energy generation method is gradually becoming the focus of the solar energy industry. Photovoltaic power generation has progressed through first-generation crystalline silicon cells and second-generation thin-film cells, and the current industrialization process is gradually shifting to efficient CPV system power generation. Compared with the previous two generations of batteries, CPV uses multi-pass III-V compound batteries, which have the advantages of large spectral absorption and high conversion efficiency. In addition, the required battery area is not large, and replacing expensive semiconductor materials with relatively cheap concentrated devices can effectively reduce costs and reduce production energy consumption when used on a large scale in power generation.

Summary

In conclusion, it can be said that solar energy is inexhaustible as a long-term, universal and huge source of energy. Compared with other energy sources, the use of solar energy is clean and pollution-free, and the use of solar energy does not cause environmental pollution. Ecological Environment when humanity is

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facing an energy and environmental crisis, it is urgent to find a clean, efficient and relatively sufficient energy situation to meet social and economic development, and solar energy is one of the best choices. At present, the development of solar energy is mainly based on the state of solar cells. By further improving the automatic management of solar batteries, it is possible to achieve continuous monitoring of the device, timely elimination of malfunctions, and long-term service of the equipment. After several decades of development, solar cells are already mature technologies and are used in all aspects of human production and life. With the continuous improvement of technology, solar cells will achieve more development and benefit the human society.

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